Research Day 2013
Research with Impact

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Proceedings

A" Aalto University

Aalto Research Day 2013

Proceedings

Edited by:

Katri Kauppi, Karolin Kirschenmann, Teemu Leinonen, Sofia Pantouvaki, Oscar Person and Alexandre Schwob

Foreword by the Organizing Committee

The second annual Aalto Research Day takes place on the 26th of September 2013 in Otaniemi. The purpose of Aalto Research Day is to bring together all researchers of the different schools in Aalto for networking and sharing their research. This year the event is co-organized by the School of Business and the School of Arts, Design and Architecture. Researchers from all six schools of Aalto University were invited to participate in the event as audience and/or as presenters.

The theme of Aalto Research Day 2013 is 'Research with Impact', following the Aalto University vision of "being an institution internationally recognized for the impact of its science, art, and learning". This publication contains a short presentation of the posters, demonstrations and presentations of Aalto Research Day 2013. The proceedings are organised into two sections: the first part contains all presentation abstracts, while the second contains all poster and demonstration abstracts. The abstracts are listed in alphabetical order (by first author's last name) in both parts.

We would like to thank all Aalto researchers who contributed to the Research day with their submissions and proposals. We have received an overwhelming response to this year's call for papers and presentations, and the number of participants has been the highest possible according to time and space availability. We would also like to thank colleagues from other schools who assisted in the review process. The posters/demos included in the display are an excellent representation of the variety of research done across Aalto University, and we hope you will all enjoy exploring them during the poster session. The presentations provide an insight and reflections into the positive and negative aspects of the life of a researcher, and allow for a great forum to share experiences. In addition, during the Research Day you will be able to hear keynote talks, presentations and a panel discussion on the theme of 'Research with Impact'.

We hope you will enjoy reading about the research included in this publication and attending the R-day!

The Organizing Committee

Organizing Committee

Dr Katri Kauppi
Assistant Professor in Logistics
Aalto BIZ

Dr Karolin Kirschenmann
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Aalto BIZ

Dr Teemu Leinonen
Associate Professor of New Media Design
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Dr Sofia Pantouvaki
Professor of Costume Design
Aalto ARTS

Dr Oscar Person
Assistant Professor in Design Integration
Aalto ARTS

Dr Alexandre Schwob
Assistant Professor in Marketing
Aalto BIZ

Programme

Morning Session 9:00 - 12:00

9:30 - 9:40	Opening words by the Organizing Committee
9:40 – 10:00	Deputy President Ilkka Niemelä "Research with Impact at Aalto University"
10:00 - 10:40	Keynote speaker: Dr. Mikko Kosonen, President of Sitra "What is research with impact"
10:40 - 11:40	Panel discussion - "What is research with impact", moderated by Professor Kalevi Ekman

Aalto Faculty representatives:
ARTS: Professor Pia Lindman
BIZ: Professor Matti Suominen
CHEM: Academy Professor Jukka Seppälä
ELEC: Professor Raimo Sepponen
ENG: Professor Olli Varis
SCI: Professor Paavo Kinnunen

Student representative: Eetu Pursiainen, Aalto SCI

Industry Representatives
Dr. Leena Mörttinen, Director, Confederation of Finnish Industries
Dr. Reija Hirvikoski, Chair of OISTAT Performance Design

11:40 – 12:00	Short film "Portrait" by Saara Cantell, Aalto ARTS
Commentary by Professor Susanna Helke, Aalto ARTS

Lunch & Posters / Demos Exhibitions 12:00 - 14:00

Lunch buffet in the Lobby with interactive posters, demonstrations, exhibitions, artefacts, installations and performance by Aalto doctoral students and faculty. Opportunity to vote for the best presentation.

Conference sessions 13:30 - 15:00

Conference sessions on: Key Research Life Episodes. See separate programme on next page.

Afternoon session 15:05 - 15:35

"Summary of the day through the eyes of an external observer", journalist Terho Puustinen

Best Poster/Exhibition Award

Closing words by the Organizing Committee

Conference Sessions: Key Research Life Episodes

13:30 – 15:00

Session 1 [Room A]: Is my Project Me? Initiative and Personal Trajectories in Researchers' Paths

Chair: Alexandre Schwob

13:30 – 13:45 *The Beauty of Project Work - Using Aesthetics in Project Management*
Juhani Tenhunen, School of Arts, Design and Architecture

13:45 – 14:00 *The Aalto BIM Initiative: Who, What and Why?*
Vishal Singh, Jan Holmström and Kary Framling, School of Engineering

14:00 – 14:15 *The Secret Floor under Us - Turning Points of ELSI People Monitoring System from Basic Research to a Product*
Matti Linnavuo, School of Electrical Engineering

14:15 – 14:30 *My Role in the Killing of a High-tech Company and Why I'm Happy about It*
David Lloyd, School of Chemical Technology

14:30 – 15:00 Discussion

Session 2 [Room B]: Good News vs. Bad News – Assessing the Value of Research

Chair: Sofia Pantouvaki

13:30 – 13:45 *In All Fairness*
Piyali Rudra, School of Business

13:45 – 14:00 *On the Predictability of Scientific Success*
Santo Fortunato and Raj Kumar Pan, School of Science

14:00 – 14:15 *When Academia met Costume: The Birth of Research in Costume and Dress*
Sofia Pantouvaki and Elena Trencheva, School of Arts, Design and Architecture

14:15 – 14:30 *Showing the Way for Industry Dudes and Academic Rules*
Virpi Roto, School of Arts, Design and Architecture

14:30 – 15:00 Discussion

Session 3 [Room C]: Connecting Universes – Building Significant Relationships between Research and Society

Chair: Karolin Kirschenmann

13:30 – 13:45 *Innovative New Firms in Finland*
Heikki Rannikko and Tomi Heimonen, School of Business

13:45 – 14:00 *Grounding Open Data*
Yulia Tammisto, Juho Lindman and Matti Rossi, School of Business

14:00 – 14:15 *How a Learning Technology Project becomes a School Redesign Service*
Tarmo Toikkanen and Anna Keune, School of Arts, Design and Architecture

14:15 – 14:30 *You, Me, Everyone - and Health Factory*
Raimo Sepponen, School of Electrical Engineering

14:30 – 15:00 Discussion

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ABSTRACTS OF PRESENTATIONS

On The Predictability of Scientific Success

Santo Fortunato, Aalto SCI

Raj Kumar Pan, Aalto SCI

Correctly assessing a scientist's past research impact and potential for future impact is fundamental to all personnel recruitment decisions in science. Formally and informally, quantitative measures for impact of previous work are already heavily involved in the recruitment and evaluation process. Of greater concern in the recruit process is what a candidate will do in the future. Recently attempts have been made to develop models capable of predicting a scientist's future impact by way of his or her future h-index. Here we present a cross-sectional analysis of 762 longitudinal careers drawn from three disciplines: physics, biology, and mathematics. Applying future impact models to these careers we identify a number of subtle, but critical, flaws in current models. Specifically, cumulative non-decreasing measures like the h-index contain an intrinsic spurious correlation, resulting in a significant overestimation of ``predictive power''. Applied to a non-cumulative measure, a scientist's year to year increase in h-index, models exhibit far less predictive power. Moreover, the predictive power of these models vary greatly with the career age of scientists, indeed producing their least accurate estimates for already risk-burdened early career researchers. These results place in doubt the suitability of linear regression models of future h-index for real application in recruitment decisions and indicate that a new crop of more powerful algorithms must be developed before quantitative measures of future impact come of age.

Secret Floor Under Us - Turning Points of ELSI People Monitoring System from Basic Research to a Product

Matti Linnavuo, Aalto ELEC

The presentation will guide the audience through the main turning points of the development of an position sensing system. The presentation will start from the idea of locate a living person without any tags or other attached equipment with capacitive sensors. The research went through basic research and feasibility studies to system demonstration phase, when also the idea of the commercialization came into mind.

The business idea was successful in the Venture Cup competition and a company was established. The young company had a tight cooperation with the University and the realization of several applications and sites took place.

The start-up company was acquired by a bigger company together with the sensor technology. Now the ELSI system is a commercial product.

My Role in the Killing of a High-Tech Company and Why I'm Happy about it

David Lloyd, Aalto CHEM

This talk describes a particularly dark episode early in the presenter's research career, which eventually lead to a major turning point in his viewpoint of research. It describes his role in the decision to liquidate the company he was working for, the feelings of disappointment and guilt this evoked and what he learnt from it.

The company, Hydrogen Solar, was involved in the commercialisation of technology for the photocatalytic production of hydrogen using solar energy. Inspite of numerous patents, prestigious awards, millions of euros of investment and years of work, a moment was reached when it became clear that the technology was fundamentally flawed.

The talk provides describes how this process unfolded and draws numerous important lessons that anyone interested in doing meaningful research needs to know. These include:

1. The tendency of researchers to become blinkered by they own frame of reference and believe their own hubris.
2. The danger of becoming emotionally attached to one's own research.

It also expands on the view that research is a Darwinian process. This means that we need to fearlessly put our work through the severest tests possible in the hope that it will fail them. It explains that this process of destruction can create exactly the conditions that stimulate new discoveries and personal growth by forcing us to question our preconceptions and understand the real weaknesses in our work.

When Academia Met Costume: The Birth of Research in Costume and Dress

Sofia Pantouvaki, Aalto ARTS

Elena Trencheva, Aalto ARTS

Dress is part of our everyday lives, of everyone's identity. It reveals information about the wearer: Thanks to dress, we encounter characters, even within our daily routine. Contemporary fashion and costume constitute a set of sign systems, to the extent that the statement 'costume is a narrative tool' is more broadly understood. But how dress constructs its meanings in a given context and what it signifies in the eyes of the beholder is not entirely clear yet. Literature on costume is scarce and considered so marginal that scholars conducting research on the topic are obliged to apply knowledge of completely different areas, ranging from cultural studies, history, gender studies, sociology, psychology and ecology to semiotics, economics, cybernetics and many more. These fields may border on but usually do not pass through to the field of costume studies, neither do they individually focus on an in-depth study of human character - an essential aspect of costume research. It is also assumed that those pursuing and studying fashion and costume are frivolous, "not serious enough" and that the field of dress research "does not deserve any intellectual consideration" (Kawamura, 2011). Is it worthwhile to engage in costume studies?

This presentation aims at introducing the 'dark side' of the long and still ongoing evolution of dress and costume studies. It also comments on issues related to the difficulties in communicating the impact of such research to scholars in more advanced areas of "hard" sciences. Precisely because costume is an extremely under-researched area, new costume researchers are called upon to reveal its history and theory in order to be able to focus on the multifaceted functions and meanings of costume and dress, not only within the context of spectacle and media, but also in the performance that is everyday life.

Kawamura, Y. Doing Research in Fashion and Dress, Oxford/New York, Berg, 2011.

Innovative New Firms in Finland

Heikki Rannikko, Aalto BIZ

Tomi Heimonen, Aalto BIZ

At Aalto University's Small Business Center we have studied firms from Tekes customer register longitudinally between 2007 and 2012. In our presentation we show some results of this monitoring effort. Especially we are interested in new innovative firms that are being increasingly targeted by the national innovation and entrepreneurship policies. In our analysis we approach innovative firms by studying the Tekes NIY program through which approximately 160 firms by now have enjoyed support for their innovation commercialization activities. We inspect how these subsidized firms have performed so far in comparison to reference groups and also theorize about what are the secrets behind the success of an innovative new firm. Our topic is highly important in the context of higher education and research. Innovation interventions such as NIY program of Tekes and Aalto University are part of the same innovation-entrepreneurship system. Therefore, it is important to realize and understand within the Aalto community what the current innovation/entrepreneurship interventions are, how they work, how they perform and what possibilities they offer for the university spin-offs.

Showing the Way for Industry Dudes and Academic Rules

Virpi Roto, Aalto ARTS

This presentation is a personal story about making an impact in a new research field.

I was working at a corporate research unit during the period when term 'user experience' (UX) became commonplace. The dudes in business units asked me, the UX researcher, to fix all usability problems in our products, create graphics that would make customers love them, utilize the gained experience of users, or anything in between. At the same time in academia, researchers attached wires on people's faces and got lots of publications on the emotional reactions people had while interacting with products. I felt these guys had landed from different planets that did not talk the same language. I decided to go and define user experience.

Since then, I have tried to serve as a bridge between industry and academia and managed to narrow the distance between the two worlds. I found great people on both sides to work on UX definition and also on UX methods, serving both industry dudes and academic rules. We influenced the ISO definition of UX, wrote the Wikipedia definition, published the most cited publication on defining UX, brought key UX specialists together to write a UX white paper, launched a web site allaboutux.org, gave keynote talks, and ran several workshops and SIG sessions to get the people onto the same page on what UX means.

We never counted the number of publications submitted, nor did we have formal funding for these activities. We thought there was a need for our work, and we wanted to make the life of UX people easier. And of course our own.

But what was the impact of all these efforts? I will tell the good and the bad news in my presentation.

In All Fairness (The Dark Side)

Piyali Rudra, Aalto BIZ

Often times, as a student of science, I see myself questioning things, which do not warrant interrogation, and is best left unexplained. I have also doubted that if we try to understand something too minutely, will that thing disintegrate into its basic building blocks such that its formation then holds no value to us? I am an Indian, and I arrived in Helsinki almost 9 months ago to begin my doctoral studies at the School of Business. Ever since, living here has been pure joy, making friends, enjoying the clean air and now lately hearing summer birds sing. So now it is but logical that I have wondered about why life in Finland is so different from that of India? Consequently, when I apply the science lens, I go back to colonialism, impact of industrial revolution on British colonies and the sufferings therewith. But this does not discount the fact the as a nation, India had always been unprepared against its invaders, so much so, that entire cities in South India got wiped out by conquerors time and again and what endures now are the ruinous remains. But these remains are squalid, there is no (and has been none), regard for what we lost and why we lost. This then comprised my investigation before I began the doctoral pursuit. This was normal and straightforward and also historically sound. But juxtaposition with Finland and also its war with Russia made me ask so to why should this small nation be so good to its people and a behemoth like India be so unkind? Was India exploited or was too less sovereign to prevent exploitation? The decline continues even today, India is nowhere close to the promise it showed earlier and our atavistic traits are raining its ugly heads. But why am I saying all this? What is the dark side here? And since I am researching in resource economics, what then is my research experience? Well, my experience is painfully linked to my being Indian, and it confounds me as to how this biological statistic has both enabled and disabled me. This duality can be easily extrapolated to how my work can and will benefit society. Do I notice it when observing others? Is this impact necessarily positive in their mind? These are grave questions and I am certain their answer is affirmative, they do impact societies, but societal fabric precludes the ability of the outcome to go either way. For societies, as open minded and humanitarian as Finland's, scientific research most definitely impacts society. For India, on the contrary, most research, especially the good ones frightfully end up being unpatented, unethically reproduced, uncompensated and finally in the wrong hands. So the dark side we talk about is not too dark here, but almost a black hole in countries as depraved as India. So for me, coming here and now conducting research has been a gift and consider if you may, I wish that I were in good favor of receiving this gift so as to see a better, bigger and sustainable Finland in a future, where I will be no longer around.

You, Me, Everyone - and Health Factory

Raimo Sepponen, Aalto ELEC

Health Factory, the newest factory in Aalto University, will be established in the beginning of year 2013. Health Factory seeks solutions for concrete problems in the field of health and well-being and combines expertise from Aalto University and its stakeholders. One of the aims of Health Factory is to create new business activity. A successful solution can be used as a foundation for a new business or may be incorporated as part of an existing company.

An example of possible problems to be solved could be new methods required in the cognitive rehabilitation of stroke patients, which have been developed in Health Factory in cooperation with the Helsinki University Central Hospital. The Health Factory is not research- but problem-driven. Several other examples which address the main Finnish health problems are elaborated in the presentation.

The Health Factory aims to find solutions for problems with a social significance. The solutions are assessed by case-specific mentoring groups and clients affected by the solutions. There is a demand for companies in the field of health and well-being in societies around the world, and Finland has the expertise and knowledge required for this. Health Factory is a process that channels expertise to where it is needed.

The Aalto Bim Initiative: Who, What and Why?

Vishal Singh, Aalto ENG

Jan Holmström, Aalto SCI

Kary Främling, Aalto SCI

The Aalto BIM initiative is a multidisciplinary program at Aalto University spanning across the Departments of Civil and Structural Engineering, Industrial Engineering and Management, and Computer Science and Engineering. The Aalto BIM initiative offers exciting opportunities for researchers at all levels who are interested in the research on Building Information Modelling and related areas. The initiative offers excellent supervision and mentoring opportunities with three BIM professors across construction, operations management and computer science disciplines, and a distinguished professor on lean construction. The recently launched BIM initiative aims to build on Finland's leadership in construction research through on-going partnership with national and international research centres and institutions of high repute.

This presentation is about the people who are part of the Aalto BIM Initiative. We talk about who we are, why we are part of this initiative and what we hope to achieve through this initiative? We also talk about our approach to working with other researchers and what kind of people we would like to engage with.

Grounding Open Data

Yulia Tammisto, Aalto BIZ

Juho Lindman, Hanken

Matti Rossi, Aalto BIZ

In presentation "Groudning Open Data" I am going to talk about the phenomenon of open data from business and societal perspective. The content of the presentation is a an ongoing research on open data that is done as a part of PhD dissertation in Information Systems (Aalto BIZ, Information and Service Economy department) that is supported by Aalto Service Factory. This material was developed together with fellow senior researcher Juho Lindman (Hanken School of Economics) and professor Matti Rossi (Aalto BIZ) and its parts have been already published in a number of papers (see the list below).

The structure of the presentation will be divided into 3 blocks. The first one will introduce the concept of open data and describe in examples what this term refers to. The second part will reveal where the societal phenomenon of open data came from, why it has gained a momentum and what were prerequisits for it to happen. The final block will summarize the results of the previous two by suggesting possible developments of open data in the future and discussion on how sustainable this movement might be economically.

1. Yulia Tammisto. Open Data as a Societal Shift towards Collaboarative Economics (in progress)
Yulia Tammisto, Juho Lindman. Comparison of Open Source and Open Data Business Models (in progress)

2. Yulia Tammisto, Juho Lindman. (2012). Open Data Definition. 3rd International Conference on Software Business 2012,18-20.6, Cambridge, MA, USA.

3. Yulia Tammisto, Juho Lindman, Matti Rossi. Open Data as a Next Research Frontier in Information Systems (in progress).

4. Juho Lindman, Yulia Tammisto. (2011). Open Source and Open Data: Business perspectives from the frontline. 7th International Conference on Open Source Systems, 6-7.10, Salvador, Brazil.

5. Yulia Tammisto, Juho Lindman. (2011). Open Data Business Models. The 34th Information Systems Seminar in Scandinavia (IRIS2011). 16-19.8., Turku, Finland.

The Beauty of Project Work

Using Aesthetics in Project Management

Juhani Tenhunen, Aalto ARTS

Aesthetics, in its original eighteenth-century meaning and project management don't have anything at all in common. The aesthetics was then determined to study mainly the man made art objects. Contemporary project management is of course man made, but can't hardly be described as art. However, the 300 years of aesthetics writing and thinking has changed its meaning from the study of the beautiful and the sublime in art, nature and other human artifacts, to cover also the aesthetics of naturally born objects, and goes even further to more conceptual level, when the manufacturing of the items and seeing "aesthetically" interesting in such things that are not beautiful or sublime. In the nature visually sublime and beautiful scenes can easily be reasoned as protected, but if the landscape doesn't have anything special or is even somehow ugly looking, like field of bushes or salt desert, we often think, that the area is worthless and do not consider any observation. But if we look the area deeper, we can notice that there can be interesting things going on in that wasteland. [Saito 2007]

The organizational aesthetics have also been studied from environment of organization points of views, where workplace's aestheticization is being thought to help for example when changing the strategies. The aestheticization can be reduced to relate only the environments or the visual outlook, or because of the flexibility of aesthetic thinking and aesthetic values, it can be applied even evaluating things where previous thinking and operation principles are not anymore sustainable. Artistic thinking can be seen as expedient to raise value of some everyday life maneuvers like cooking or also as pedagogical or therapeutic instrument.

How a Learning Technology Project Becomes a School Redesign Service

Tarmo Toikkanen, Aalto ARTS

Anna Keune, Aalto ARTS

The Learning Environments research group in the Department of Media of Aalto was invited to join an integrated project, funded by the EC. The project had a pedagogical part and a (much larger) technological part. Our team was situated in a design role in the linchpin between these.

The basic premise of iTEC (Innovative Technologies for an Engaging Classroom) was to start from interesting scenarios, design rapid prototypes, and pilot those in at least 1000 classrooms in 18 EU countries (the pedagogical part) create a repository of easy-to-use widgets, and a recommendation engine that allows teachers to start with a scenario, get recommendations on tools, people and events, and to compose their own lesson plans (the technological part).

When writing the project plan, we made sure to write our work package description in such a way that it allows for later adjustment and reinterpretation, so we are not bound by the project plan. We also proposed that the project be organized into 5 cycles, which iteratively create prototypes and pilot them.

The huge technological products promised in the plan were delayed and were not proving to be very useful. The Learning Activities and quick prototypes developed by our team were, in turn, very successful. The prototypes, however, were not as quick as anticipated, due to the immaturity of the underlying frameworks, and progress was slow. A reinterpretation of our team's outputs needed to happen after the first year of the project.

At the project's half-way point, the whole project shifted focus, and our team's results were raised to be the flagship outcome of the entire project. So an initially quite technology-heavy project is now realising that real change happens through participatory design with teachers and students, and our team's work and results are the most valuable output of the entire project, and the focus of dissemination, mainstreaming and sustainability efforts.

This presentation will give the story of our team's journey through this project, the challenges of getting partners to understand the value of our work, how the shift happened, what influenced it, and how we expect our work to impact European schools.

ABSTRACTS OF POSTERS AND DEMONSTRATIONS

Affordance Networks of Cruise Ship

Markus Ahola, Aalto ARTS

Cruise ship is a unique setting containing isolated moving environment, multi-cultural social space, and hundreds of different activities and services. This complex system provides well-known leisure activity of cruising that is replayed everyday around the world by thousands of passengers. From passengers' perspective cruising is an experience. Experience is individual witness of activity influenced by stimulus from product or service. Experiences are always relevant and have significant affect on emotions. However, generic features that are building the well-known cruising experience are unknown.

My research aims to create understanding on different features and their relation behind cruising experience from design perspective. Goal is approached with understanding actor networks of cruising experience. Actor network -concept enables identification of networks that are establishing immaterial capital, emotions, and value for the passengers' that are seen as key factors of futures cruise environment development. Because the design perspective on investigated topic research concentrates on identification of non-human actors from the networks. Identified objects and architectural details are studied by the means of their affordances. Basically, how human perception correlates with intended cruising experience produced by the affordance networks?

User experiences and behaviour has been widely researched, but lacks investigation of experiences as networks. My approach adds knowledge on how cruising experience can be analysed and illustrated through actor networks and affordances of the networks. Because, experiences and perception are always individual it's impossible to define unambiguous networks or all the affordances of the actors in cruising experience and therefore it's more valuable to identify essential affordance networks and understand the dominant logic behind.

With provided knowledge cruising experience can be better understood if the socio-technical-system is considered as a network of affordances and traditional department thinking is forgotten. Comprehensive understanding of passengers' needs and desires reveals untapped potential for improving user-oriented cruise ship environment design.

Bioinformatics for Deciphering the Deep Groundwater Microbial Communities

Nicole Althermeler, Aalto SCI

Anna Cichonska, Aalto SCI

Yvonne Herrmann, Aalto SCI

Nicolas Hoyo Rios, Aalto SCI

Hongyu Su, Aalto SCI

Esa Pitkänen, Aalto SCI

Juho Rousu, Aalto SCI

Malin Bomberg, VTT Technical Research Centre of Finland

Mikko Arvas, VTT Technical Research Centre of Finland

Merja Itävaara, VTT Technical Research Centre of Finland

Ilmo Kukkonen, The Geological Survey of Finland

Lasse Ahonen, The Geological Survey of Finland

Characterization of microbial communities in bedrock groundwater has been facilitated by recent advances in diverse measurement data. Together geochemical measurements and advanced metagenomic sequencing are able to give a comprehensive picture of microbial communities and their surrounding environment. Exploring this environmental portrait and determining the information containing the greatest new insight is the next step.

We present the GEOBIOINFO project where we aim to understand microbial metabolic activities in bedrock by developing and applying bioinformatics methods for metagenomics data. Our goals include detection of deep biosphere biogeochemical processes, reconstruction of microbial metabolic networks from sequenced microbial genomes or metagenomes, analysis of metabolic networks with geochemical data, and identification of functional modules that are represented by parts of communities.

The research outcomes have wide applications for example in risk assessment for long term storage of nuclear waste. The methods developed are independent of samples and can serve as pipeline for associating community's taxonomic structure and metabolic potentials of any genomics or metagenomics data.

Lifetime Projection of LED Light Sources

Hans Baumgartner, Aalto ELEC

Dominique Renoux, LNE France

Anna Vaskuri, Aalto ELEC

Tuomas Poikonen, Aalto ELEC

Petri Kärhä, Aalto ELEC

Erkki Ikonen, Aalto ELEC

Solid state lighting is becoming a real alternative for general purpose lighting. High volume manufacturing is decreasing the prices of LED light sources, so it is expected that incandescent and fluorescent lamps will gradually lose their market position for LED lighting. This is further enhanced by legislation. European Union started to phase out incandescent lamps in 2009, and USA in 2012.

Lifetime is a critical issue with LED lamps, because customers are expecting long lifetimes to justify the higher costs. In ideal conditions, the LED lifetime can be hundreds of thousands of hours. However, impartial research results about LED lamp lifetime are not available.

Illuminating Engineering Society of North America (IES) has defined the lifetime of LED lamps by lumen maintenance. The lamp is at the end of its lifetime when the luminous flux has decreased to 70% or 50% of the initial value [1]. Luminous flux decreases slowly, so it is not possible or at least practical to measure LED lamps for ten years. A lifetime prediction method is required to estimate the lifetime by using a data from a shorter period.

LED lifetime depends on the temperature of the LED chip. In higher temperatures, the lifetime of an LED decreases. We have studied the prediction of the lifetime of LED lamps by ageing lamps both at the room temperature and at two elevated temperatures of 45 °C and 60 °C. Five different types of high quality LED lamps from two manufacturers were studied. The measurement data at the room temperature covered a time period of almost two years.

IES has defined an exponential curve-fit method to project LED lamp lifetime. The projected lifetime at room temperature (23 °C) for the different types of LED lamps varied in our measurements from very long to 30 000 hours. Variations were due to the different working principles of the LEDs used to produce white light. A correlation between the ambient temperature and the LED lifetime was found. At 60 °C temperature, the lifetime of an LED is three times shorter than at the room temperature. Also other LED failure mechanisms than the decrease of the luminous flux were found.

Interaction with Physical Artefacts for Informal Learning in Work Context

Merja Bauters, Aalto ARTS

The poster presentation tries to describe a process of design, some challenges encountered when designing ideas and prototypes for informal learning in the field of construction sector and the vocational training system.

The research is executed in a the 7th framework programme, Learning Layers - Scaling up Technologies for Informal Learning in SME Clusters. The whole design in the projects follows the co-design approach (Leinonen, Toikkanen and Silfvast, 2008). Namely, co-design approach is flexible design process for parallel design activities and process. It is an iterative process as are the agile software development methods, which are used in the Learning Layers project. The important aspect of the co-design approach is that requires that all stakeholders take part in the process – especially the end-users, the actual users who are/will/should be using what ever is designed. Another very important factor is that the artefacts of the iterative cycles, e.g. mock-ups, wireframes, testing results, created practices, from low level to high level prototypes are valuable outcomes and research results as such, and that the process attempts to engage the end-users for sustained activities, thus it is a process that can go on long, it just changes its focus during the journey toward most enjoyable usage experiences.

The main brake through in design occurred in an open design conference that AALTO held. There further design teams were created and the ideas from which to start were generated. See: Co-constructing of learning materials: https://vimeo.com/62605726, Sharing ideas: https://vimeo.com/62602455 , Content maturing ideas: https://vimeo.com/62604353 ; Sessions on gaming (Scaffolding game reflections: https://vimeo.com/64377484, Gaming session: https://vimeo.com/64379395, scaffolding model activities and tool creation design activities: https://vimeo.com/64382615 Creating things hands on: https://vimeo.com/64384000.

The design team Sharing Turbine is one that focuses on the interaction with physical artefacts. Its idea is briefly the following: In the training, vocational centres in Germany they use a "white folder" to document the work project that have been executed. This folder is in paper and very hard to use when in field, in the constructions site. It complicates the immediate influx of informal learning experiences at the workplace. An additional complicating factor is that the workers cannot easily share the physical folder when they have to demonstrate their experience and know-how to others: e.g. their master for assessing their task solutions or peers for collaboration with them while the apprenticeship or to share experiences and work habits that are encountered in the work place that do not follow the ones directed in the learning phase in the centres.

The Sharing Turbine will try to find out how and what parts could be digitalized and even more with what kind of wearable, augmented reality applications to smoothen down the gap between physical work and needs to the digitalized ones.

The challenges that have been encountered now when ethnographic background work has been executed, around 3 workshops has been designed and executed, are for example: lack of users' interest, dis-interest of seeing beyond what is the current situation, change resistance.

The lack of users' interest in taking part in workshops and design activities is well known and there exists various methods to overcome this. However, lack of time, and recourses (money) is not easily

overcome. If there is no way of providing large enough compensation of the used time and missed earning possibilities, the potential future benefits are often not enough. This means that often the users taking part are not motivated and may not belong exactly to the target users.

The dis-interest is related to the above point, however, this is easier in the sense that if there is enough information of the users it is easier to find out arguments and actual issues that are in the interest of the users. Often these offerings are extrinsic but in ideal case these turn into being intrinsic motivations to take part.

Last but not least the change resistance is also one that is well known. There are many methods for example, the change laboratory method to deal with this issue. However, many of these "solutions" need a lot of time, and the change resistance should be tackled already in early stages and if possible it should be turned into a benefit.

In the poster presentation, these challenges are opened up further and what was done is described, as well as the potential prototypes that have emerged from the co-design process are presented.

Leinonen, T., Toikkanen, T., and Silfvast, K. (2008). Software as Hypothesis: Research-Based Design Methodology.
Proceedings of Participatory Design Conference. Presented at the Participatory Design Conference, Indiana University, Bloomington, ACM.

Aging Together? Co-Design and Everyday Practices

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This poster aims to elaborate on some design strategies suited for extended collaborative design with communities of ordinary people. We refer to them as "Aging together strategies" as they seek to gradually uncover and make jointly visible the design space available for a community of practice (Wenger 1998) and realize an evolving line of well-suited technologies, media and practices within a community. In doing this, we draw from and contribute to the ideas for "designing for practices" (e.g. Shove et. al. 2007, Björgvinsson 2008), which depart from the observation that it is change in the everyday practices that is the targeted outcome of design, and that those practices by their nature intertwine systems that are simultaneously affected by other developments aside design. Our approach rests on the assumption that the available space for design is not limited to designed objects, but includes immaterial designs that affect how social arrangements, norms, timing and the pacing of everyday routines are carried out (Botero et al 2010, Hysalo 2010).

The strategies have emerged and been iterated in a long-term design collaboration with a co-housing project by elderly people. We use that project to illuminate the rationale and challenges brought out by doing interventions based on these strategies; as they appear to us after the experience, in light of several iterations of the same approach in different settings (Botero 2013).

Succinctly presented they are:

Start with social practices. Design activities do not occur only at the studio or in exploratory workshops. They are already present in the practices, infrastructures and development trajectories of people who come together to become the "clients" "users" and "designers".

Explore the constituency, build new alliances if needed. It is key to explore stakeholder configurations to be able to achieve the kind of practice and technology or media change that is being envisioned and determine if the agendas of each party can be aligned.

Start with the relevant small "access design". Design engagement is not guaranteed to work. A well bounded initial teaser can give a sense of how the collaboration feels like—should everybody want to get more serious or not!

Manage expectations. Set joint goals and do not expect or do not have the participants expect that you or resources will be there forever. Clarify and check these constantly. Apply for funding as the project advances and needs arise.

Cultivate an open agenda. The idea is not to focus on realizing a killer application but instead, fostering contributions that lead to improving the practices in the community.

Go there, be there. Collaborators should get a real feeling of each other. If the community is dispersed or only beginning to emerge, people should meet, workshops should be arranged and similar experiences studied as a starting point.

Build scaffolds. Provoke imagination and cultivate the sense of possibilities by offering the community a sense of what could be done. Bring concepts, materials, solutions and practices from

elsewhere. Design avenues can be explored in hands on workshops and with experiments. Tune in by doing it on site if possible.

Build and release prototypes iteratively, rapidly and from early on. Follow how things are being used, what ideas for improvement, shortcomings, contradictions, new design directions etc. may have emerged and respond to the evolving needs through collective and cumulative design iterations.

Alternate close working periods with lighter engagement. Make the most of the time spent together, but also allow people to find their own ways to use the technology and try things out on their own and avoid spending designer hours unduly. Communications channels should be created towards this end.

Foster ownership of the process, technology and media. Offer advice, solution help and alternatives so that the community can make final decisions. Negotiate and decide jointly which new design directions are pursued further and clarify why.

Keep attentive to partial failures and what can be learned from them. An encompassing and stable design is slow to achieve and may easily embody things that are not needed or that end up serving other purposes. Failures can provide serendipity handles.

Embed design at different levels. Support multiple access modes and make sure there are parallels from old to new to weave things together. Make possible design activities at different scales.

Avoid design locking-in with crucial choices (e.g. technology). Open and/or flexible alternatives for technologies and infrastructures should be preferred whenever possible. An open discussion about things such as intellectual property rights should not be avoided.

Together they outline the initial contours of an approach suited for realizing extended and evolving design engagements with ordinary communities in their everyday life practices. It should be noted, however, that initiation strategies aside, these strategies are pervasive rather than chronologically relevant guidelines. Our aim during the Aalto research day is to discuss these premises with other researchers and gather ideas for further development.

This text is based on the following published article: Botero, A., & Hyysalo, S. (2013). Ageing together: Steps Towards Evolutionary Co-design in Everyday Practices. CoDesign, 9(1), 37–54.)

Botero, A. (2013). Expanding design space(s) - Design in communal endeavors (Doctoral Dissertation). Aalto University, School of Arts, Design and Architecture, Helsinki, Finland.
Botero, A., Kommonen, K.-H. and Marttila, S., 2010. Expanding Design Space: Design-In-Use Activities and Strategies. In Proceedings of the DRS 2010 Conference. Design and Complexity. Montreal, Canada: DRS.
Björgvinsson, E., 2008. Open-ended participatory design as prototypical practice. CoDesign International Journal of CoCreation in Design and the Arts, 4(2), pp.85-99.
Hyysalo, S., 2010. Health Technology Development and Use: From Practice-Bound Imagination to Evolving Impacts 1st ed., New York, NY, USA: Routledge.
Shove, E. et al., 2007. The Design of Everyday Life, Berg Publishers
Wenger, E., 1998. Communities of practice: learning, meaning, and identity, Cambridge University Press.

Co-Creating a New Research Landscaping Service for Aalto Library: Utilizing The "Correspondent" Mode in Customer Integration

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Customer involvement is becoming a must for organizations when they innovate new services. However, we know much less about customer integration in new service than in new product development. In this research we apply a service-dominant-logic based customer integration approach, where the customers are involved as "correspondents" – being in a real-life, value creating service situation when piloting the service. The case organization of our research is Aalto University Library, and the new service co-created together with customers and other stakeholders is a research landscaping service for doctoral students. In this study we report our findings from the co-creation endeavor. The goal is to increase understanding on stakeholder integration in service innovation and to contribute to the introduction of the new service.

Customer integration is becoming increasingly important for innovating new or improved services. Such concepts as *customer co-creation* (Prahalad and Ramaswamy, 2004), *open innovation* (Chesbrough, 2011), *user innovation* (von Hippel, 2005), *community-based innovation* (Füller et al., 2006) and *crowdsourcing* (Brabham, 2008) have all recently received intense interest by service businesses and public organizations. However, service organizations are facing a challenging task: how to choose an appropriate method for their customer involving innovation endeavor. Chesbrough (2011) claims that we know much less about how to innovate in services than about how to develop new products and technologies, and this poses a key problem for advanced economies. He suspects that the customer may need to participate throughout the innovation process, as tacit knowledge, which emerges during the innovation process, cannot be collected in advance. This may partially be explained by the nature of services, as the users have a more prominent, interactive role in the actual service provision (Menor et al., 2002).

Edvardsson et al. (2012) have constructed an insightful framework that can be used as a decision tool for choosing between appropriate customer integration methods in service innovation. Their framework is anchored in the service-dominant logic (Vargo and Lusch, 2004), which sees that customers should be involved in service development and that use situations are critical for understanding value creation. The framework depicts a matrix of four modes based on the information related to the use situation (either *in situ* or *ex situ*) and the resource contexts (either in context or ex context) that are available to the customer (see Figure 1).

Edvardsson et al. (2012) report that much of the information used in service innovation practice comes from "reflective practitioners", meaning customers who are not in the service situation (they are thus ex situ) or do not necessarily have an actual need for service, but who have previous experience from the service's resource context (they are thus in context). However, they conclude that those methods that allow users to identify their own needs and solutions - and which are also obtained in the natural use context – are most likely better at providing influential information regarding the preconditions for better value creation in service.

Use situation
(activities and interactions at a specific situation)

	In situ	Ex situ
In context	**THE CORRESPONDENT,** reporting live from the situation ➢ Empathic design, lead-user method, CUDIT method	**THE REFLECTIVE PRACTITIONER,** reporting from the armchair ➢ Participatory design, toolkit for user innovation, living labs, customer group involvement, conversational approach
Ex context	**THE TESTER,** reporting from the virtual heaven ➢ Information acceleration, avatar-based innovation	**THE DREAMER,** the creative who generates wild and imaginative ideas ➢ TRIZ method, free elicitation, GAP-based Quality Function Deployment

Resource context (resource constellations available to the customer)

Figure 1 Framework for relating use information to methods for service development with method examples in each mode. Adapted from Edvardsson et al. (2012)

This "correspondent" mode consists of methods where the participant reports live from the service situation ("*in situ*–in context"). It has more seldom been employed in service innovation (Ainasoja et al., 2010, Edvardsson et al., 2012), and also research is scarce from this mode of customer integration. Several methods are available for the correspondent mode, such as empathic design and the lead-user method (see Figure 1).

In this research we depict how Aalto University Library involved customers and also other relevant stakeholders when co-creating a new research landscaping service for doctoral students. The library delivers the latest research results, via offering over 50.000 scientific e-journals through various databases to its customers. Although superb in terms of coverage, the magnitude poses also challenges for researchers. The new research landscaping service is aimed at complementing the library's existing 1-hour information retrieval (IR) kick-off session for the doctoral students, which has been offered as a service since 2002. Research landscaping, on its part, utilizes contemporary text-mining and science visualization tools (see Figure 2), and their application is becoming a must for researchers tackling with the exploding amounts of literature in electronic science databases (Porter et al., 2002, Cobo et al., 2011, Bragge et al., 2012).

Besides the target customers of the service, also a senior researcher and a recently graduated doctoral student, both being early adopters of research landscaping tools (Bragge et al. 2007, Sunikka and Bragge, 2012), were invited in this service innovation project as stakeholders by the library.

The goal of this research is to increase understanding on customer and stakeholder involvement in service innovation through an approach that is founded on the service-dominant logic (Vargo and Lusch, 2004). The results are expected to contribute also to practice, as a service to be launched in Fall 2013 (see service blueprint at Figure 3) at the Aalto University Library.
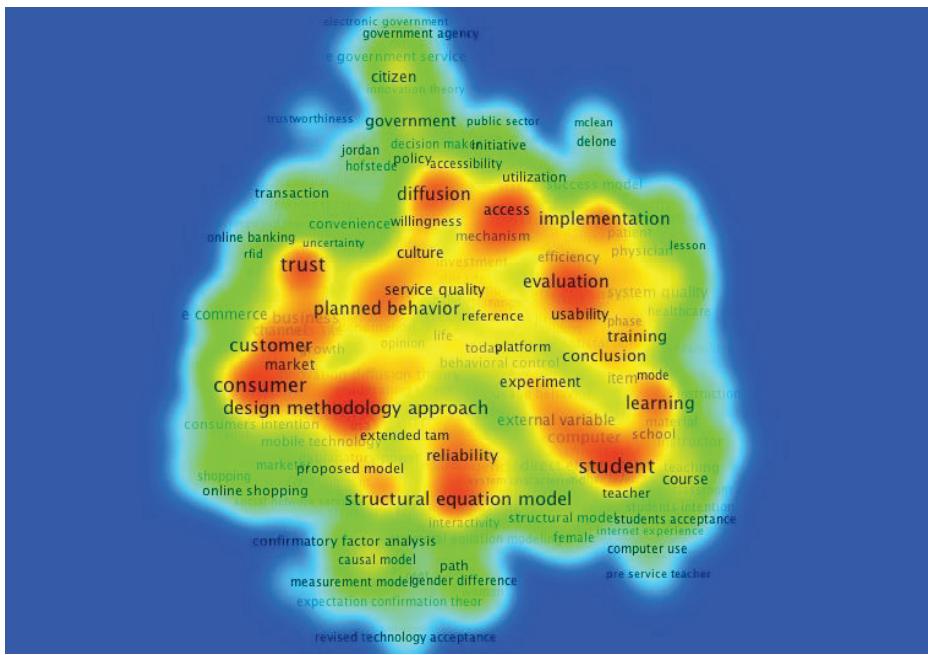
Figure 2 An example of a research landscape created using the VOSviewer visualization tool on "Technology Acceptance Model" literature (with over 2200 search results from Scopus database)
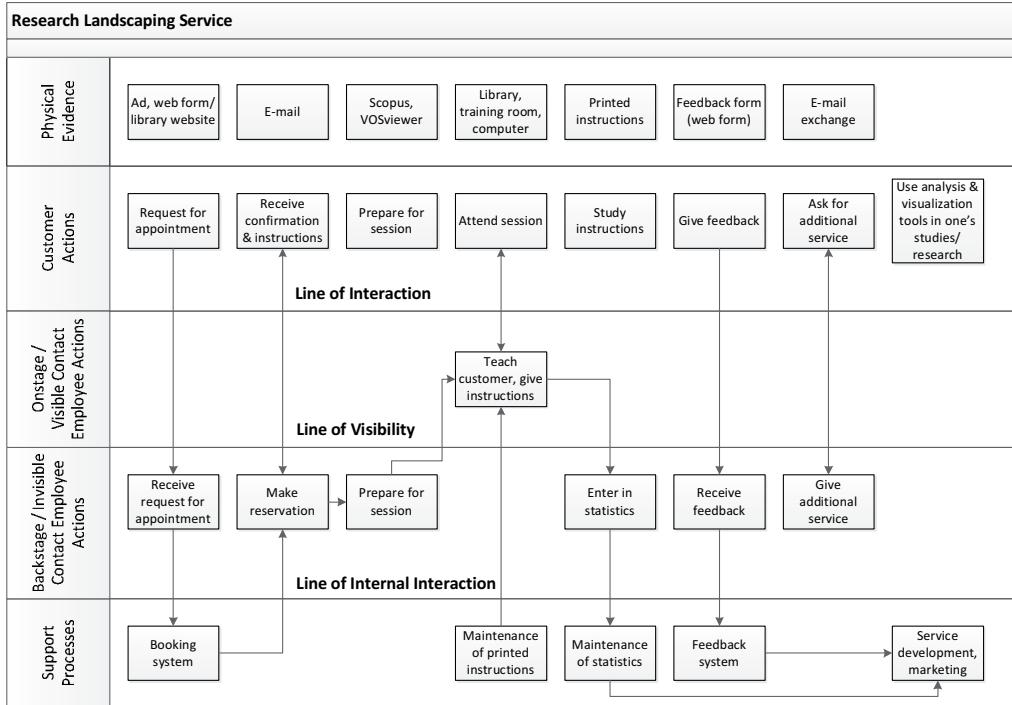
Figure 3 Process depiction of the new research landscaping service

Ainasoja, M., S. Rytövuori, E. Vulli, R. Hautala, E. Reunanen, E. Kaasinen and M. Kulju (2010). *Experiences from involving users in four fields of service. A summary of the case studies of the UseIn project*. (in Finnish). TEKES.

Brabham, D. C. (2008). "Crowdsourcing as a Model for Problem Solving: An Introduction and Cases.", *Convergence: The International Journal of Research into New Media Technologies*, 14(1), 75-90.

Bragge, J., S. Relander, A. Sunikka and P. Mannonen. (2007). "Enriching Literature Reviews with Computer-Assisted Research Mining. Case: Profiling Group Support Systems Research". In *Proceedings of the 40th HICSS Conference*, January 3-6, 2007 Hawaii, USA.

Bragge, J., P. Korhonen, H. Wallenius and J. Wallenius. (2012). "Scholarly Communities of Research in Multiple Criteria Decision Making: A Bibliometric Research Profiling Study". *International Journal of Information Technology and Decision Making* 11(2): 401-426.

Chesbrough, H. (2011). "Bringing open innovation in services". *MIT Sloan Management Review*, 52(2), 85-90.

Cobo, M. J., A. G. López-Herrera, E. Herrera-Viedma and F. Herrera. (2011). "Science Mapping Software Tools: Review, Analysis and Cooperative Study among Tools". *Journal of the American Society for Information Science and Technology* 62(7): 1382-1402.

Edvardsson, B., P. Kristensson, P. Magnusson and E. Sundström (2012). "Customer integration within service development—A review of methods and an analysis of insitu and exsitu contributions". *Technovation*, 32(7-8), 419-429.

Füller, J., M. Bartl, H. Ernst and H. Mühlbacher (2006). "Community based innovation: How to integrate members of virtual communities into new product development", *Electronic Commerce Research*, 6(1), 57-73.

Menor, L. J., M. V. Tatikonda and S. E. Sampson (2002). "New service development: areas for exploitation and exploration". *Journal of Operations Management*, 20(2), 135-157.

Papastathopoulou, P. and E. J. Hultink. (2012). "New Service Development: An Analysis of 27 Years of Research". *Journal of Product Innovation Management* 29(5): 705-714.

Porter, A. L., Kongthon, A. and J. C. Lu, (2002), "Research Profiling: Improving the Literature Review, Scientometrics" 53(3), 351-70.

Prahalad, C. K. and V. Ramaswamy (2004). "Co-Creation Experiences: The Next Practice in Value Creation.", *Journal of Interactive Marketing*, 185-14.

Sunikka, A. and J. Bragge. 2012. "Applying text-mining to personalization and customization research literature – Who, what and where?". *Expert Systems with Applications* 39(11): 10049-10058.

Vargo, S. L. and R. F. Lusch (2004). "Evolving to a New Dominant Logic for Marketing". *Journal of Marketing*, 68(1), 1-17.

Von Hippel, E. (2005). "Democratizing innovation: The evolving phenomenon of user innovation", *Journal für Betriebswirtschaft*, 55(1), 63-78.

Development of Efficient Yeast Expression System for Humanized Therapeutic Proteins

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Baker's yeast, Saccharomyces cerevisiae, has been utilized for thousands of years in making everyday goods such as bread, beer and wine. Due to its wide occurrence and ease of culturing, yeast cells were in the center of early molecular research. During the 20th century many methods for genetic and molecular manipulation of yeast were developed. Today, Saccharomyces cerevisiae is not only one of the most important model organisms used in biological research but also an essential part of food and biotechnological industry.

The available toolkit for exploiting yeast cells makes the organism well-suited for industrial applications. Currently yeast cells are employed for example in the production of bio-ethanol. Compared to other microbial work horses (e.g. E. coli) S. cerevisiae is more suitable for production of complicated, eukaryotic proteins products. These include medically interesting agents such as cytokines, hormones and antibodies. Easy and cheap availability of sophisticated medication would improve treatment efficiency and patient life quality. Efficient production of proteinous drugs in yeast cells has also potential in relieving the burden of healthcare costs, which are continuously increasing in industrialized countries at governmental and individual levels.

Antibodies are proteins that are produced by the immune system to fight against a specific disease-causing agent. Cancer cells also acquire modifications that make them distinguishable from the healthy cells. Antibodies thus could be used in a great variety of medical applications from diagnostics to defeating difficult illnesses. Currently these proteins are produced in mammalian cell derived systems, so called hybridomas. This is however costly and not very well-suited for high yields. Engineering yeast cells to secrete humanized antibodies could provide easier and cheaper access to new treatments.

Our focus is to develop a professional yeast expression system for high yield production of human-like antibodies. This involves optimizing of the secretory system, folding capacity and addition of the correct post-translational modifications. Most notably the N-linked glycans, sugar residues covalently attached to the protein, must be modified to the correct human form. N-glycosylation is fairly important for proper protein folding and functioning. Manipulating the N-glycosylation pathway in yeast allows the sugar residues to correspond to the human N-glycan versions. By developing the N-glycosylation competent strain further, our aim is to achieve an efficient, biotechnologically relevant yeast cell line capable of high-yield glycoprotein production. Around 70 % of medically interesting proteins have sugar residues attached to them, so this strain would also provide a promising platform for the production of other products.

The secretory pathway of yeast cells is not intrinsically very efficient. Another approach in our study is to implement facilitating modules into the system. These include factors that enhance protein folding and agents that make the cells secrete more efficiently. By comparing expression systems optimized by evolution (e.g. antibody secreting B-cells) with low-yield cellular entities, specific parts of efficient production systems can be identified and transferred into the desired yeast strain. Addition of foreign proteins may help the expression host to adapt to the high protein

synthesis levels. Designing the yeast cell to resemble the natural protein factories makes them more likely to become one.

Because of the high amount of factors that play a role in efficient protein production, one of the research approaches is using high-throughput screening of different yeast strains. For this purpose, we are using a Hamilton ML Star liquid handling workstation for automated sample processing. The pipetting robot is capable of testing the protein production of up to 320 samples per run. In addition, it can pick colonies from a mutant library to start up to 960 cultivations and in the end select the most interesting ones for further analysis.

Although our research is centered on antibodies for the moment, our results are not limited to one type of protein. The developed strains can be utilized in the production of other glycoproteins as well. Optimizing and studying protein secretion in yeast cells is not only interesting for the medical industry but also has application in other fields. In food and fuel industries, high-yield yeast expression systems could be employed in the production of substances with high nutritional value and more efficient enzymes.

Re-Awakening an Underexplored Framework: Lessons for the Internationalization of SMEs in an Emerging African Market

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The term "internationalization" has been defined severally among various scholars in the field of international business (IB) to imply the process by which firms become gradually involved and committed in the international or overseas market. Over the years, internationalization of the firm has remained a dominant topical issue in the IB literature and numerous studies have dwelt on the subject. This development is not unexpected as firms continually internationalize or expand operations beyond their traditional markets as a way to increase their profitability, growth, and sustainability through cheap labor, economies of scale, increased competition, bigger market size, access to raw materials, and several other obvious advantages that accrue from operating in the international market frontier. Consequent to this, firms (both small and large) have found a major competitive advantage through competing in the international (overseas) market. This pursuit of growth and competitiveness among firms is not restricted to the developed markets alone as firms have seen increasing internationalization into and out of emerging markets- those countries restructuring their economies along market-oriented lines, offering a wealth of opportunities in trade, technology transfers, and foreign direct investment.

Obviously, as extant literature in the IB field reveals, most firms had employed the more prominent internationalization theories including the Dunning's eclectic paradigm, Uppsala Model, the resource-based theories, the transaction cost theory, the network approach, and several other theories as guide in their foreign market operations. Obviously, these theories, like every other theory in the scientific world, have their usefulness and limitations. Some firms that applied them succeeded in their foreign market expansion effort much as some others failed woefully in the process, but the fact remains that existing works in the international business literature seem to have forgotten one of the major founding theoretical frameworks established to guide internationalization, thereby downplaying its relevance and failing to accord it the deserved status in the in the field of international business.

The paper argues that though the Helsinki Model by Reijo Luostarinen happens to be among the earliest theories that laid the foundation for subsequent works on internationalization, it is underexplored and thus relegated to the background in the IB literature. In this case, the usefulness of the framework as a pacesetter in the field of international business is not fully appreciated relative to the other models in its category such as the highly celebrated Uppsala Model. The Helsinki Model fully recognizes that small firms do not have the huge resources to embrace the foreign market like their large multinational counterparts. Consequently, the Model relies on the premise that operating in a foreign market is a risky venture which must be approached with every amount of shrewdness hence; internationalization should be treated as a stage- or step-wise process. In line with this, the Helsinki Model recommends four different operation modes for firms to embrace in their foreign market expansion processes depending on their resource capabilities and stages in the internationalization process. The Model includes non-investment marketing operations (NIMOs), direct investment marketing operations (DIMOs), Non-investment production operations (NIPOs), and direct investment production operations (DIPOs). While DIMOs and DIPOs are internalization operation modes, NIMOs and NIPOs) are externalization operation modes. Another

major potential of the Helsinki Model is that it treats internationalization holistically as a process involving both inward and outward market operations.

Focusing on Nigeria, this paper seeks to revisit the Helsinki Model with a view to reawakening its potential as an indispensable tool for the internationalization process of the firm. The paper deliberates on the inward and outward internationalization process of the firm, as outlined in the Helsinki Model, with particular reference to small and medium-sized entrepreneurs (SMEs) seeking to expand their international market operations into and out of Nigeria. The choice of Nigeria in this analysis is obvious as the country is Africa's largest foreign direct investment (FDI) recipient and second largest economy, one of the top ten fastest-growth economies in the world, and among the world's leading emerging markets.

The paper is intended to embrace the qualitative research approach in line with IB research principles. In this case, the paper relies on extant publications in the IB literature dealing with the internationalization of the firm. Particular attention is paid to the works of Reijo Luostarinen on the subject. Also, materials on the characteristics of both the Finnish and Nigerian markets as well as their SMEs are reviewed and employed in the study.

As its contribution to the IB literature, this paper demonstrates that the contemporary internationalizing firm losses huge potential by not embracing the Helsinki Model. It is worth mentioning that adopting the wrong approach has been a major reason many firms fail in their foreign operations. Particularly, the paper re-awakens the usefulness of the Helsinki Model by demonstrating that SMEs should embrace it as their guiding theoretical approach to internationalize into and out of this fast emerging African market. By so doing, the Helsinki Model will start to be put in its deserved position in academia and among firms as one of the dominant internationalization theories.

Information Visualization for Encouraging Reflection and Awareness

a Proposal for Visualizing Learning and Well-Being

Eva Durall, Aalto ARTS

The proposal focuses on the visualization of learning performance and well-being with the aim of fostering reflection and awareness. By drawing the attention to learning and well-being, the project combines two currently promising areas such as Personal Informatics and Learning Analytics. It is expected that allowing learners to capture and visualize quantitative data about their states and habits will offer them rich materials that support discussion with their peers and with more knowledgeable ones. This project builds on participatory design and a research-based design process.Users are involved in the early stages of the design process in order to incorporate people's concrete wishes and expectations. Currently, the project is in a product design stage. The aim of the project is to develop a working prototype that follows a calm technology approach that can be tested in learning contexts.

1. Introduction

The combination of computers with Internet access and sensors has allowed people to collect data about a myriad of personal aspects dealing with physiology, behavior, habits and thoughts. In this context, the Quantified-Self movement has appeared as a way to develop self-knowledge through data. The availability of measurable personal data can be used, as Li, Dey & Forlizzi highlight, for self-reflection to help people become more aware of their own behavior, make better decisions, and change behavior. (2011, pp.405)

Personal informatics, also known as Quantified-Self, has become quite popular in fields dealing with sports and health. In these contexts, monitoring data about health and exercise has been used for supporting informal learning and behavior change. In sports, some examples of body tracking products include Nike+[1] and its fuelband[2], Fitbit[3], and Moves[4]. Concerning wellbeing, applications such as HeartMath[5], and mindbloom[6] offer opportunities to users to learn about their progression and undertake new challenges concerning healthy habits.

In the learning field, self-awareness has been considered as a critically important component of metacognitive knowledge (Pintrich, 2002). In the field of e-learning, the high proportion of interactions that are computer-mediated has created an interest about how this data can be used to improve teaching and learning. Similarly to personal informatics, learning analytics models are presented as a tool that informs and empowers instructors and learners.

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[1] Nike+. http://nikeplus.nike.com/plus/products/gps_app/

[2] Nike+ fuelband. http://www.nike.com/us/en_us/c/nikeplus-fuelband

[3] Fitbit. http://www.fitbit.com/

[4] Moves. http://www.moves-app.com

[5] HeartMath. http://www.heartmath.com/

[6] Mindbloom. https://www.mindbloom.com/lifegame

Fig. 1. Moves iPhone app.

Considering the key role of self-knowledge for self-regulation and metacognition, self-understanding should be at the center of systems that monitor student data. In this sense, some authors (Duval 2012, Clow 2012, Kruse & Pongsajapan, 2012) have noted that learning analytics should be considered as a tool for the student. In order to encourage self-understanding of learning processes, it is crucial to stop considering learning as an isolated activity that does not interrelate with other aspects of peoples' lives. In general, educational institutions should understand that they are only one venue where learning happens, and to utilize holistically the other areas of life where their students are active. Qualitative aspects, such as the student's well-being, might be worth to be taken into consideration since they can impact learning performance. This paper presents an innovative approach to learning analytics that combines data about wellbeing and learning performance with the aim of fostering self-understanding. It is expected that the visualization of these datasets, focused on well-being and learning, will allow the students to reflect about their habits and learning practices and gain awareness.

2 Visualizing the Data for Gaining Awareness

Due to the power of images for synthesizing complex information, information visualization has been recognized as a powerful tool for reducing cognitive load, offloading short-term memory, allowing for easier comparisons, and generally facilitating inferences (Shneiderman, 1996; Tufte, 1990 and 1997).

Heer and Agrawala (2008) have also highlighted the strength of visualizations as tools for sense making in which information is collected, organized, and analyzed to generate knowledge and inform action. In this sense, Viégas and Wattenberg (2006) argue for what they call communication-minded visualization: Visualization systems designed to support communication and collaborative analysis. The underlying idea of this approach is that participants learn from their peers when they build consensus or make decisions. Others authors, such as Masud et al. (2010), claim that visualizations should be conceived as transformation processes that provide awareness, as well as social and reflective insights.

Visualizing the data can be a powerful resource for supporting reflection, individual or in groups, and therefore gaining awareness. Some of the questions that emerge in this context, is how to make large volumes of data meaningful for users. How should this data be displayed in order to improve self-understanding, reflection and awareness? One answer to this question can be found in the design philosophy underlying slow technology. According to Hallnäs and Redström (2001), slow technology responds to the need of actively promoting moments of reflection. Even if how to visualize people's data is still a work in progress issue, the reflective technology approach offers interesting insights since it encourages the person to question about the technology in itself.

3 Methods

To design tools that effectively assist self-reflection, it is crucial to understand how people think about well-being and learning in relation to their everyday practices. For this reason, the project builds on participatory design and a research-based design process (Leinonen 2008, 2010). It is an iterative process characterized by the following phases: contextual inquiry, participatory design, product design and prototype as hypothesis. The aim is to involve users from early stages of the project in order to incorporate their wishes and expectations.

Fig. 2. Research-based design process (Leinonen, 2008, 2010). Image created by A.Keune.

At the moment, some exploratory interviews have been realized to people aged between 24-60 years old that combine work and studies and that are concerned about their well-being. The information gathered during the interviews informed a participatory design session. In the short-term, next steps include the development of the concept design, building of low-fi prototypes and the organization of more participatory design sessions. The aim of the project is to develop a working prototype that can be tested in learning contexts.

4 Conclusions

The underlying assumption of the research is that information visualization can be a powerful tool for encouraging reflection and awareness about learning. By drawing the attention to learning and well-being, the project combines two currently promising areas such as Personal Informatics and Learning Analytics. It is expected that allowing learners to capture quantitative data about their

states and habits will offer them rich materials that support discussion with their peers and with more knowledgeable ones.

Slow and calm technologies bring inspiring ideas into the design of the prototype since, rather than designing for effective work, the aim is to foster reflection following a calm approach.

Clow, D.: The learning analytics cycle: closing the loop effectively. In: LAK12: 2nd International Conference on Learning Analytics & Knowledge, pp. 134-138, ACM, NY, USA (2012)

Duval, E., Verbert, K.: Learning Analytics. eleed, 8 (2012). Retrieved June 27, 2013 from http://eleed.campussource.de/archive/8/3336

Hallnäs, L., Redström, J.: Slow Technology - Designing for Reflection. Personal Ubiquitous Computing, 5, 201-212 (2001)

Heer, J., Agrawala, M.: Design considerations for collaborative visual analytics. Information Visualization, 7, 49-62 (2008)

Keller, T., Tergan, S.O.: Visualizing Knowledge and Information: An Introduction. In: Knowledge and Information Visualization: Searching for Synergies, Keller, T., Tergan, S.O (eds) pp. 1-23. Springer, London (2005)

Kruse, A., & Pongsajapan, R.: Student-centered learning analytics. (2012)

Masud, L., Valsecchi, F., Ciuccarelli, P., Ricci, D. & Caviglia, G.: From data to knowledge - visualizations as transformation processes within the data - information - knowledge continuum. In: 14th International Conference Information Visualization, (IV), pp. 445 – 499. IEEE (2010)

Pintrich, P.: The role of Metacognitive Knowledge in Learning, Teaching and Assessing. Theory Into Practice, 41(4), 219-225 (2002)

Leinonen, T., Toikkanen, T., & Silfvast, K.,: Software as hypothesis: research-based design methodology. In: 10th Anniversary Conference on Participatory Design 2008, PDC'08, pp. 61-70. ACM, Bloomington (2008)

Leinonen, T.: Designing learning tools - methodological insights. Ph.D. Aalto University School of Art and Design. Bookwell, Jyvaeskylae (2010).

Li, I., Dey, A.K., Forlizzi, J.: Understanding My Data, Myself: Supporting Self-Reflection with Ubicomp Technologies. In: Proceedings of the 13th international conference on Ubiquitous computing, UbiComp '11, pp. 405–414. ACM, NY (2011)

Shneiderman, B.: The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations. In: IEEE Visual Languages. Boulder, CO, 336-343 (1996)

Tan, S.C., Divaharan, S., Tan, L., &Cheah, H.M.: Self-directed learning with ICT: Theory, Practice and Assessment. Ministry of Education, Singapore (2011). Retrieved

Tufte, E.R.: Envisioning Information. Graphic Press, Cheshire, Connecticut (1990)

Tufte, E.R.: Visual Explanations. Images and Quantities, Evidence and Narrative. Graphic Press, Cheshire, Connecticut (1997)

Viégas, F.B., Wattenberg, M.: Communication-minded visualization: a call to action. IBM Systems Journal, 45, 4, 801-812 (2006)

New Primary Standard of Optical Radiation Operating at Room Temperature

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The qu-candela project [1] of the European Metrology Research Programme developed the Predictable Quantum Efficient Detector (PQED) that was demonstrated to be a very useful semiconductor device for absolute optical power measurements at room temperature [2]. The PQED consists of induced-junction photodiodes made of low-doping p-type silicon mounted in a light trapping configuration. The deviations between the predicted and measured responsivity values indicate that at room temperature the internal quantum efficiency of the PQED is equal to one within about 100 ppm (ppm = parts per million) over the visible wavelength range [2, 3].

A new compact room temperature PQED has been designed and constructed. The device consists of two large area (22 mm x 11 mm) photodiodes operated in reverse bias mode. In order to reduce losses due to specular reflection, the photodiodes are aligned so that 7 reflections take place before a small fraction of incident light leaves the device. The cylinder shaped detector has an outer diameter of 75 mm and a length of 215 mm. The detector is equipped with an adjustable window aligned in Brewster angle for high transmission of p polarized light and the air-tight assembly is filled with dry nitrogen. The detector can also be used without the window, in which case a dry nitrogen flow system is utilized to prevent dust contamination of the photodiodes.

The PQED may replace the sophisticated cryogenic radiometer, which is operated close to the temperature of 4 K, as a primary standard of optical power giving the benefits of room temperature operation and ease of use similar to conventional trap detectors.

[1]   http://www.quantumcandela.net

[2]   F. Manoocheri et al, Proceedings of NEWRAD 2011 Conference (Hawaii, USA, 2011) pp. 13-15, available at http://newrad2011.aalto.fi

[3]   J. Gran et al, Metrologia 49, S130-S134 (2012

Fibre Orientation Phenomenon in Concrete Composites: Measuring and Theoretical Modelling

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The use of composites is increasing in various applications since they are considered as innovative and improved materials to enhance conservative construction industry. One of the options to increase the strength and durability of concrete (matrix) is the addition of fibres. The present research is dedicated to the study of the properties and use of concrete reinforced by short hooked-end steel fibres (steel fibre reinforced concrete, SFRC). The development of partly brittle composite system is closely connected

with the necessity to study its deformation and fracture or cracking mechanics. The adding of steel fibres to the concrete matrix leads to anisotropic behaviour, i.e. direction dependent properties. The current material models of short fibre composites may not take the orientation of fibres into account adequately. Thereby, one of the goals of the research implemented was the formulation of the orthotropic constitutive relation for SFRC, which considers the orientation distribution of fibres by an orthotropic stress and strain

relation. This objective was achieved utilizing the orientation distribution function (ODF) and the alignment tensors (ATs). Employing the latter quantities it was possible to describe true material properties and comply with the principle of material frame indifference. The material symmetry of SFRC was assigned by the eigenvectors of the 2nd order AT and the ODF was used for weighting the contribution of fibres in material symmetry axes. The postulated material model for SFRC can be successfully used in the computation methods as for example the finite element/volume methods. The developed model is directly ready to be used in finite element codes as it establishes the relation between the stress and deformation of the composite through the orientation weighted fourth-order elasticity tensor.

Future Game Animation

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Does 3D game character animation have to be as time-consuming as it is? Can we animate more efficiently using recent low-cost 3d interface devices? Do we need premade animations at all – could we just develop intelligent simulated characters that improvise physically and aesthetically appropriate movements from scratch in real time? If we can, what new kinds of game mechanics and character behaviors does it enable?

We present a recently started research project about novel computer game animation tools and technology. The project attempts to make animating faster, cheaper, and more accessible. Ideally, we want to enable game designers and programmers to create animation themselves in order to help rapid prototyping and exploring of different ideas, ultimately leading to increased innovation capability.

More specifically, the project has three goals

1. Save time in animating by reducing the amount of needed user input, e.g., the number of keyframes. Our approach to this is to develop AI (more specifically, optimization and machine learning technology) that synthesizes physically valid animation based on goals and constraints, transforming the role of the animator from manual labor towards a supervising choreographer. For example, one defines the starting pose and kicking pose of a jumpkick and the AI generates the needed steps, jump and landing.

2. Further reduce time by optimizing the interfaces for inputting the remaining keyframes as well as AI goals and constraints. We utilize recent low-cost 3d input devices such as Microsoft Kinect and Razer Hydra that can be used to pose a character or do quick motion capture that can then be polished either manually or using the AI.

3. Create new gameplay innovations through technical innovation. We investigate what kinds of novel gameplay mechanics can be designed and implemented using a real-time version of the AI.

The expected deliverables of the project are

1.Software and interfaces for creating and exporting animations to existing game content pipelines. Together with the industry partners, we will identify the best ways to integrate our tools to their production processes and pipelines. The basic options are to either create standalone animation software that exports suitable common formats or implement the interfaces and algorithms as plugins to existing 3d animation software.

2. A software library for developing game prototypes using the real-time AI. This will be implemented as an extension to the widely used Unity3D game engine. The software will be released as open source.

Energy Optimization in Ice Hockey Halls I. The System COP as a Multivariable Function, Brine and Design Choices.

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We adopt an analytical method, called functional optimization, to find which design and operating conditions maximize the Coefficient Of Performance (COP) of the cooling system (brine pumps and cooling tower) in an ice hockey hall.

The COP is addressed as a function of several variables, like electric consumption and brine physical properties. By maximizing such function, the best configuration and brine choices for the system can thus be determined accurately and rigorously. We investigate the importance of pipe diameter, depth and brine type (ethylene glycol and ammonia) for average-sized ice rinks. An optimal brine density is found, and we compute the weight of the electric consumption of the brine pumps on the COP. Our formulas are validated with heat flow measurement data obtained at an ice hockey hall in Finland. They are also confronted with technical and cost-related constraints, and implemented by simulations with the program COMSOL Multiphysics.

The multivariable approach here discussed is general, and can be applied to the rigorous preliminary study of diverse situations in building physics and in many other areas of interest.

New Approaches to Urban Planning – Insights from Participatory Communities

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The ´New approaches to urban planning` is the result from an eight-year-long action research on urban planning in a neighbourhood of Helsinki (Horelli, 2013). The new approaches, such as participatory e-planning and time planning, comprise methods that allow us to analyse, develop, implement and monitor physical, functional and participatory structures at the neighbourhood level and beyond. They enable models of urban planning and community development that may bring about an architecture of opportunities. This means the building of a supportive infrastructure of everyday life that encourages citizens to participate in the shaping of their own local environment, on the basis of daily and future activities, at different scales.

As urban planning is facing challenges related to the self-organising character of urban reality and the massive spread of technology, the new approaches to urban planning are vital in order to manage the complexity of current context and its wicked problems. Our action research (2004-2012) has responded to this call. It has been funded during the years by the European Social Fund, Tekes and the Finnish Academy. The last phase of the study (Participatory Local Community as an Issue of Time planning, Palco, 2013) comprised a transdisciplinary umbrella for researching new urban planning approaches. The research questions were: What are the new approaches to urban planning and how can they enhance citizen participation in the shaping of communities and their supportive infrastructure of everyday life? The argument was that new policy instruments, such as ICT-assisted urban and time planning, will benefit both individuals and communities, if multilevel and multi-dimensional measures are simultaneously orchestrated in a participatory and context-sensitive way.

The design of the research consisted of four sub-studies dealing with Urban complexity management (Wallin, 2013), Local co-governance as a deliberative system (Jarenko, 2013), Walking as locally-based activity of everyday life (Kuoppa, 2013), and Digital tools for ICT-mediated participation (Saad-Sulonen, 2013). The implementation of the study took place through action research intertwined with a Learning-based network approach to urban planning (Lena). This methodology comprised both traditional data gathering methods (surveys, observation, archives) and new (digital) enabling tools (workshops, social media) that helped to mobilise stakeholders to take part in the shaping of their environment.

The impact of the action research can be seen as physical results (new urban planning targets, such as the renovation of the metro station, building of a community yard, local websites), organizational arrangements (informal and semiformal co-governance elements and modes of self-organisation), social cohesion (a community of young and elderly people around the Roihuvuori yard). These are examples of the supportive infrastructure of everyday life that was strengthened not only through the action research but through the mobilization and the engagement of the neihgbourhood activists.

The research also brings about an academic input to the discussion on public participation and the challenges of urban planning in a welfare state by conceptual and methodological results. The

recognition that the City is ´a problem of different types of complexity`, which requires varying planning interventions and management methods, means that the traditional techno-rational approach has to be complemented by expanded participation. Participation as self-organisation is a new concept that should be recognised in urban planning, as well as in the design and use of digital media. Multiple participations not only increase environmental fit but also provide necessary new planning knowledge from a number of new groups of people who use urban and community informatics. This can be co-processed locally in partnership with residents, administrators, entrepreneurs and politicians, if the local co-governance elements, such as local forums and committees, are in place. The new task for administrators and planners is to understand the significant interplay between the formal, semi-formal and informal activities, networks, partnerships and structures.

These multifaceted results will hopefully have an impact on the field of planning theory, as we are intensively marketing our book by using the social media, participating in several conferences and by editing a special issue on Urban Planning and Community informatics in a peer reviewed journal.

Horelli, L. (Ed.)(2013). Approaches to Urban Planning as a challenge from the glocal community. Helsinki: Aalto University.

Jarenko, K. (2013). Local Co-Governance in Herttoniemi:A Deliberative System. In L. Horelli (Ed.), New Approaches to Urban Planning, Insights from Participatory Communities. Helsinki: Aalto University.

Kuoppa, J. (2013).Sensing, Learning and Transforming a Neighbourhood by Walking. In L. Horelli (Ed.), New Approaches to Urban Planning, Insights from Participatory Communities. Helsinki: Aalto University.

Palco (2013). https://wiki.aalto.fi/display/Palco/Participatory+Local+Community

Saad-Sulonen, J. (2013). Multiple participations. In L. Horelli (Ed.), New Approaches to Urban Planning, Insights from Participatory Communities. Helsinki: Aalto University.

Wallin, S. (2013). Urban Complexity Challenging Urban Planning. In L. Horelli (Ed.),New Approaches to Urban Planning, Insights from Participatory Communities.Helsinki: Aalto University.

Springing of a Large Cruise Ship

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Background

Ship springing means the low-frequency vibration of a ship hull girder, which is caused by the waves that a ship encounters. Springing has become an important matter for the ship building industry in the latter half of the 20th century due to the constantly increasing size of ships. A longer ship length means a more flexible hull. A more flexible hull means a greater risk of wave-induced vibration. In the context of the previously published scientific studies, springing-type vibration is usually seen as a serious risk for the long-term fatigue damage of freighters. In the context of the present work, it is relevant that long-lasting vibration is a risk for the comfort of the passengers in the large cruise ships. Passenger comfort is an important factor in the design and construction of large cruise ships.

The research on springing can be seen as combining and balancing between the understanding on the dynamics of ship structures and on the dynamics of the wave loading on a hull surface. As springing is observed by vibration of structures, it is logical that the structural responses have been the primary source of information on springing. As a consequence, the understanding of development of the loading on the hull in terms of pressure distributions and deforming free-surface level has not got serious attention. Another aspect, that makes analysing the loading on hull surface challenging, is the relatively low magnitude of local wave loads and the importance of the high frequency contribution of the wave loads.

Understanding the development of springing excitation on a hull is important, because it can allow reducing springing by hull design. In the recent year, the development of the computational methods and resources has enabled getting information on such flow phenomena and details, which cannot be measured. Getting new information using a computational method requires careful preparation. In the case of a numerical method, the convergence behaviour of the relevant results of each computational case must be studied. Further, a representative computational result needs to be compared with a respective experimental result in order to study the validity of the method in question.

The objectives of the present study

In this study, a RANS-solver with an interface capturing method is applied in order to get new insight on the development of springing excitation on a hull. Applying such methods to loads of a ship advancing in waves has been considered in several validation-type studies, already. However, as Hänninen et al (2012 and 201x) have pointed out, studying springing excitation makes the flow case different to the previous wave load cases. The reasons for that are the very short incoming waves and the importance of observing the loads at a very local level. One major task of this study is to show that the applied flow solver works adequately in the present flow case. Completing this task has included doing model tests in the towing tank in Otaniemi in order to get the necessary validation data and to observe the flow case in the reality.

The main purpose of this work is to describe how the second harmonic springing excitation develops along the length of the hull of a cruise ship. Such information is believed to be original, which also means that an established and commonly accepted way of finding it does not exist. In this work, the development of the second harmonic springing excitation is exposed using computational fluid dynamics (CFD).

The original features of this work

1. A RANS-VOF method has been applied to a flow case of a ship advancing in very short and steep waves. It has been shown that the numerical solution behaves reasonably on the necessary levels of detail of studying the loading.

2. The computation is validated against original experimental results. This part of the work includes designing and doing the model tests.

3. The development of the second harmonic loading on the hull is shown. The reasons (hull form / local behaviour of the flow) for the main characters of the development are explained.

Hänninen SK, Mikkola T, Matusiak J (2012) On the numerical accuracy of the wave load distribution on a ship advancing in short and steep waves. J Mar Sci Technol 17:125-138

Hänninen SK, Mikkola T, Matusiak J (201x) Computational and experimental study on local ship loads in short and steep waves. Under review in J Mar Sci Technol

Building Bridges between Mainstream and Critical Human Resource Management (HRM) Education Through the Concepts of "Organization Culture", "Ethics", "Language" and "Power"

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Recently it has been accentuated how the lack of critical perspectives can be seen in all management studies, vastly because a major number of Business and Management Schools are unwilling to include critical insights and teaching into their syllabuses (Vince and Reynolds 2009, p. 101). Also within Human Resource Management (HRM) the selected textbooks include mostly functionalistic mainstream research (Watson 2004) and, furthermore, the weight of any academically rigour research has been limited due to the publishers' will of accentuating books' commercial value, which emphasises further the unfortunate trend of students being rarely provided critical and alternative insights (Kelly 2004).

At first, in my poster presentation, I will try to demonstrate how the contemporary HRM education is indeed dominated by functionalistic mainstream textbooks and, secondly, how this challenge could be overcome from Critical Management School (CMS) perspective. One possible approach of bringing critical insights into HRM education is – instead of the unlikely alternative of HRM courses relying on critical textbooks – done by elaborating four concepts; organization culture, ethics, language and power.

The strength of these particular concepts is them all being in the essence of both mainstream and CMS-minded HRM scholars, regardless whether the context is domestic or international. This can provide fruitful classroom dialogues between different schools of thought as the strengths, weaknesses, differences and similarities of different theoretical approaches can be brought forth through reflection of the concepts. In addition, as topics organization culture, ethics, language and power enable the introduction of a great variety of critical perspectives as will be demonstrated in the poster. For example, several streams within Critical Theory, postmodernism and Labour Process Theory can be discussed trough the selected concepts.

This poster presentation will contribute the Aalto Research Day by providing practical and novel methods to overcome some of the challenges that HRM education faces due to, for example, institutionalization of education, lack of alternative approaches in teaching and political pressure directed towards business schools in general. I believe that similar questions can exist also within other fields of social sciences - and why not within all Aalto's fields of research and science!

Kelly, D. 2004. Book reviews. Personnel Review, 33 (6), p. 711-719.

Vince, R. & Reynolds, M. 2009. Reflection, Reflective Practice and Organizing Reflection. In: Armstrong, S.J. & Fukami, C. V. (eds) The Sage Handbook of Management Learning, Education and Development. London: Sage.

Watson, T. J. 2004. HRM and Critical Social Sciences Analysis. Journal of Management Studies, 41 (3), p. 447-467.

Functional Wicking Surfaces

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1. Introduction

Paper-based microfluidic analytical devices (µPADs) are aimed at being low-cost, portable and disposable. Their analytical function is designed to be independent of external pumps, instrumentation or power. They are usually very simple and therefore easy to use, and they provide fast diagnosis in the case of medical application (Carrilho 2010, Mukhopadhyay 2010). These devices may also offer analytical solutions for developing countries and other analytically demanding or remote environments. Coupling paperfluidic devices with a portable imaging device, such as a mobile phone, enables remote testing to be made, in which the actual diagnosis is performed by an off-site expert (Martinez et al. 2008).

Paperfluidic devices have multiple applications in, for example, environmental and food packaging analyses, as well as in medicine. The medical applications of paperfluidic devices include detecting glucose and protein levels from urine samples (Martinez et al. 2008), measuring liver enzyme levels of blood samples (Pollock et al. 2012), and instantaneous blood typing (Khan et al. 2010). Other applications include detecting and disabling Eschericia coli (E. coli) bacteria (Jabrane et al. 2011) and detecting pesticides in food and beverage samples (Hossain et al. 2009).

The basic principle of paperfluidic devices is as follows: a drop of the sample, which can be, for example, blood, urine or soil, is either placed on the sample, or the device is dipped into the sample, after which the paper wicks the fluid through hydrophobic containment walled channels and guides it to various stations where either enzymatic or colour changing detection takes place. Other reactions are also being considered (Mukhopadhyay 2010). Wicking (also known as absorption, penetration or imbibition (Park et al. 2007)) refers to the spontaneous suction of a fluid into a porous medium due to capillary pressure (Masoodi & Pillai 2012). The most common paper used in these kinds of paperfluidic devices is filter paper or chromatographic paper (Khan et al. 2010, Martinez et al. 2008, Pollock et al. 2012). The paper is patterned with hydrophobic channels, which can be created by using photolithography, various printing methods or plasma and laser treatments, and by using hydrophobising agents, such as wax, photoresins, silicone polymers, organic polymers or sizing agents (Ballerini et al. 2012, Martinez et al. 2010). The patterns can either be formed by blocking the pores physically or by modifying the surface (Ballerini et al 2012). The devices can have one detection assay or multiple assays. Reagents, such as blood antibodies (Khan et al. 2010) or bacteriophages (Jabrane et al. 2011), are deposited into the stations (Mukhopadhyay 2010) and diagnosis can be made, for example, by studying the colour intensity (Pollock et al. 2012) or the chromatographic separation of fluid components (Khan et al. 2010). However, in all the examples above using uncoated paper as the support medium, the resolution of wicking and testing is limited by the relatively large size of paper fibres (typically ~50 µm in width and up to ~5 mm long).

The aim of our project is to develop and design functional wicking substrates for diagnostic and analytical printed test kits, which have the potential to provide better spatial resolution and requiring less volume of test sample. The objectives of the project, therefore, include 1) clarifying

the wicking mechanism in micro and nanoporous structures, 2) determining the effect of localized surface energy differentiation, 3) clarifying whether these wetting differential properties can be reproduced in practice, and 4) developing to the point of proof of principle the selective wicking of a chosen model species.

2. The experiments

We are using a non-absorbent synthetic paper as a base material and we are coating it with different combinations of speciality porous coating pigments and binders. The synthetic paper allows us to study the wicking properties of the different coating structures without the interference of the paper structure. At a later stage, barrier coated fibrous substrate may be considered for environmental sustainability and subsequent composting. The chosen coating pigments include fumed silica, modified calcium carbonate (MCC) and two diatomaceous earths (diatomite). Silica pigments have been the most typical inorganic absorbents used to form coatings for ink jet printing, but due to their expensive cost, high binder demand and low solids content, due to their relatively high viscosity, other pigments have been considered to replace silica (Lee et al. 2003, Swerin et al. 2008). One of these is MCC, which has been shown to have a rapid absorption rate and also a high absorption capacity (Ridgway et al., 2004). A further advantage of MCC is that it is a pH buffer contributor in a compostable end product. Diatomite structures also offer strong capillarity and high permeability (Ridgway et al., 2006). For the action of the analytical station, high surface area of these materials can likely be a big advantage, especially for weakly soluble reagents or light supported reactants.

The chosen binders will include a fully hydrolysed polyvinyl alcohol binder (PVA), a stryrene acrylic (SA) latex binder and an inorganic binder, such as sodium silicate. Polyvinyl alcohol (PVOH, PVA) binders are typically used in absorptive inkjet coatings (Ridgway et al. 2011), but recent studies by Lamminmäki (2012) and Ridgway et al. (2011) have shown that fluids transfer faster in latex containing coatings than in polyvinyl alcohol containing coatings. PVOH binders may also prevent wicking (Boylan 1997). Inorganic binder is considered to deliver the advantage of being inert in respect to the organic content of sample fluids and potential organic reagents.

In phase one of the experiments different coating structures will be developed by using the different pigment and binder combinations, and the pore network structures and wicking properties of these will be examined. In phase two hydrophobic patterns will be introduced, and flow of various test fluids in the channels will be investigated. The patterns will be created on both filter paper and the newly designed coated samples by using a special inkjet printer (Dimatix Materials Printer DMP-2831) and an experimental laser treatment adopting both ablation and substrate heating. Three hydrobising agents, polydimethylsiloxane, alkyl ketene dimer and polystyrene, will be used in a first screening step. In further phases of the experiments the microfluidic device will be tested with different reagent and fluid combinations to study the potential for chromatographic separation based on both differential adsorption and hydrophilic-oleophilic balance, taking advantage of recent advances in the understanding of the hydrophobic force (Brandner et al. 2011, Hansson et al. 2011, Hansson et al. 2012, Hansson et al. 2013).

Ballerini, D.R., Li, X. & Shen, W. Patterned paper and alternative materials as substrates for low-cost microfluidic diagnostics. Microfluid Nanofluidics 13(2012):5. pp. 769-787.

Boylan, J.R. Using polyvinyl alcohol in ink-jet printing paper. TAPPI J. 80(1997):1. pp. 68-70.

Carrilho, E., Martinez, A.W. & Whitesides, G.M. Understanding wax printing: a simple micropatterning process for paper-based microfluidics. Anal. Chem. 81(2009):16. pp. 7091-7095.

Hossain, S.M.Z., Luckham, R.E., McFadden, M.J. & Brennan, J.D. Reagentless bidirectional lateral flow bioactive paper sensors for detection of pesticides in beverage and food samples. Anal. Chem. 81(2009):21. pp. 9055-9064.

Jabrane, T., Dubé, M., Griffiths, M. & Mangin, P.J. Towards a commercial production of phage-based bioactive paper. J-FOR 1(2011):1. pp. 6-13.

Khan, M.S., Thouas, G., Shen, W., Whyte, G. & Garnier, G. Paper diagnostics for instantaneous blood typing. Anal. Chem. 82(2010):10. pp. 4158-41654.

Lamminmäki, T. The comparative dynamics of bulk liquid flow and interpolymer diffusion during inkjet ink imbibition in porous coating structures. Doctoral dissertation. Aalto University School of Chemical Technology. Espoo 2012.

Lee, H-K., Joyce, M.K. & Fleming, P.D. Influence of pigment particle size and packing volume on printability of glossy inkjet paper coatings. IS&Ts NIP19: Conference on Digital Printing Technologies. New Orleans, USA. October 2003. pp. 613-618.

Martinez, A.W., Phillips, S.T., Carrilho, E., Thomas III, S.W., Sindi, H. & Whitesides, G.M. Simple telemedicine for developing regions: camera phones and paper-based microfluidic devices for real-time, off-site diagnosis. Anal. Chem. 80(2008). pp. 3699-3707.

Mukhopadhyay, R. Paper-based diagnostics. Chemistry World. November 2010. pp. 50-53.

Park, H., Kang, S.W. & Ryu, S. Wicking process of penetrants and inkjet inks on printing media. IS&Ts NIP23: Conference on Digital Printing Technologies. Anchorage, Alaska, USA. September 2007. pp. 121-125.

Pollock, N.R., Rolland, J.P., Kumar, S., Beattie, P.D., Sidhartha, J., Noubary, F., Wong, V.L., Pohlmann, R.A., Ryan, U.S. & Whitesides, G.M. A paper-based multiplexed transaminase test for low-cost, point-of-care liver function test. Sci. Transl. Med. 4(2012):152.

Ridgway, C.J., Gane, P.A.C. & Schoelkopf, J. Modified calcium carbonate coatings with rapid absorption and extensive liquid uptake capacity. Colloids Surf., A 236(2004):1-3. pp. 91-102.

Ridgway, C.J., Gane, P.A.C. & Schoelkopf, J. Achieving rapid absorption and extensive liquid uptake capacity in porous structures by decoupling capillarity and permeability: nanoporous modified calcium carbonate. Transport Porous Med. 63(2006):2, pp. 239-259.

Ridgway, C.J., Kukkamo, V. & Gane, P.A.C. Effects of binders and additives on inkjet coating pigment pore structures. TAPPI PaperCon'11 Conference. Covington, KY, USA. May 1-4, 2011. pp. 1305-1319.

Swerin, A., König, A., Brandner, B., Andersson, K. & Lindgren, E. The use of silica pigments in coated media for inkjet printing: Effects of absorption and porosity on printing performance and depth profiling using confocal Raman spectroscopy. 10th Advanced TAPPI Coating Fundamental Symposium. Montreal, Quebec, Canada. June 11-13, 2008. pp. 178-203.

Brandner, B.D., Hansson, P.M., Swerin, A., Claesson, P.M., Wåhlander, M., Schoelkopf, J. & Gane, P.A.C., Solvent segregation and capillary evaporation at a superhydrophobic surface investigated by confocal Raman microscopy and force measurements. (2011) Soft Matter 2011, 7, 1045–1052 | 1045 [DOI: 10.1039/c0sm00704h]

Hansson, P.M., Skedung, L., Claesson, P.M., Swerin, A., Schoelkopf, J., Gane, P.A.C., Rutland, M.W. & Thormann, E., Robust hydrophobic surfaces displaying different surface roughness scales while maintaining the same wettability. (2011), Langmuir, (doi:10.1021/la201121p) 2011, 27 (13), pp8153–8159.

Hansson, P.M., Swerin, A., Schoelkopf, J., Gane, P.A.C. & Thormann, E., Influence of surface topography on the interactions between nanostructured hydrophobic surfaces. (2012) Langmuir ACS Nano, Langmuir. 2012 May 29; 28(21):8026-34

Hansson, P.M., Hormozan Y., Brandner, B.D., Linnros, J., Claesson, P.M., Swerin, A., Schoelkopf, J., Gane, P.A.C. & Thormann, E., Effect of surface depressions on wetting and interactions between hydrophobic pore array surfaces. Langmuir : the ACS journal of surfaces and colloids, 07/2012; 28(30):11121-30

Hansson, P.M., Hormozan, Y., Brandner, B.D., Linnros, J., Claesson, P.M., Swerin, A., Schoelkopf, J., Gane, P.A.C. & Thormann, E., Hydrophobic pore array surfaces: wetting and interaction forces in water/ethanol mixtures. Journal of Colloid and Interface Science 396 (2013) 278–286

New Catalyst Materials for Ethanol Based Fuel Cells

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At the moment, the most popular fuel of alcohol fuel cells is methanol (CH_3OH) due to its relatively simple structure as it contains no carbon-carbon bonds. This means it can be easily oxidized to CO_2 to generate electricity. However, methanol is a very poisonous substance and should be replaced with less harmful alcohols (e.g. ethanol or ethylene glycol). However, carbon-carbon bonds present in more complex alcohols are difficult to break and oxidation does not proceed to CO_2 leaving the energy of the fuel partly unused. In this study, new nitrogen-modified carbon nanotube catalysts are tested for efficient ethanol oxidation in fuel cells. The studied catalysts are platinum-ruthenium supported by either few-walled carbon nanotubes (FWNT-PtRu), nitrogen-doped FWNTs (N-FWNT-PtRu) or aniline covered FWNTs (ANI-FWNT-PtRu). Nitrogen containing carbon materials have already been used as oxygen reduction catalysts, indicating they are active towards oxygen, which is required for complete ethanol oxidation.

The catalysts are first tested outside the fuel cell with rotating disc electrode, which is a simpler and faster method than actual fuel cell tests to characterize the catalytic properties of the materials. In these test, it has been found that both N-FWNT and ANI-FWNT are more active towards ethanol oxidation than the plain FWNT in alkaline conditions. In acidic conditions, the activities of the catalysts were similar. The catalysts are next tested in an alkaline membrane fuel cell to make sure that the catalytic activity is preserved in actual fuel cell environment.

Aalto Apps & Os – Identifying the Challenges and Opportunities of Open Innovation Ecosystems

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Mobile apps and the phenomenal success of app store model are good examples that illustrate the significance of user-driven innovation. However companies behind the leading mobile ecosystems, in particular iOS and Windows Phone, have chosen very competitive policies and are rather moving towards closed fortresses and are not necessarily fostering openness and collaboration (see e.g.: Karhu et al., 2013),. Meanwhile elsewhere, due to progress of HTML5 and the rise of new Linux based platforms (like Tizen, Sailfish) we are seeing some signs of increased openness as well.

We propose that instead of pursuing closed and competitive policies, to foster truly effective and long lasting user driven innovation and more sustainable (mobile) services, design, development and distribution ecosystems should be made more open and foster collaboration between different actors. In particular, these ecosystems should provide tools and means for all actors with variable backgrounds to contribute to the projects. There is a heavily underutilized resource in involving and engaging users, designers and other actors besides developers to mobile app development. Our earlier research (Botero et al 2012) shows, and experience so far has been, that these parties would be extremely motivated to learn and contribute, if they are given a chance to do it. Moreover, due to recent advances in development tools, this idea is now possible to realize (Hsu et al 2012). While practices and tools for software development have been advancing in more open and collaborative directions, research and experimentation to include other actors is still limited.

The goal of the research is to empirically investigate ways for engaging people with different development skills to mobile app development. More specifically, the goal is to construct detailed descriptions of the technological and social challenges and opportunities for collaborative app development among people with various development skills. Our initial research questions are:

- What kind of technological and social challenges restrict/enable people with different development skills to engage in collaborative mobile app development?
- What is the effect of providing supportive tools separately and as integrated toolset?

Our empirical setting is Aalto University. We believe that university campus and study activities are natural places for ideas to be born and tested. At the moment in Aalto these type of development activities are not well connected and occur mostly as silos in the different schools. This makes it difficult for students and researchers to build on the work of others or even find collaborators. To both foster collaboration and to collect empirical data we are building an experimental environment we call Aalto Apps & Os. Aalto Apps & Os (http://www.apps8os.org/) aims at promoting and integrating service and application innovations that spring up as part of campus activities (e.g. via courses and study projects) with the resources and ideas of the wider Aalto community; students in other campuses, startups, local community, etc.

As a platform it is a very open environment that supports those who are motivated by starting an own business (Apps), but more importantly also those who are doing "other stuff" (Os). By "other

stuff" we mean work that is more experimental in character, or that aims at supporting marginal or community oriented services (e.g. third sector, NGOs, etc). Aalto Apps & Os will have a low barrier for publishing all kinds of "stuff" and encourages cross-school collaboration

We are currently experimenting with a combination of tools that are already individually available but have not yet been orchestrated together: (Including: MIT App Inventor a tool for engaging non-developers into mobile service development; Funf framework for utilizing mobile sensing capabilities of phones; Google Maps Android API V2). We are integrating these tools and conducting a series of pilot experiments. During the pilots we will make the tools available for a group of people (students) from various backgrounds working on a real life project or challenge. For research purposes, we also instrument these challenges using tools, such as github, so that progress, contributions and results from the activities can be followed and data collected.

During Aalto R-Day we want to gather feedback for the idea, discuss our initial findings and connect with other researchers interested in these topics from other perspectives.

Botero, A., Karhu, K., & Vihavainen, S. (2012). Exploring the Ecosystems and Principles of Community Innovation. In A. Lugmayr, H. Franssila, P. Näränen, O. Sotamaa, J. Vanhala, & Z. Yu (Eds.), Media in the Ubiquitous Era, pp. 216–234. IGI Global.

Hsu, Y.-C., Rice, K., Dawley, L. (2012). Empowering educators with Google's Android App Inventor: An online workshop in mobile app design. British Journal of Educational Technology 43, E1–E5.

Karhu, K., Tang, T. & Hämäläinen, M. (2013). Analyzing competitive and collaborative differences between mobile ecosystems. Work in progress, to be submitted to Telematic and Informatics.

Mask Estimation and Imputation Methods for Missing Data Speech Recognition in a Multi Source Reverberant Environment

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We present an automatic speech recognition system that uses a missing data approach to compensate for challenging environmental noise containing both additive and convolutive components. The unreliable and noise-corrupted ("missing") components are identified using a Gaussian mixture model (GMM) classifier based on a diverse range of acoustic features. To perform speech recognition using the partially observed data, the missing components are substitutedwith clean speech estimates computed using both sparse imputation and cluster-based GMM imputation. Compared to two reference mask estimation techniques based on interaural level and time difference-pairs, the proposed missing data approach significantly improved the keyword accuracy rates in all signal-to-noise ratio conditions when evaluated on the CHiME reverberant multisource environment corpus. Of the imputation methods, cluster-based imputation was found to outperform sparse imputation.The highest keyword accuracy was achieved when the system was trained on imputed data, which made it more robust to possible imputation errors.

Effects of Attractions on Pedestrian Flow

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Self-organized pattern formation of pedestrian crowds, such as lane formation, turbulent movement, and human trails, has been subject to interest of various disciplines. The microscopic pedestrian flow models have described the pedestrian motions in terms of driving, repulsive, and attractive forces. However, little attention has been paid to attractive interactions between pedestrians and objects including shopping displays and museum exhibits. In reality, such attractive interactions may lead to impulse stop behavior; pedestrians stop walking to destination and join the attractions. This study investigates the collective effects of attractive interactions between pedestrian and objects by devising the social force model with attractive forces. Simulations demonstrate "yielding-to-temptation effect" characterized by spontaneous gathering of pedestrians around the attractions. Increasing the magnitude of attractive force yields the transition from moving state to agglomerate and competitive states. Intermediate attractive interaction exhibits agglomerate state displaying pedestrians standing around the attractions. Strong attractive interaction reveals competitive state; frenzied pedestrians rush into the attractions and push other pedestrians. The "yielding-to-temptation effect" associated with extreme desire may cause tragic pedestrians incidents similar to consumer misbehavior occurred in recent Black Friday sales in the United States. This study implies that efficient and safe use of pedestrian areas is achievable for certain level of density and attractiveness.

"From Design-oriented Research To Research-inspired Design – Co-constructing Intelligent Environments & Cultivating Research into Science-Fiction Prototypes"

Tiina Kymäläinen, Aalto ARTS

Intelligent Environment Research

Intelligent environment is the co-operation between people and the environment when the technological offering is composed in a way that it is obvious to the people. The intelligence is not a quality of people, technology or the environment, but the ecosystem they construct.

Design Inspired Research

At best, IE is the co-operation between people and the environment when the technological offering is composed in a way that it is obvious to the people [2]. Therefore the technology embedded environments are studied and evaluated with people who live, work and act in them. One of the main problems within the field is, that IE has been studied and developed for more than twenty years, but the implementations are rare. Currently it is seen important that the environments are constructed piecemeal and supplemented when necessary. In my PhD I have studied how the IE ecosystems are co-constructed with people in a do-it-yourself fashion. The design-oriented research aims to build prototypes and is extremely fulfilling. Yet, as a designer I have the in-build urge to apply the knowledge – and further change and improve things.

Research Inspired Design

Another problem in the practise is that the researchers might end up with interesting findings, relating for example to the user experience of the systems, but the prevailing technology cannot fulfil the requirements. The turning point in my personal research history was when I found similar minded people, within the IE field, who experienced the same frustration and attempted to solve the problem by capturing the essence of the research findings into science fiction prototypes. These prototypes have a societal mission and they address the needs of the people who truly own the domains. In my PhD work I use science fiction prototypes as design outcome of IE research work that go beyond the research, provide long-term solutions for the technology, and introduce new opportunities and designs applicable in near or distant future.

Bentham, Jeremy. Panopticon. London: T. Payne, 1791.

Kuutti, K., T. Keinonen, and L. Norros. "Kaasinen: Älykäs ympäristö suunnittelun haasteena (Smart environement as a design challenge)." Älykkäiden ympäristöjen ekologinen suunnittelu (Ecological approach to the design of intelligent environments).(In Finnish)

Consistent Across-Subjects MEG Responses to a Silent Movie

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Watching a movie triggers in the viewer's brain a multitude of processes that, despite the complexity of the movie stimulus, can in certain brain areas be remarkably similar across spectators, as has been shown by functional magnetic resonance imaging (fMRI). These similarities likely reflect time-locking of brain activity both to the visual features and the contents of the movie. Here we extracted consistent intersubject time-courses from noisy but temporally very accurate magnetoecephalographic (MEG) signals; MEG's time resolution is in millisecond time range compared with seconds for fMRI.

We showed a silent 15-min black-and-white movie "At Land" twice to eight healthy adults. We trained spatial filters by multi-set canonical correlation analysis (M-CCA) that maximized the correlation between subjects, providing multiple orthogonal time-courses (canonical variates) in the selected frequency band. The spatial filtering resulted in time series with statistically significant intersubject correlations in the bands below 10 Hz. The maximum intersubject correlation was 0.26 ± 0.074 (mean $\pm$ SD) in the lowest 0.03–1 Hz band. Steady-state responses corresponding the movie frame rate of 24 Hz occurred in the posterior brain regions, with high intersubject correlation of 0.25 ± 0.08.

To assess the anatomical locations of the source currents contributing to these signals, we correlated the spatially filtered signals with the source currents obtained by minimum-norm estimation (MNE). The most prominent sources were in visual areas (V1/V2), but also in posterior parietal (PPC), lateral occipital (V5), superior temporal sulci (STS) and in motor (M1) and premotor areas. The findings demonstrate the feasibility of the optimized spatial filters in unravelling across-subjects consistent movie-related MEG traces.

SALI - a Place Where Stroke Patients Revive

Matti Linnavuo, Aalto ELEC

In this demonstration, a cognitive skills diagnosis and rehabilitation environment is demonstrated. The environment consists of several stimulus generators and reaction sensors, like lights, screens, and movement sensors. The system is developed in cooperation the Helsinki University Central Hospital.

In this demonstration, the guests can themselves try the developed diagnosis and rehabilitation tests, which resemble a virtual reality games. These games, however, are stripped-down to focus on specific cognitive problems in individuals. Thus no monsters, goblins, swords or laser guns are seen. Nevertheless, the games of higher degree will put a challenge to everyone and also those not interested in stroke rehabilitation might at least enjoy the game.

Health Chair - One Stop Shop of Your Health Development

Matti Linnavuo, Aalto ELEC

Mikko Paukkunen, Aalto ELEC

In the demonstration, the Health Chair developed in the Health Factory is presented. Health Chair is a conglomeration of the main health measurements like blood pressure, pulse, EKG, blood oxygenation, weight etc. All measurements are made simultaneously when the person is sitting in a chair.

The Health Chair is not intended to replace the well established clinical diagnostic measurements performed routinely at the doctor's practice. The idea is to easily collect a time series of health data, calculate and analyze the trends of the results and, when appropriate, alert the person or care personnel of the prospective problem.

In the demonstration, the audience may sit on the chair and measure their health data. Of course, during the Research Day, there is no possibility to establish any trend examination, but the values of one's pulse and blood pressure could be interesting.

Global Practices or Local Practices? Human Resource Management in Subsidiaries of Finnish Companies in China

Wei Lu, Aalto BIZ

In today's business world, companies increasingly operate internationally and even globally. Companies not only create corporate values and code of conduct and promote these to their units across the world, but also formulate common practices of people management and disseminate them throughout the entire organization. A question arises: how subsidiaries of international companies manage human resources in various countries given the differences in national institutions and cultures? More precisely, how do the global practices made at the headquarters (HQs) fit to the local context of foreign operations? What are the outcomes of HQs-transferred practices: do foreign subsidiaries carry out the HQs' global practices, localize the practices, or make own locally designed practices? These issues are investigated with an in-depth case study on a total thirteen subsidiaries of Finnish companies operating in China.

Finnish companies are operating more than 200 subsidiaries in China who employ totally over 70,000 people and have net sales of 21 billion euro. This makes China the second largest country for Finnish foreign operations in terms of number of employees and net sales (BOFIT, 3.5.2013). Yet, there is rather limited research focusing on human resource management (HRM) in subsidiaries of Finnish companies in China. Through systematic examination of six HRM practices (recruitment and selection, compensation, benefits, training and development, performance management and employee representation) this study aims to provide fresh insights in innovative practices in people management in China. This will potentially benefit Finnish companies and also possibly other foreign companies operating in China.

The Finnish-Chinese context provides an interesting setting theoretically. Finland is a small and open economy with a strong domestic push to international market (Luostarinen, 1994). Finland is typically categorized as a coordinated market economy despite the changes in several of its subsystems such as finance and state coordination (Moen and Lilja, 2005) and in many ways a highly stable society. Further, Finland is typically considered following the Nordic model of industrial relations (Lilja, 1998) which manifest in human resource management. China is a huge country. It has been undergoing transition from a centrally planned economy towards a market economy and experiencing fundamental changes in legal and socio-economic systems, norms and values and all spheres of the society for over three decades. This contrasting context is expected to shed light on how the national differences in institutions between the host country, China and home country, Finland interact with power and interest of HQs and subsidiaries, and what kinds of practice outcome are produced as the result of such interaction. This is expected to contribute to the literature on international transfer of HRM practices in a configuration of institutional factors and subsidiary-HQs power relations.

BOFIT Weekly 18 • 3.5.2013. Bank of Finland • Institute for Economies in Transition.

Lilja, K. (1998). Finland: continuity and modest move towards company-level corporatism. In Ferner, A. and Hyman, R. (eds.) Changing Industrial relations in Europe. UK: Blackwell. pp. 171-198.

Luostarinen, R. 1994. Internationalization of Finnish firms and their response to global challenges. UNU-WIDER

Moen, E. and Lilja, K. (2005) Change in coordinated market economies: the case of Nokia and Finland. In Morgan, G., Whitley, R. and Moen, E. (eds.) Changing capitalisms? Internationalization, institutional change, and systems of economic organization. Oxford: Oxford University Press. pp. 352-379

Towards Healthy, Sustainable and Energy Efficient Buildings

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Tao Lu, Aalto ENG

Martti Viljanen, Aalto ENG

Buildings have a significant impact on energy use and the environment, accounting for 30-40% world energy consumption and significant amounts of carbon dioxide (CO2) emissions. The growing concerns on impending global warming and scarcity of energy resources lead to efforts to elevate sustainable solutions in the building sector. Advances in technology are increasingly improving the state of art in sustainable building, which has called many challenges. One of the most important is related to the installation of extra or super insulation for heating and cooling the buildings to cut energy and CO2 consumption. This inevitably leads to a rise of humidity which both affects indoor air quality (IAQ) and causes mould growth associated with health risk. It has been reported that mould in building structures, in general, costs up to billions a year in Finland. In addition, challenges come from sustainable retrofitting, controlling and managing a larger number of existing buildings to meet the energy and CO2 reduction targets. In response to these challenges, we propose an approach in cross-Aalto research. We have developed an efficient and useful building simulation model which can predict heat, moisture and indoor air quality for energy efficient control. Many research results from the model have been published in major international journals. This new approach extends these research results and introduces a new prediction and control model to a healthy, sustainable and energy efficient solution on building performances which incorporates mould growth modeling process of the building. The new modelling approach aims to resolve the underlying physical and chemical equations that control energy usage, indoor air environment and mould growth in buildings. The outcomes of the research will help improve energy efficiency in a healthy and safe way with sustainable building construction solutions as well as repair and retrofitting methods.

Optical Measurement Platform for Tire-Road Rolling Resistance Studies

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Ari Juhani Tuononen, Aalto ENG

Yi Xiong, Aalto ENG

Nowadays, the economic and ecological efficiencies of ground vehicles have received considerable attentions due to high oil prices and increasing public awareness of global warming. In 2011, the gasoline consumption by the vehicle fleet was about 346 billion liters in Europe in which 20% were dissipated by tyre-road rolling resistance, accounted for about 4% of total EU-level CO_2 emissions. Recent studies show that, an improvement of approximately 10% on tire-road rolling resistance performance will result in 1.6% -3% reduction on total fuel consumption, and 2 g/km on CO_2 emission. Thus, the low rolling resistance tire would have a significant impact on fuel consumptions and global CO_2 emissions. However, up to now, the fundamental mechanism of tire-road rolling resistance is still unclear. With over ten years' research experience in tire sensing technology, the vehicle engineering group at Aalto University, proposed and developed an optical measurement platform and a corresponding procedure for tire-road rolling resistance studies to understand the fundamental phenomena behind it. Compared with other existed tire-road rolling resistance approaches, such as laboratory drum method, trailer method, coast-down method etc., the proposed method could reveal the tire tread deformation mechanism on different pavements by calculating the tread thickness within the contact patch. Therefore, the proposed platform is of great interest to both green tire manufacturers and pavement designers. As a powerful engineering tool, this platform, utilizing the latest laser sensor technology, not only has the capability of on-line measuring tire tread deformation in multi-dimensions but also can examine road roughness effects.

Surface texture, as a crucial parameter influencing tire-road rolling resistance, is scale dependent; having roughness on different length scales. Most surface descriptors, like Ra (average texture depth) and RMS (root-mean-square texture depth) lack sensitivity to direction of the texture i.e. whether the asperity is a valley or peak on top of the fact that they cannot provide information about micro-level texture heights and distributions. Since asphalt pavements show nearly perfect self-affine fractal behavior, the best approach would be to use fractal characteristics as surface descriptors due to their scale independent nature.

The physics involved in tire-road rolling resistance lies upon the detailed interaction between surfaces in contact. Seeing that rolling resistance is tightly connected to the contact mechanisms along by the fact that road texture is a critical component, determining contact geometry of two surfaces clarifies the effect of road roughness on rolling resistance. While small-scale roughness induces a softer contact between tire and road, it has been usually neglected in many previous contexts stating that rolling resistance and rolling noise are only a function of large surface undulations and unevenness; even the World Road Association (PIARC) which has established standard categories of texture, classified by wavelength, assigned a range of 10mm-50m texture as the influential wavelengths on rolling resistance.

In order to obtain an accurate and reliable relation between texture and rolling resistance, one requires inclusive information of road pavement topography. A two-dimensional height map of a real road surface yields to a full description of surface characteristics, but this is not applicable in common practice, since such knowledge about all road types and surfaces is neither available nor

possible at the moment. An alternative option is to take advantage of a line scan or a parallel set of line measurements recorded via on-board laser sensors set up on a vehicle. The key task in the latter approach is to find and then extract useful road surface descriptors from the one-dimensional height data in a manner that facilitates best approximation of the two-dimensional topography of the real pavement surface under investigation. It is our attempt to combine two methods of pavement texture quantification; on-board 1D line-scan data acquisition during vehicle operations and high resolution 2D optical profilometry scans, so as to test the reliability of the on-line 1D measurement, and also to employ the methodology into rolling resistance analysis.

If the implemented method of characterizing 2D height map from a 1D line scan gives in satisfying approximation of texture indicators, the outcome of the research would be really outstanding in terms of the origin of tire-road rolling resistance as it will be the first fundamental study of this topic and a big step forward development of a low rolling resistance tire. This would actively promote and contribute to the European Commission objective of reducing carbon emissions to a large extent (aim is 60 % by 2050) from transportation sector.

Impact of Urbanisation on Long-Term Sustainability of Supply Chains

Marta Malik, Aalto BIZ

Sustainability of supply chains becomes a burning issue of the modern life. Sustainability of a community imposes an impact on welfare of the state where the community resides. Urban areas become a point source of carbon dioxide emissions because of high concentration of transportation and industry. To maintain a capability of an existing infrastructure in absorbing hazardous environmental impact caused by economic activity, governments have to intensively invest into the environmental infrastructure of the urban area. Today many researchers discuss sustainability-related notions and merits, many discuss how important it is for policy-makers and business strategists to develop appropriate environmental strategies for greening their business, many monitor an attitude of enterprises towards the issue, and many states introduce a law in order cure current environmental consequences of economic activity. Although corporate sustainability is viewed as 'the incorporation of social, environmental, economic and cultural concerns into corporate strategies' (Eweje, 2011), introduction of an environmental component into decision-making process so that companies could forecast and manage their environmental footprint in the long-run is not discussed in the literature. Hence, the research investigates how businesses could become more proactive in management of carbon dioxide emissions. The proposed model would enable businesses to seek for a trade-off between benefits, costs and carbon dioxide emissions. It would allow introduction of an environmental component into decision-making process so that companies could manage their environmental footprint in the long-run. The fact that today we face environmental problems caused by economic activity underpins that it could hardly been done before.

The modern global economy represents a huge network of industries. Whereas there are certain common trends that drive the prosperity of most of the industries, an interrelation exists between the industries as well. The primary trend that drives the development and defines the structure of an economy is urbanisation. Urbanisation moves the demand for goods and services in the area up and it triggers up the supply as a result. To stay responsive to their customers companies have to implement changes into their supply chain operations. The changes make the environmental footprint of the company vary. In order to manage carbon dioxide emissions at the same best level as companies do for catching opportunities for getting the highest possible revenue, companies should apply a tool that would allow minimisation of emissions while obtaining a desirable bottom line.

The reason to pay attention to the topic of managing sustainability is that overall urbanisation is beneficial for the economy, but overurbanisation creates hazardous environmental footprint. In order to preserve resources and minimise environmental impact of urbanisation, governments need to intensively invest into infrastructure of urban environment. Intensive investments into environmental infrastructure eat up welfare of the state (GDP). To enhance urban metabolism companies of all industries which operate on the market should integrate environmental component into their decision-making process. Most of the actions that are taken nowadays to maintain environmental sustainability of urban areas are more reactive than proactive. It results in the environmental infrastructure lagging behind urbanisation. In turn, local societies still remain endangered by surrounding environmental conditions.

The given research topic 'Management of long-term sustainability of the supply chain' is an extension of the analysis that was initially done by the researcher as master thesis on the topic 'Impact of urbanisation on long-term sustainability of logistics operations' written as a case study for KONE.

Under the master thesis the author modelled the cause-effect relation that explains how urbanisation influences carbon emissions of logistics operations through driving up the construction sector that predefines demand for elevators and escalators that the company needs to ship to a particular market. Thus, the purpose of the research was to test the assumption that it is urbanisation that drives the construction market up and, in turn, increases the demand for elevators, encouraging the companies of the E+E industry to adapt its supply chain practices to meet the demand, while the changes in the supply chain practices impact the environmental performance of the company's logistics operations. The results showed that the logic is viable and that it is urbanisation that drives sustainability of logistics operations.

Thus, the purpose of the doctorate research is to investigate how to apply the logic so that it would become a tool for managing carbon dioxide emissions through forecasting and managing of business-related independent factors for MANY industries.

Young Consumers Discourses Concerning Digital Technology

Heidi Mikkonen, Aalto BIZ

This interpretative research examines young people's discourses concerning digital technologies. The research is based on consumer culture theory tradition and the theoretical framework consists in transhumanism. The goal is to find out, what kind of meanings young people give to digital technology, especially mobile phones and computers.

The data was collected from Finnish secondary school pupils by essays (292) and interviews (20) and analyzed by using discourse analysis. Two main themes have been found:

1) Benefits, Opportunities, Dangers and Threats Concerning Digital Technologies

Transhumanism is interested in searching boundaries, dangers, benefits and possibilities of technology. Under the first main theme there are three discourses: 1) health and welfare, 2) fears, safety and privacy protection, and 3) control, self-regulation and addictive consumption.

2) Digital Technology in Young People's Identity Construction

The second theme focuses on digital technology in young people's identity construction, and here I concentrate on discourses which support or reject the transhumanistic idea of the enhancement of intellectual, physical, and psychological capacities. There are four discourses under this theme: 1) social capital, communication and entertainment vs. rational use of digital devices, 2) self-expression and sharing, 3) possession and extended self and 4) enhancing capacities and self-development.

This research is relevant for many reasons. First, technology plays a significant role in defining the cultural experiences of contemporary childhood and adolescence. Secondly, digital technology has been the most consequential factor in changing young people's lifestyles and consumption patterns, and according to this research it plays a crucial part of young people's everyday lives. Thirdly, there is a debate about benefits, opportunities, dangers and threats of digital technology to young people in societies, where digital technology is an integral part of adolescence.

This research brings some new insights to young people as consumers and citizens from young people's own point of view. The results of the study are relevant not only to economics and marketing, but also to educational sector (like schools), legislators, families and society in general.

Distributed Dislocation Technique in Fracture Mechanics

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Juha Paavola, Aalto ENG

Djebar Baroudi, Aalto ENG

The application of structures under different loading conditions necessitate considering the presence of defects. The effects of defects such as crack or cavity should be studied in order to estimate the strength of the structure in the different situations including static, elastodynamic and transient loading. Different methods are presented and available in the literature for the linear elastic fracture analysis. Among those, dislocation-based solutions have advantages in some aspects. Utilizing the dislocation in the modeling of the cracked structures (as a green function) provides a method which is capable of the analysis of the interaction of multiple defects. This method which is entitled as the Distributed Dislocation Technique (DDT) has been applied for the static and the elastodynamic analysis of defects in linear elastic fracture mechanics.

In this technique, first the behavior of the domain is determined in the presence of a proper dislocation. To do this, the equilibrium equations of the domain should be solved with the proper boundary conditions of the structure as well as the dislocation conditions. This analytical solution is usually determined with the aid of proper transform theories such as Fourier transforms. Then the dislocation is distributed along the crack configuration, and with the aid of Buckner's principal, the cracked structure is modeled and a system of integral equations is derived. The solution of this system provides the field parameters such as stress or deformation components of the structure. Finally proper parameters such as stress intensity factors are determined to provide a measurement tool for the engineers [1-2].

Once the DDT formulation is fulfilled, then it would be possible to consider various configurations of cracked domain. This is quite an advantage, since many methods are limited to special crack configurations. On the other hand, DDT is less complicated and includes less computational effort than finite element method.

The DDT can be implemented in a generalized form to cover different types of materials, such as inhomogeneity, magneto-elasticity or electro-elasticity. The different types of loading including static, elastodynamic and transient have also been analyzed via DDT. Recently, we have considered the application of this technique to concrete. There has been some progress but yet there is much to reach a mature result in this area.

The mechanical, electrical, magnetic and thermal loading might be applied to the structure as well. To investigate these kinds of loadings, proper dislocation should be defined. Mechanical dislocation is quite common, while this definition has been extended to electrical, magnetic and also thermal dislocations (jumps) [3-4]. The solutions of these dislocations are determined and the result is used in the DDT to analyze the cracked domains under combined mechanical, electrical, magnetic and thermal loadings.

DDT used to be more of interest in the classical elasticity framework but not in the gradient elasticity theories. Although there are several solutions for the dislocation in gradient frameworks, such as first or second strain gradient theories, these solutions have not been used for the fracture

analysis yet. Recently, the authors have generalized the DDT from a linear elastic formulation to a gradient elasticity framework. The results depict the capability of the DDT in the field of gradient elastic fracture mechanics [5].

A drawback of this technique is that the problem of the dislocation should be solved analytically. Once this is done, the DDT will result in a system of integral equations (in some cases ill-posed equations) which is usually solved numerically. The solution of Ill-posed integral equations needs proper technique.

In this presentation, the authors intend to provide an overview of different fracture problems that they have recently handled utilizing the DDT.

[1] Mousavi SM, Fariborz SJ (2012) Anti-plane elastodynamic analysis of cracked graded orthotropic layers with viscous damping. Appl Math Model 36:1626-1638.

[2] Mousavi SM, Fariborz SJ, Paavola J (2012), Screw dislocation in functionally graded layers with arbitrary gradation, J Struct Mech 45: 125–132.

[3] Ravandi M, Mousavi SM, Fariborz SJ (2012), Application of thermo-elastic dislocation on a cracked layer under thermal field, ECF 19, Russia,.

[4] Mousavi SM, Paavola J (2013), Analysis of cracked functionally graded piezoelectric strip, Int J Solids Struct 50:2449-2456.

[5] Mousavi SM, Paavola J, Baroudi D (2013), Distributed dislocation technique for mode III fracture of graded materials in gradient elasticity theory, Int J Fract, submitted.

Managing Environmentally Sustainable Design in Business Networks – the Case of Shipbuilding

Pekka Murto, Aalto ARTS

Guidelines to environmentally sustainable design often highlight the importance of early intervention in the concept design stage, designing from a clean slate and extensive control over the product lifecycle. However, the emergence of business networks poses many challenges to such ideals. As companies focus on increasingly narrow core competencies they become interdependent on their network. Also, single actors in business networks cannot fully control other companies in the network. This suggests that realizing the ideals of eco-design is not devoid of problems in business networks.

The research focuses on uncovering the challenges of eco-design in business networks through a case study on shipbuilding. Shipbuilding is a prime example of a product realized through a complex network of actors. The process of ship design and building requires skills and knowledge from multiple different experts and is characterized by close collaboration between shipyards, their clients and various suppliers. The specific focus of the case study is the development of a cruise ferry that became the most sustainable ship of its kind.

Results from the case study challenge many of the ideals of environmentally sustainable design. First, instead of a single concept design stage that would set the course of action for later stages, there were multiple different stages of concept design and detailed design in the studied project. Second, the role of the designers was in many respects very traditional, focusing on functionality and aesthetics. Third, similar tasks in the project were conducted in different stages by different actors with very different backgrounds and motives, with only little or no awareness of each other. These results suggest that to successfully manage eco-design in business networks may require different approaches to those suggested in most eco-design literature.

Modeling Mixing in the Chemical Industry

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When moving from the chemist's laboratory to large scale manufacturing of chemicals, the change in scale poses challenges for the chemical engineer. At large scales mass transfer often becomes limiting. This limit can be raised with the introduction of effective mixing. However, the scale-up of mixing processes is not straightforward. Correlations are geometry dependent and uncertain at different scales. Pilot plants to study mixing are expensive and measurements take time and money. Therefore, the Chemical Engineering research group has created modeling methods in order to mathematically predict the scale up of mixing processes. These models alleviate the need for expensive piloting.

The starting point in the methodology is CFD, Computational Fluid Dynamics, which is a predictive tool for the solution of flow fields in mixing equipment. However, CFD is computationally very demanding as the reactor needs to be split into hundreds of thousands of computational cells. Therefore it is not appropriate as a design tool for the chemical industry. Once a flow field has been solved with CFD, the mixing reactor can be compartmentalized into high and low mixing areas. With only ten to a hundred of these compartments, a compartmental model can be used to solve the comprehensive functioning of the reactor. This includes the solution of chemical reactions as well as mass and heat transfer in the reactor. Dispersed phase population balances representing e.g. bubble and particle size distributions in the reactor can also be solved.

The compartmental modeling approach can be used for very complex systems. Bioreactors are one example. They involve very complex rheology as well as a need for effective oxygen mass transfer and overall mixing of substrates. Another possibility is crystallization, which is also very dependent on the mixing in the system. Local variation in the reactor can be modeled and mixing variables tuned accordingly. Reactor geometries can be compared for efficiency in order to help in the design of these types of reactors.

How to Handle the Prima Donna of Structures?

Antti H. Niemi, Aalto ENG

Thin shells are applied as structural components in many areas of engineering including civil, mechanical, aerospace and naval engineering. Slenderness of a structure minimizes its self-weight and construction material. In addition, curved shells carry transverse loads in a very effective way by coupling membrane and bending actions through the geometric curvature. Various buildings and monuments around the world, such as the Haukilahti water tower in Espoo, exploit this property which was known long before scientists and engineers had begun to mathematically analyze structural responses. On the other hand, shell structures may fail catastrophically if certain design principles become violated. The term prima donna of structures has been coined for shells to reflect the variance in their performance and sometimes rather extreme sensitivity to geometric and material imperfections. The research project is aimed at design and analysis of reliable computational methods for shell analysis.

Subject-Specific Signals Can Be Removed from Group-Fmri Data With a New Correlation-Based Method

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Introduction

We present a simple but effective correlation-based method (maxCorr) that finds from group-fMRI data signals that correlate maximally with signals within the data of one subject and minimally within the data of other subjects.

Methods

MaxCorr: Given a set of signals, maxCorr finds a signal s that maximizes the weighted sum of squared correlations between s and each signal in the set. To extract subject-specific signals, negative weights can be used for the other subjects or their contribution can be removed by signal-space projection.

The performance of maxCorr was evaluated both with simulated and real fMRI data. During fMRI, also ECG, respiration and pupil size were recorded. For the real fMRI data, both inter-subject correlation (ISC) and general-linear-model (GLM) analysis was performed.

Results

Simulated data: maxCorr found the subject-specific signals both in temporal and spatial domains. In both domains, the sources were separated better with signal-space projection than with negative weights.

fMRI data: The maxCorr-extracted subject-specific signals correlated significantly with the physiological signals and motion derivatives of that particular subject. Removing the five most deviant signals from each subject's data reduced the variance on average by 23.6% and improved the p-values of the 3000 most significant voxels of the ISC map by 29.1 dB. Adding these signals as nuisance factors in the GLM design increased the amount of activated voxels by 32.78% and improved the p-values by 24.9 dB ($p < 0.001$ FWE corrected).

Conclusions

Our novel maxCorr method is able to find from group-fMRI data subject-specific signals that are related to subject movement or physiological noise caused by heartbeat or respiration. Removing the most deviant signals from each subject's data improves the power of group analysis by reducing the overall data variance.

*) Also presented in OHBM 2013

Corticokinematic Coherence—A Novel Means to Study Proprioceptive Afference to the Human Brain

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We have shown that hand kinematics (movement velocity, acceleration etc.) are strongly coherent with magnetoencephalographic (MEG) signals recorded from the primary sensorimotor (SM1) cortex of the human brain (Bourguignon, et al. 2011 Neuroimage 55: 1475–9). We have applied this corticokinematic coherence (CKC) method to repetitive passive (performed by the experimenter) and active finger movements and shown that the coupling between the MEG signals and hand kinematics is mainly driven by proprioceptive (sensory organs monitoring movements) afferent input to the SM1 cortex, with negligible effect of cutaneous input (Piitulainen et al. 2013 Neuroscience 238:361–70).

CKC can be computed between any motor-action-related peripheral signal reflecting movement rhythmicity (acceleration, force, pressure, and electromyography; Piitulainen et al. 2013 Neuroimage 72:83–90) and MEG (in our case, 306-channel neuromagnetometer, Elekta Oy, Finland). The coherence occurs at movement frequency (F0) and its first harmonic (F1), typically reaching 0.2–0.8 for 2–3 Hz movements during 3-min recordings. We have used the CKC strength as a measure of the cortical responsiveness to proprioceptive input.

In addition, cross-correlograms or cross-spectra between motor-action-related peripheral signals and MEG derived from the coherence analysis can be used in time or frequency domain for source modelling to search for the cortical origin of the CKC, essential for functional mapping of the SM1 cortex. We have designed a novel CKC-based SM1 cortex mapping of hand area, useful for e.g. patients with lesions (e.g. stroke patients) or atypical organization of hand sensorimotor function (e.g. brain tumor patients). Importantly, CKC based on passive movements can be applied even in patients with motor dysfunction and paralysis, movement can be elicited by other person or device.

Influence of Power Line Impedance to The Luminous Efficacy Measurement of Solid-State Light Sources

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We present a setup for luminous efficacy measurement of solid-state light sources (SSLs) [1]. Luminous efficacy is defined as the luminous flux produced by the light source divided by its active electrical power consumption. Solid-state lamps (SSLs) can provide better energy efficiency and durability as compared to the incandescent and fluorescent lamps. A typical SSL consists of light-emitting diodes (LEDs), built-in electronics, a heatsink, and optics covering the LEDs. The small built-in power supplies draw short pulses of current at each power line cycle, and produce harmonic distortion to the electrical network. Depending on the driver topology, the light produced by the lamp may have pulsed shape also [2].

The method for measuring the luminous flux of light sources has been highly optimized during the years [3]. The luminous flux is measured using a 1.65-m integrating sphere, whereas the angular and spectral characterizations are carried out using a goniospectrometer [1]. Due to the instability and high harmonic content of the power system, a programmable AC power supply is used for supplying the operating voltage for the SSLs. The power supply allows to achieve total harmonic distortion (THD) of less than 1 % for the voltage, and stability better than 0.1 %. However, a problem may arise from the fact that the output impedances of such power supplies may differ from the impedance of the power system. This may cause differences in the measured THD and active electrical power. Some simple drivers used in SSLs can be sensitive to the supplying impedance [4]. Earlier studies show that SSLs with high harmonic content, sometimes as high as 280 %, and low power factor are difficult to measure with low uncertainty due to temporal variations in the measured electrical power [1].

In order to study the influence of the power line impedance to the electrical power measurement of SSLs, an adjustable power line impedance emulator (PLIE) was designed and constructed. The device allows to emulate the minimum and maximum impedance measured for the power line in a frequency range of 50 Hz – 1 MHz. The resistance and inductance values can be adjusted within three different frequency ranges using switches in the front panel. It is expected that by using the PLIE, the electrical power consumption of light sources with sensitive electronics can be more reliably measured with AC power supplies of different manufacturers. In addition, lower measurement uncertainty can be reported for the measurement of luminous efficacy. Results of test measurements conducted for a group of SSLs with the PLIE will be presented at the Aalto Research day.

1. T. Poikonen, T. Pulli, A. Vaskuri, H. Baumgartner, P. Kärhä, and E. Ikonen, "Luminous efficacy measurement of solid-state lamps," Metrologia 49, S135–S140 (2012).

2. Z. Ye, F. Greenfeld, and Z. Liang, "A topology study of single-phase offline AC/DC converters for high brightness white LED lighting with power factor pre-regulation and brightness dimmable feature," Orlando: Proc. IEEE 34th industrial electronics conference, 1961–67 (2008).

3. J. Hovila, P. Toivanen, and E. Ikonen, "Realization of the unit of luminous flux at the HUT using the absolute integrating-sphere method," Metrologia 41, 407-413 (2004).

4. D. Zhao and G. Rietveld, "The influence of source impedance in electrical characterization of solid state lighting sources," Washington: Proc. IEEE Precision electromagnetic measurements conference CPEM, 300–301 (2012).

Discontinuum Modelling in Ice Mechanics

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Ice ridges are common and important features in Northern seas and the loads due to them have to be taken account in the design of marine structures. An important part of a ridge is its underwater part called keel, which is a rubble pile of ice blocks. As this rubble pile is a collection of individual ice blocks, it is efectively discontinuous and can not necessarily be modeled as a continuum. The loads caused by this pile are anyhow often significant, hence research on its material proper-ties is needed. An important method for deriving the properties of ice rubble are the punch through experiments. In Aalto university, School of Engineering, Department of Applied Mechanics, we have performed model tests and have successfully modeled punch through experiments using three dimensional discrete element method (DEM) and two dimensional combined inite discrete element method (FEMDEM). In both of these modeling methods, the ice rubble is modeled block by block as discontinuous material. Using the models, we were able to analyze punch through experiments in detail. The discontinuous modeling of rubble enabled us to observe physical phenomena potentially ren- dered out from the more traditional continuum models e.g. we found that the behavior earlier understood to be a result of advancing failure within rubble, modeled as rubble material softening, was in fact due to changes in the rubble geometry during an experiment. In addition, we have successfully used our simulations to study physical phenomena behind ice loads on structures.

Improved Diffusers for Solar UV Measurements

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Accurate monitoring of solar ultraviolet (UV) radiation is important because of the various implications that UV radiation has on human health. The most significant beneficial health effect of UV exposure is the vitamin D3 synthesis in the skin, which is induced by the short wavelength radiation. Harmful effects of UV exposure include – but are not limited to – photokeratitis, erythema, and different forms of skin cancer.

Solar UV radiation scatters strongly in the atmosphere, and the diffuse component of the radiation accounts for a significant portion of the total UV radiation that reaches the surface of the Earth. To measure the total solar UV irradiance, the entrance optics of the measurement device needs to collect radiation from the entire hemisphere. This is typically achieved by using a shaped diffuser whose angular response, ideally, is proportional to the cosine of the zenith angle of the incoming radiation.

We used a combination of measurements and simulations to optimize the cosine response of solar UV diffusers. At the first stage of the process, various material samples were measured for their diffuse transmittance properties in a goniometric setup to find out the most promising material candidate for use in an improved diffuser head. Quartz materials with gas bubbles that acted as scattering centers were found to be attractive alternatives to the traditional PTFE (polytetrafluoroethylene, Teflon) materials for this purpose.

Cost savings can be obtained when simulations are carried out before diffuser fabrication as compared to a purely trial-and error based diffuser optimization. For this reason, a Monte Carlo ray tracing algorithm was developed to simulate light propagation, scattering, and absorption inside the diffuser. The effects of the inner sidewall of the diffuser housing, the shadow ring, and the protective weather dome were also accounted for. The algorithm was validated by comparing measured and simulated results of the test samples. The algorithm was then used to optimize two types of detectors, one with a planar diffuser and the other with a spherically shaped diffuser. The integrated cosine errors of these detectors were calculated to be $f_2 = 1.4$ % and 0.66 %, respectively.

Kataja - Visualizing Biolinguistics

Jukka Purma, Aalto ARTS

My research is about creating a tool to help linguists in the field of generative grammar to teach, research, explore and present their findings. The work presented here is done for Doctor of Arts dissertation in New Media, at the Department of Media in Aalto School of Arts, Design and Architecture.

For me, generative grammar and its latest incarnation in biolinguistics, provide the most interesting path to research one of the cornerstones of human cognition, the human linguistic capacity. However, the current research is difficult to approach, because:

a) Confusing position: Everybody knows what linguistics is about, but there are many branches in the tree of linguistics, and generative grammar is just one of the branches. If you throw a rock at flock of linguists, you probably hit someone who has a negative view on generative syntacticians and is generally not interested in syntax —even more so in Finland, because of how schools in linguistics form and maintain their identity.

b) Even within the history of this sub-field, the theory has gone through many changes and resets, but some concepts and terminology has remained from earlier iterations. To understand these you either have to learn the history and earlier arguments or accept them without understanding the reasoning behind them. This is more dangerous because:

c) Generative grammar is about abstract entities behind the observable linguistic structures. It is difficult to see these abstract entities in action, to see them earn their names.

The main goal for Kataja, visualization software demonstrated here, is to make syntactic structures visible and tangible in such way that they can be manipulated in real time in presentations and in teaching situations. To make structures a concept you can grasp like molecular structures in chemistry. All of the transitions and changes are animated to help audience to follow how derivation proceeds from linguistic constituents and features to structures. The user interface is designed to stay out of the way and allow staying in presentation mode while interacting with the structure.

Secondary goal for Kataja is to produce the highest quality static visualizations or tree graphs available for scientific articles. When trees grow more complex, there isn't guarantee that one certain visualization algorithm produces the best results. Kataja allows easy testing of several algorithms to one structure and manual adjustment and fine tuning of each branch, constituent and feature. The output from Kataja is vector graphics in PDF format, fulfilling needs for printed publications. Kataja's limited scope makes it possible to focus on typography and graphical design that is the best fit for this purpose.

Tertiary goal is to provide a research instrument to test syntactic theories, especially theories dealing with case assignment and multidomination (structures where one constituent appears in several places). Kataja is divided into visualization environment and interchangeable syntax / Universal Grammar engines that provide the derivations to visualize. My future linguistic research will be done by tuning and creating syntax engines to produce derivations.

In the history of science scientific instruments have played a role that is easily undervalued, especially now when instruments are often software. Varying prevalences of e.g. Microsoft Office, TeX/LaTeX, MATLAB, R, and tools of special sciences create expectations and standards of how research should be presented. With software environments that do both data analysis and presentation, the software influences the whole research workflow and the practices of how the research should be done. This guidance and support provided by familiar toolset can be misleading. When research strays from the workflows and presentation capabilities that the software offers, communication of the research becomes cumbersome, more difficult, and seemingly 'wrong' for wrong reasons.

Among dangers of software influencing the research there is a positive implication: Science can be pushed to a certain direction by providing instruments that make it interesting, enjoyable and productive for researchers to go to that direction. I'm making a push towards exploring hidden mechanisms of human syntactic processing.

Computer Vision Methods for Materials Research

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Antti Huhtala, Aalto SCI

Sven Bossuyt, Aalto ENG

Our research makes use of computer vision techniques to study how materials deform. Special patterns, with many "squiggly" high-contrast edges, are applied to an object to ensure that when the object moves, this results in visual changes everywhere. These changes are observed using digital cameras and computer programs interpret them in terms of local physical displacements in a calibrated coordinate system. Thus, the technique builds up a full-field description of the variations in time and space of the displacements and deformations of the object, without touching the object.

The methods we use have a lot in common with computer vision techniques in other fields, such as digital video compression and motion capture for computer graphics or gaming consoles. However, in our applications we are able to ensure that the images and experimental conditions are ideally suited for the methods we use, so we are not so concerned with methods to resolve typical difficulties encountered in other fields. Conversely, we push the precision with which displacements are determined to extreme limits, and routinely use these techniques in applications where such precision is necessary to make the techniques useful.

A good example is the use of high-speed video to capture images of the vibrations of an object after impact. The details of the different frequency components of the displacement field, some $10\,000\times$ smaller than the size of the pixels, can be extracted quite easily with the proper combination of mathematical methods. Those results in turn can be applied to non-destructive testing and evaluation of materials, damage detection and structural health monitoring.

Intuitive Thinking in Creative Design Process and Developmental Aspects of it

Asta Raami, Aalto ARTS

Intuition is described to be one of the most important tools of creation among designers, artists and researchers. Intuition is an integral part of our thinking and together with reasoning faculties it forms the basis of our thinking. Intuition is considered to be instant and rapid process of knowing, which relies on at least partially on unconscious knowledge structures (Bastick 2003, Glöckner & Wittermann 2010).

Research with people suffering from specific neurological damages confirm that even simple everyday life without intuition is impossible (Volz & von Cramon 2008). Even though recent research proposes that there are several types of intuition, very little agreement remains as to what the specific types are. However, the effects of using intuition are well recognized (Bastick 2003, Shefy & Sadler-Smith 2004). Numerous studies in art, science and business have proved us that intuition has a central role in the development of breakthrough innovations and novel ideas. Several Nobel-prize-rewarded persons have mentioned intuition as their furthermost tool. (Shavinina 2003, Shavinina 2009, Larsson 2002)

Researchers in the area of decision-making have noticed that in some problem-solving situations intuition leads to remarkable better solutions than conscious reasoning. Intuition can be superior especially if there is either too little or too much information, or even simultaneous over- and under load of information: too much information yet lack of essential information. Analytical mind chocks with too many options, and it cannot fully operate when a lot of essential information is lacking, for example illustrate options outside of imagination. Under these types of conditions the advantage of intuitive thinking is profound (Dijksterhuis & al 2006, Nordgren & Dijksterhuis 2009, Klein 1998; Frank & al 2006, Gigerenzer, 2007). Increasing amount of problems in design – as well as in the world – tend to be like these, tangled knots, which cannot be solved by the rational intelligence alone. Intuitive faculties can filter usable outcomes from numerous amounts of raw data, give new directions to possible solutions and exceed the limits of our mind. Therefore we need new types of thinking, capacity of extended mind, courage to look at the potential of intuition and courage to develop it. Both of these different thinking faculties need training and practice in order to advantage the potential of them. However, our formal education and even design studies are strongly based on development of reasoning faculties and intuition is kept hidden or ignored hence its potential is lost. Even if intuition is used the argumentation has to be based on rationalization.

The focus of the presentation is to sum my research outcomes on intuition development among designers. The research data has been collected from creativity and intuition coaching courses during the last ten years including my experience as a teacher and a designer. The data includes designers' descriptions of their intuitive experiences, the ways they understand and utilize intuition as well as their experiences of developing intuition further. The emphasis of the research is on utility of intuition not the validity of it.

The data reveals that the highly intuitive experiences are usually extremely meaningful to the person and they have an essential role when creating. Yet they are kept private due to the common tendency to hide and deny intuition. The outcomes suggest that when bringing these experiences into consciousness and especially when they are shared with others, it helps a person to build a

deeper understanding of personal creative process. As a result it also strengthens the professional expertise and personal self-esteem.

The data strongly supports the current understanding that intuition can be developed (Seligman & Kahana 2009, Vrugtman 2009, Kautz 2005). Even a single course can encourage a person to pay more attention to intuition and hence increases the awareness and use of intuitive faculties. Therefore one of my main interests has been researching how intuition can be developed to a direction of an intentional and reliable tool, that is, opposite to a random coincidence and arbitrary information.

Bastick, T. (2003). Intuition. Evaluating the Construct and its Impact on Creative Thinking. West Indies: Stoneman & Lang.

Dijksterhuis, A., Bos, M. W., Nordgren, L. F., & van Baaren, R. B. (2006). On making the right choice: the deliberation-without-attention effect. Science, 311(5763), 1005–1007.

Frank, M. J., O'Reilly, R. C., & Curran, T. (2006). When memory fails, intuition reigns: midazolam enhances implicit inference in humans. Psychological Science: A Journal of the American Psychological Society / APS, 17(8), 700–707.

Gigerenzer, G. (2007). Gut feelings: the Intelligence of the Unconscious. New York: Viking.

Glöckener & Wittermann (Eds.) (2010). The Foundations for Tracing Intuition. New York: Psychology Press.

Kautz, W. (2005). Opening The Inner Eye. Explorations on the Practical Application of Intuition in Daily Life and Work. iUniverse

Klein, G. A. (1998). Sources of power: How people make decisions. Cambridge, Mass: MIT Press.

Larsson, U. (ed.) (2002). Cultures of Creativity. Science history Publications/The Nobel Museum, USA.

Nordgren & Dijksterhuis (2009). The Devil Is in the Deliberation: Thinking Too Much Reduces Preference Consistency. Journal of Consumer Research, 36(1), 39-46.

Seligman, M.E., & Kahana, M. (2009). Unpacking intuition: A Conjecture. Perspectives on Psychological Science, 4(4), 399-402.

Shavinina, L. V. (2003). Understanding Scientific Innovation: The Case of Nobel Laureates. In L. V. Shavinina (Ed.), The International Handbook on Innovation (1st ed., pp. 445-457). Amsterdam: Elsevier Science.

Shavinina, L. V. (Ed.). (2009). Scientific Talent: The Case of Nobel Laureates. In International Handbook on Giftedness (pp. 649-669). Dordrecht: Springer Netherlands. Retrieved from http://www.springerlink.com/content/kk0t0781810vu322/

Shefy, E., & Sadler-Smith, E. (2004). The intuitive executive: Understanding and applying 'gut feel' in decision-making. Academy of Management Executive, 18(4), 76–91.

Volz, K. G., & von Cramon, D. Y. (2008). Can Neuroscience Tell a Story About Intuition? In H. Plessner, C. Betsch, & T. Betsch (Eds.), Intuition in Judgment and Decision Making (pp. 71-87). New York: Lawrence Erlbaum Associates.

Vrugtman, R. (2009). Dimensions of Intuition first-round validation studies. St. Louis, Mo. University of Missouri-St. Louis.

Spatiotemporal Visualizations of European Concert Halls

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Introduction

This research attempts to explain why some concert halls sound better than others and what perceptual attributes contribute to the general opinion of extraordinary acoustics. Subjective comparison of concert halls is not an easy task, because preferred acoustics depend on a number of elements. The music, the conductor, and the performance of the orchestra greatly affect the listening experience, and the contribution of the auditorium acoustics is hard to isolate with subjective surveys. To overcome these challenges, we have developed several new technologies and techniques. The first is a loudspeaker orchestra, which standardizes the musical performance. The second is spatial sound field analysis, which allows us to evaluate the effect of the auditorium. And finally, sensory evaluation methodology borrowed from the food and wine industry allows us to evaluate the multidimensional perceptual aspects of the experience. The combination of sensory profiles and spatial analyses have resulted in an interpretation of what physical characteristics of the sound field result in the perception of great acoustics. With these methods we have made major advances in room acoustic evaluation.

Measurement tour

In November of 2012 six researchers from the virtual acoustics team took these technologies on the road and did a measurement tour in central Europe. During nine days, we traveled more than 3000km by bus and installed the loudspeaker orchestra on the stages of ten prominent concert halls. The tour followed from Amsterdam - Cologne - Wuppertal - Bruxelles - Stuttgart - Vienna - Berlin and finally to Munich. The loudspeaker orchestra consisted of 34 loudspeakers controlled by 25 signal channels. Studies have shown that the directivity of the loudspeakers approximates the directivity of real instruments. Measurements of signals from these loudspeakers taken with a six-microphone array gave us data that allows us to analyze and compare the spatial sound fields of each hall. Additionally, we can reproduce the hall conditions in the lab and make side-by-side listening comparisons of these geographically isolated rooms.

Spatial sound field analysis

With measurements from the tour in hand, we were able to begin to pick apart the differences between halls and determine what features distinguish great sounding halls from mediocre and poor ones. Standard measurements that apply omni-directional measurements and parameters derived from them are not adequate for describing the details of concert hall acoustics. Inherently, spatial

properties of the sound field are lost, and these spatial details are a major component of the musical presentation. Until relatively recently, spatial analysis of the sound field has been limited to simple microphone response patterns, such as omni, figure-of-eight, or cardioid. However, microphone array analysis techniques allow high spatial resolution measurement and evaluation of concert hall sound fields. These measurements can be used for time-frequency and spatio-temporal analysis to unravel the underlying physical phenomenon and perceptual consequences. The analysis technique used here extracts an amplitude and direction for each time instant in the response of the room. The resulting illustrations show the wide band sound energy distribution in space at different time windows. When mapped over plan and section drawings of the halls the visualizations show intuitively which surfaces reflect the energy originally emitted from the stage. These visualizations allow us to understand the links between architecture and acoustics in a conspicuous way.

Binaural dynamic responsiveness

Listening tests have revealed that shoebox shaped halls are more preferred, and the visualizations show that these halls have distinctively more lateral energy in the sound field. This energy is the result of strong early reflections from sidewalls and balcony faces. This finding prompted an investigation into why lateral energy is associated with more preferred halls. One of the main perceptual dimensions associated with preference is loudness, and it seems that lateral reflections contribute to loudness in such a way that the dynamic range of halls with such reflections is enhanced.

Real music performance involving musical instruments and a human listener contains factors far from linear. First, variation in musical dynamics is one of the basic means of expression in compositions and music performance. The effect of playing dynamics on the sound spectrum of the musical instruments is not linear. Instead, louder playing excites the higher harmonics more than the lower harmonics near the fundamental frequency. Hence, the difference in the high-frequency content is large between soft and loud playing. The degree of this effect depends on the instrument. Second, the binaural directional hearing is also highly nonlinear, and it emphasizes high frequencies more when the sound arrives laterally from the sides of the head instead of the median plane. The acoustics of the concert hall has a direct connection to the amount and directions of reflected sound energy, and thus, to the binaural frequency response. Because the orchestra produces more high frequencies when it plays loudly, and binaural hearing disproportionately amplifies these frequencies when they arrive from the sides of the head, a significant boost in loudness is perceived. This seems to be a key factor in the preferred acoustics of the best concert halls.

Conclusion

The acoustics of a concert hall are heavily a matter of taste. However, by using a loudspeaker orchestra to create identical performances for comparison, we have been able to obtain reliable preference ratings for many halls. Sensory evaluation methods have revealed the perceptual dimensions hidden behind these judgments. The sensory profiles are useful to interpret physical measurement data and have led to the concept of binaural dynamic responsiveness to explain the preference ratings based on the geometry of the architecture.

The Hidden Potential of Design in Language Acquisition

Tania Rodriguez-Kaarto, Aalto ARTS

Communication among individuals of a pluri-cultural society is subjected to many factors, where sense making in this environment involves the convergence of 'plural realities' (Mirzoeff, 1999) implying different interpretations of one same event. This is a complex problem that needs more consideration in design thinking. For adult immigrants in Finland and any other country the most empowering part of assimilation is proficiency in language. It is a deep transformation process, where we change the way we make 'meaning and sense of things'. From this perspective, one of the most pressing issues in language teaching is the disparity between the content of the books taught in class and everyday life and spoken language outside.

In language courses, an empirical study was carried out in order to assess the effectiveness of Finnish language books for foreigners. By analyzing graphic features, content and discourse analysis, some of the books showed potential for improvement both in readability and accessibility and on the discourse they weave for the learner to interpret. This study also revealed that there is unexploited opportunities to impact education and assimilation in emerging design practices that place importance on social transformation. Can design improve language acquisition?

Study Mobile Application Development as a Context Of Creative Activity: How to Enhance the Creativity of Application Developers?

Maryam Roshan, Aalto BIZ

The digital world has recently witnessed a considerable change in the structure of mobile services by introduction of application ("app") platforms. These platforms are based on mobile phone operating systems (e.g. Apple's iOS, Google's Android or Nokia-Microsoft's Windows) and enable the distribution of third-party developed apps to mobile users. The apps can have various purposes of hedonic, utilitarian or mixed. On one side, the platform providers offer the tools and regulations for third-party developers to create the apps, and on the other side, users can download the apps via their smartphones that work on the same operating system.

The application platforms are a good example of generative platforms. A generative platform allows the capacity for production of new content on it by users without direct involvement of the platform provider. Therefore, the application platform provides an environment for a large number of heterogeneous developers who want to develop and distribute their apps to the mobile users. Developers are in charge of the entire process from development of the apps to the after-sales service to the users who have downloaded their apps. They compete with each other to make their apps distinguishable among the pool of existing apps on the platforms, and meanwhile support each other in the development process through communities.

The success of a platform in the long run is associated to the existence of varieties of apps on it. Hence the platform provider needs to engage a large number of third-party developers to the platform. Additionally, it should stimulate the creative work of those developers, through its platform design and its controlling policies. The conflict between the controlling vs. keeping the platform generative is a challenge for the platform provider. It needs to find a balance in order to maintain the developers, and meanwhile preserve the platform from fragmentation.

Throughout time, the application market on platforms tends to get saturated and makes it more difficult for developers to monetize. Therefore, more attention is needed to know the ways of maintaining the developers on the platform and stimulating their creativity to enhance the possibility of making the app distinguishable which can provide a higher chance of monetizing.

This study takes into the consideration that in order to understand how to find the balance between control and generativity in order to maintain the developers on the platform and enhance their creativity, it is necessary to learn about developers' attitudes and their development processes. Therefore, it aims to understand the following:

1- What are the motivations of developers in working on a particular platform and on different types of apps – does the motivation differ for hedonic, utilitarian or mixed apps?

2- How do developers identify and evaluate the ideas for their apps? Is there any difference with regard to the type of app (whether it is hedonic/utilitarian or both)? Or along some other dimension(s)?

3- How do developers use the available tools and means in order to develop their apps? Are there any cases of creative use of the tools and means in order to reach their goal in different phases (e.g. in development process, monetizing, etc.)?

Combining Participations.

Bringing Together Participation in Urban Planning and Participation in the Design of Digital Technology to Inform Participatory E-Planning.

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My presentation will be about my doctoral thesis, which I am currently finalizing at the Department of Media. The thesis is a trans-disciplinary work on participatory e-planning, or, in other words, digitally-mediated citizen participation in urban planning. It introduces the role of participation in the design of digital technology and the importance of taking such participation into consideration when exploring the way participatory e-planning can be shaped in the near future. The focus on the design of digital technology is balanced with sensitivity to urban planning. The outcome is a work that introduces a mixed conceptual vocabulary and provides outcomes of relevance to different fields operating at the intersection of digital technology, urban planning, and participation. The thesis aims in particular to reduce the current gap between the fields of urban informatics, which approaches the use and design of mundane technology in urban space, and e-planning, which focuses on the use of digital technology in urban planning, often from an expert-driven position.

The thesis provides a new conceptualization of participatory e-planning, which aims to be more in tune with the realities of the digital age and its emerging culture of participation. This is a culture of information-centered and digitally mediated peer production and sharing. So far, participatory e-planning, as approached by the urban and e-planning fields, has only examined the meaning of participation from the standpoint of urban planning, and ignored participation in the design of digital technology. By acknowledging the latter it is easier to understand and tap into the dynamics of the new culture of participation, as well as face the challenges and uncertainties of the new technological landscape of mundane digital tools associated with it.

My work is guided by the following overarching research questions: How to re-conceptualize participatory e-planning? What and how to design for participatory e-planning? These two questions are intimately interconnected and reflect my position as a design researcher. By engaging in design activities insight was gained into re-conceptualizing participatory e-planning, and vice versa. Thus, the overarching aim of the research is to propose a reconceptualization of participatory e-planning that is in tune with the digital age, and at the same time, inform the design of digital technology so that it would support a more contemporary form of participatory e-planning.

The conceptual and theoretical framework that I have constructed relies on perspectives on participation from the fields of information technology design and urban planning. This framework has permitted me to examine participatory e-planning in relationship to participation in the design of digital technology and participation in urban planning. Each of these two types of participation can further be understood as either non-existent (non participation), staged by experts, such as designers or planners (staged participation), or as happening through use (participation as design-in-use in the case of digital technology) or through citizen action (participation as self-organization in the case of urban planning). The last two types, participation as design-in-use and as self-organization, lie at the heart of the culture of participation of the digital age. My proposed matrix of multiple participations brings together the different types of participation in one analytical tool, which I use to situate examples from literature and to position my research with respect to them.

My quest for a new conceptualization of participatory e-planning has emerged and gone hand in hand with my involvement in the participatory design of the Urban Mediator (UM), an online map-based tool for locative media creation and sharing. This design research methodological approach made it possible to explore participation in the design of the UM both through staged participation and through participation as design-in-use. The latter especially enabled the exploration of some emerging practices associated with operating with digital media and technology, such as locative media handling as well as configuring, adapting and connecting digital technologies. Moreover, by integrating the design-in-use of the UM in three cases of participation in urban planning in Helsinki, it was possible to carry out a comparative analysis of the impact that participation in the design of digital technology has on urban planning. The three cases represented staged types of participation in urban planning and participation as self-organization. The addition of an action research strategy made it possible to step back from the initial focus on the UM as a designed artifact, and address change in the way participatory e-planning would be carried out.

The concrete participatory design of the UM gave impetus to the Expanded Participatory Design (EPD) approach, which combines different and interconnected activities of participation in the design of digital technology. The EPD can also be embedded in different types of participation in urban planning. The EPD approach shifts the locus of participatory e-planning towards collaborative work based on digital media production and sharing by experts and non-experts alike.

What Are ICT's Right Properties for Creative Knowledge Work?

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Knowledge work – i.e., information-intensive work that involves non-routinized problem solving and often requires higher education competence and the use of information and communication technology (ICT) – represents economically the most important type of work in the developed countries. Occupations in sectors such as research, arts, media industry, research & development, marketing, and management fit under the umbrella definition of knowledge work.

However, although knowledge work thus deserves a lot of attention in management thinking, knowledge workers' ICT-related needs remain a poorly understood subject. Several reasons exist for the difficulty to equip knowledge workers with ICT that successfully supports their work:

1) Knowledge work's unpredictability and heterogeneity: because knowledge work is creative activity and requires deep understanding of the problem domain, it appears to have little such repeatable structure that could serve as a basis of ICT design.

2) Knowledge workers' autonomous working style: many workers are experts in their fields and have their indigenous working styles. Such an autonomy and self-directed work is not easily compatible with any software that directs users into predefined work processes.

3) Gaps in existing information systems (IS) theories: most of the IS literature has focused on ICT's adoption and diffusion as opposed to long-term use patterns. The so-called post-adoption theories have proved difficult to develop. The lack of theories makes it difficult to design ICT for knowledge workers in an informed fashion.

The above-presented challenges are a starting point for research in our "CREATIVE USE: Creative use of ICT in knowledge work" project (Academy of Finland, 2012–2016) at Aalto BIZ's Department of Information and Service Economy. We are tackling the challenges with the following approaches:

1) Focus specifically on creative ICT use: creative problem solving is the distinctive feature of knowledge work. Focusing research on this aspect may yield the most valuable gain to start from. Since creativity is not only a social phenomenon but also a cognitive one, this focus allows us to apply theories in psychology and cognitive science to knowledge work. Both of these fields of research have been underrepresented in previous literature.

2) Quantify the amount of creative ICT use in knowledge work: to prove the importance of our focus, we need to measure the extent that creative ICT use represents of knowledge work in general. We have developed a method to measure the amount of ICT use for creative purposes on an individual user level. It was originally developed for studies of everyday technologies (e.g., digital cameras). We are in a process of adapting it for a knowledge work context.

3) Combine qualitative and quantitative research: As a new subject for research, our challenge is to both understand knowledge work holistically in its context, and develop causal hypotheses for its existence, as a first step towards a more precise theory. We are proceeding in both of these fronts by studying software developers' emergent knowledge sharing practices, and by developing predictive

models for creative and heterogeneous uses of Microsoft Excel – one of the most commonly used knowledge work tools.

4) Study mobile application development as a context of creative activity: In the highly competitive mobile application market, application developers need to find ways to develop distinguishable applications and promote them to stand out among the pool of existing applications. This work context presents several opportunities for holistic research on developers' creativity and its relation to their motivations, social dynamics of the developer community, and the tools and means that are necessary for economically sustainable business.

With these approaches, we are working towards a theoretical understanding of ICT use in knowledge work. With this work, we wish to provide useful information for ICT developers in their attempts to develop better knowledge work tools, and managers for providing their knowledge workers with more effective working practices and environments.

Directional Cues in Binaural Auditory Modeling

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In binaural auditory modeling, the aim is to be able to computationally analyze sound scenarios in a similar way as humans do. In this work, that aim is approached by using knowledge from neurophysiological and psychoacoustical studies and by constructing functional models of organs that are responsible for binaural cue decoding in the human auditory pathway. The auditory system uses interaural time and level differences in the localization of sounds. Neurophysiological studies have shown that these cues are transferred into directional information in the medial superior olive (MSO) and lateral superior olive. The MSO is sensitive to interaural time difference (ITD), whereas the LSO is sensitive to interaural level difference as well as to ITD at low frequencies. The outputs of the functional models of these organs are not as such applicable in the analysis, as the level of the output varies for a point-like broadband stimulus depending on the frequency and between the models. A method is presented to combine the outputs of such models as well as an additional model of the MSO designed to decode directional cues based on broadband envelope time-shifts between the ear canal signals. Applicable cues are obtained by mapping the outputs into azimuth direction values following the idea of self-calibration, and by favoring the cue values suggesting more lateral directions. The resulting directional cues are applied to form a binaural activity map. It is shown that the activation on the map corresponds to the human perception in several scenarios of psychoacoustical experiments.

The Catalytic Activity of Au And Au/Ta Coatings for
So2 Depolarized Electrolysis for Hydrogen Production

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Hydrogen production for application in fuel cells must fulfil several criteria of economic, technical and envi-romental sustainability. Water electrolysis powered by reneable power sources is traditionally considered technique, but it requires high overvoltages (the theoretical E0 of the conventional water electrolysis 1.23 V vs. practial 1.7-2.2 V) and therefore leads to lower efficiency.

Alternative process - sulphur dioxide depolarized electrolysis (SDE) - has been developed, where SO2 is added to the anode space and it is oxidized electrochemically leading to sulfutric acid and hydrogen evolu-tion at cathode. Such overall reaction $SO2 + 2 H2O -> H2SO4 + H2$ requires only E0 of ~0.16 V, i.e. significant-ly reduced overvoltage [1,2].

One of the research challenges in SDE process is to find and deploy a proper catalyst for SO2 oxidation at the anode, because sulfuric acid formed there is strongly corrosive. In previous works platinum and gold has been proposed for catalysts [3,4]. In this work, thin Au and Au/Ta coatings on 904L stainless steel bipo-lar plates are studied for their catalytical activity and durability at the SDE corrosive environments.

The results are compared with bulk Au electrode, indicating that Au-coated stainless steel has high activity for SO2 oxidation. However, at increased overpotentials due to electrilyzer design the stainless steel might undergo excessive corrosion, especially if gold coating integrity is locally violated. Using tantalum interlayer between Au coating and the steel substarte this could be significantly reduced with only small loss in overall resistance.

Indexing and Searching 100M Images with Map-Reduce

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Most researchers and practitioners working on high-dimensional indexing agree on the following three trends: (i) the size of the multimedia collections to index are now reaching millions if not billions of items, (ii) the computers we use every day now come with multiple cores and (iii) hardware becomes more available, thanks to easier access to Grids and/or Clouds. This paper shows how the Map-Reduce paradigm can be applied to indexing algorithms and demonstrates that great scalability can be achieved using Hadoop, a popular Map-Reduce-based framework. Dramatic performance improvements are not however guaranteed a priori: such frameworks are rigid, they severely constrain the possible access patterns to data and scares resource RAM has to be shared. Furthermore, algorithms require major redesign, and may have to settle for sub-optimal behavior. The benefits, however, are many: simplicity for programmers, automatic distribution, fault tolerance, failure detection and automatic re-runs and, last but not least, scalability. We share our experience of adapting a clustering-based high-dimensional indexing algorithm to the Map-Reduce model, and of testing it at large scale with Hadoop as we index 30 billion SIFT descriptors. The lessons drawn from our work could minimize time, effort and energy invested by other researchers and practitioners working in similar directions.

Photopic-Scotopic Luminance Meter for Measurements in the Mesopic Region

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Two distinct regimes of the human visual system are the photopic vision, only active in high light conditions, and scotopic vision, only active in the low light conditions. Photopic vision uses cone cells in the eye and allows color perception. Scotopic vision uses rod cells and it is only monochromatic. Intermediate region where both types of cells are active is known as mesopic vision, and it corresponds to dusk light conditions.

We present a photopic-scotopic luminance meter characterized for measurements in the mesopic region. Recommended system for mesopic photometry was published by CIE in 2010, and according to this system, the mesopic luminous efficiency function is a linear combination of the photopic and scotopic luminous efficiency functions in the range of 0.005–5 cd/m2. The ratio in which the functions are combined is determined by the adaptation condition of the observer.

Our instrument is a spot luminance meter with two detection channels for the scotopic and photopic detection. The main parts of the instrument are an objective lens, a field stop defining the field of view, a beamsplitter and two detection channels with a photopic and a scotopic filtering respectively. The signal is measured with silicon photodiodes and a custom-built dual channel switched integrator amplifier. System control and data collection are performed with a portable computer, where luminances from the two channels are combined in an appropriate ratio to obtain a mesopic value.

The instrument is characterized for absolute spectral responsivity against a calibrated spectroradiometer using an integrating sphere based radiance source with input from a monochromator. The linearity of the responsivity is measured at a single wavelength with a laser source and a set of neutral density filters.

The results show very good noise performance, allowing measurements at the lowest part of the mesopic range with less than 1 % standard deviation of mean with an integration time of less than 1 s. Estimated expanded measurement uncertainty is 3 %.

Enabling Web-based Video Communication between Students and Teachers

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Standardization of Web Real-Time Communications (WebRTC) is going to greatly increase the deployment of interactive multimedia applications on the Internet. The resulting high bit rate multimedia traffic may suffer performance issues with call-setup (e.g., NATs and firewalls traversal, negotiation failures, non-conformant middlebox/endpoint, etc.) or media quality. Such issues may be hard to troubleshoot for developers and ISPs alike.

In the poster, we will discuss performance monitoring of media flows from the perspective of an application developer and a service provider (using packet filtering in a middlebox) and thereby offer a tool set for observing, understanding, and fixing such issues.

In the demo, we will showcase a web service to complement the existing communication channels between students and teachers/course assistants.

Quenching a Molten Mixture of Ingredient Elements into Glassy Metal Pre-Forms and the Thermoplastic Re-Shaping of those into Useful Metallic Glass Components

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Much like the properties of windows glass has much of the characteristics of the sand it is made of, so too the metallic glass has many properties of the crystallized metals it is made of. However, like a glassblower can re-shape oxide glass, so too can metallic glass be re-shaped above it's glass transition temperature.

We show the manufacture of metallic glasses in a custom built high-vacuum chamber with arc-melting by melting and mixing their composition elements. The molten alloy is copper mold cast by tilting the chamber into an amorphous solid, i.e. bulk metallic glass.

The produced metallic glass pre-form is then reheated and re-shaped into new shape while retaining the characteristically near theoretical strengths of glassy metals.

Crowdsourcing - People-Driven, ICT-Enabled Innovation

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In 1766, Sweden passed the first law protecting press freedom (OECD 2010), and by so doing signified the fundamental role of journalism in democratic societies, such that journalism is often referred to as the "fourth estate". It is evident, however, that the journalism (aka, news media) industry is facing a major challenge in its traditional value system, particularly due to the introduction of modern innovations (e.g., the Internet, web 2.0, etc.) and the radical impact these technologies have on how news are produced and consumed. A recent market assessment shows that UGC is viewed as a major threat the media industry is facing (Accenture 2007). The OECD (2010) report shows how the economics of news production and distribution have been radically altered, so that publishers in most OECD countries face a substantial decline in circulation, revenues and employment levels.

Relatively easy-to-use and inexpensive communication tools, when combined with ubiquitous crowds create an unprecedented distributed problem-solving model. As such, these ICT-enabled crowds have become a major threat, and a direct cause of disruption, to the traditional way how the profession is perceived and performed in the news business. Taken together, this has given rise to what is usually referred to today as "citizen journalism". The term has evolved to broadly describe the act of non-journalists doing the things that only journalists used to do, such as witnessing, reporting, capturing, writing and disseminating (Kelly 2009). Citizen journalism reflects an alternative mode of content production; where "producers do not make a living out of the production" of what they produce (Frohlich et al. 2012, p.1045-1046). A conflict has emerged when two different perceptions of UGC were contrasted: that of the professional and that of the amateur. In their study, Witschge & Nygren (2009) report that "most journalists consider themselves to have the sole right in producing news ... they view news as being tied to journalism and do not (want to) envisage other spaces as creating news" (p. 51-52). Obviously, news communities see the situation differently; they believe that the current journalism model does not satisfy all their needs, especially when some mainstream media decide to keep certain events in the dark. Whatever side of the argument we take, it seems certain that the impulses underlying the rise of citizen journalism are here to stay, ensuring that citizen journalism will, in some form, be a part of whatever form of media is standing after the current shakedown (Kelly 2009, p.4).

Management studies, however, tell us that adept organizations should treat novel phenomena as an opportunity, rather than a threat. Whereas some will view the crowd as a major threat and fight against them; others view the crowd as an opportunity and try to utilize them. Crowdsourcing can offer such opportunity. The term "crowdsourcing" was popularized by Jeff Howe (2006) who defined it as the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call. In the context of journalism, crowdsourcing is seen as a model for distributing the reporting function across many people (Kelly 2009, p.18); or generally as a sourcing strategy that bridges an organization with motivated and capable crowds.

It is very important to highlight the fact that crowdsourcing (as practiced today) is a relatively new, near chaotic, socially and technologically complex sourcing model. Despite the many flagship

success stories (e.g., the InnoCentive Platform and the Goldcorp Challenge); there are even more (usually untold) stories of failure, either because they have failed to engage/motivate the crowd (e.g., Levia 2010), or they have failed to retain/nurture the crowd (e.g., Schonfeld 2008). These examples put a great emphasis on the question of motivation, specifically, "what motivates the crowd"? This question was identified as one of the under-researched themes in the crowdsourcing area (Zhao & Zhu 2012). In pursuit of a deeper understanding of what motivates the crowd, we have been studying the photography crowdsourcing platform "Scoopshot". Based on in-depth interviews, and guided by the self-determination theory (Ryan & Deci 2000; Deci et al. 1999; Brief & Aldag 1977; Jones & Mawhinney 1977), we found that the crowd is motivated by a mix of both extrinsic and intrinsic motivational factors. Intrinsically, the crowd members were found to be driven by curiosity, enjoyment, and altruism, while extrinsically, they were found to be driven by monetary reward, developing one's skill and career, and recognition. We also found that the motivational factors that lead to initial usage phase are different (in origin and aim) from those leading to the sustained usage (i.e., continuance) phase. While inwardly directed motivations (e.g., curiosity and financial reward) played the dominant role in attracting the crowd – that is, making the initial usage decision – outwardly directed motivations (e.g., recognition) were extremely important to the subsequent usage decision.

Optimization of Wastewater Treatment Technologies for Reducing Ecotoxicity of Pharmaceutical Drugs Residues in the Aquatic Environment

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Pharmaceutically active compounds (PhACs) are used ubiquitously to treat humans and animals and their presence in the aquatic environment is now a rising concern of the society because of the risk they pose due to their chronic ecotoxicity. To reduce their output into the environment their fate in municipal Wastewater Treatment Plants (WWTPs) should be understood.

Today 80 % of Finnish population is connected to municipal WWTPs. Typical wastewater treatment process in Finland is biological-chemical simultaneous precipitation in which organic matter and nitrogen are removed biologically and phosphorus chemically. Lately, more attention has been started to pay to potentially harmful compounds such as persistent organic pollutants, endocrine disruptors, pharmaceuticals and personal care products.

Biodegradation is the most preferable way of entirely eliminating pharmaceuticals in WWTPs. In our study three PhACs (Ibuprofen, Diclofenac, and Carbamazepine) extensively used in Finland and found in the aquatic environment were chosen for biodegradation research. First two PhACs are anti-inflammatory drugs and the third one is used to treat epilepsy and depression. Experiments were done in three types of wastewater purification systems: a full-scale WWTP in Helsinki, laboratory scale Sequencing Batch Reactors (SBRs) and laboratory scale Membrane bioreactors (MBRs). Objectives were to optimize the removal of the selected PhACs by biodegradation in these purification systems. This was done by verifying laboratory procedures and examining the rates of biodegradation in different operating conditions. Ibuprofen was found to biodegrade up to 99% in 24 hours, Diclofenac up to 20% and no biodegradation for Carbamazepine was obtained. Three key factors of operating the plants for maximum of biodegradation efficiency were determined: adaptation to small concentrations of pollutants, proper organic loading in feeding wastewater and temperature value constancy

Inorganic-Organic Hybrid Thin Films Molecular Layer by Layer

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The rapidly developing industrial technology sets new challenges for material development as property combinations not commonly available are required. Inorganic-organic hybrid materials offer an elegant solution for the problem as they consist of both inorganic and organic constituents, providing the possibility to join the desired characteristic of each. For example, the inorganic part may bring mechanical or thermal stability, magnetic properties or electrical mobility, and the organic part could increase the flexibility or toughness of the material. Commercial applications which utilize inorganic-organic materials already today include energy applications, micro-optics, and medical applications, to name just a few.

Many of the applications, both used today and potential new ones, require the use of extremely thin material layers, known as thin films. Atomic layer deposition (ALD) is a thin-film deposition technique which is based on sequential, self-limiting gas-surface reactions. The film growth can be described by a so-called ALD cycle where each precursor is pulsed into the reaction chamber, separated with purging with inert gas to remove any excess precursor and possible by-products. The films produced by ALD are of high quality with good reproducibility, and due to the cyclic growth, the thickness of the films can be precisely controlled. Traditionally the precursors used in ALD are inorganic. The variant of ALD which uses organic precursors is known as molecular layer deposition (MLD) technique. By combining these two techniques it is possible to produce inorganic-organic hybrid thin films, mixtures of hybrids and oxides and nanolaminates consisting of nanoscale layers of hybrid and oxide. Moreover, the properties of these thin films can be precisely tuned by varying the amount of the hybrid and oxide in the structures, easily done by varying the ALD/MLD cycles during the deposition.

Although the combined ALD/MLD technique provides a powerful tool to fabricate hybrids, combining the different chemistries is not always straightforward. The used organic precursor may be flexible and especially if the reactive groups at the ends of the molecule are the same type, it may bend and react twice with the surface. This in turn hinders the growth and slows the process. One possible solution to preventing these double reactions is to use organic precursor with a stiff backbone, like aromatic precursors containing a benzene ring. In our search for the ideally growing inorganic-organic hybrid thin film we have made both Zn- and Ti-containing hybrid thin films with aromatic backbones.

We have also made mixed films by using oxides together with the hybrids. By varying the number of ALD/MLD cycles and thus the precise ratio of hybrid and oxide during the growth process, we have been able to demonstrate the controlled change of various properties. We have also observed improved barrier properties, important parameters for packaging applications, for biopolymers coated with hybrid-oxide nanolaminate structures.

The combined ALD/MLD technique shows huge promise in material research. There is a large variety of properties which can be selected from inorganic and organic constituents and then tuned by controlling the precise amount of the constituent in the material depending on the demands of the application in question.

A. Sood, P. Sundberg, J. Malm, M. Karppinen, Appl. Surf. Sci. 257 (2011) 6435-6439.

A. Sood, P. Sundberg, M. Karppinen, Dalton Trans. 42 (2013) 3869-3875.

P. Sundberg, A. Sood, X. Liu, L.-S. Johansson, M. Karppinen, Dalton Trans. 41 (2012) 10731-10739.

M. Vähä-Nissi, P. Sundberg, E. Kauppi, T. Hirvikorpi, J. Sievänen, A. Sood, M. Karppinen, A. Harlin, Thin Solid Films 520 (2012) 6780-6785.

Service Life Prediction of Repaired Concrete Structures: Hybrid of Artificial Neural Network and Finite Element Method

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The durability of repaired concrete structures continues to be a major global concern. Several repaired concrete structures still fail prematurely, regardless of improvements in repairing materials and methods, leading to costly and time consuming repairs of repairs. Studies in the field of concrete repairs showed that almost 50% of repaired concrete structures had failed in Europe and USA. Simultaneously, numerous existing concrete structures needs to be repaired as they do not meet today's safety standard. As a result, annually billions of EUR will continue to be spent in order to repair deteriorated concrete structures. For instance, more than 50% of Europe's annual construction budget is spent on repairing of deteriorated concrete structures including rehabilitating and refurbishing of existing structures. In Finland alone repairing cost of building structures is estimated to be about 5.5 billion EUR annually.

Degradation process of repaired concrete structure is a more complex theme compared with normal concrete structure since it requires essential understanding of several additional interacting factors. The factors include the condition of the structure before repaired, the suitability of the methods of repair and quality of the workmanship. Thus, unlike normal (unrepaired) concrete structure, service life of repaired concrete structure depends on the quality of the composite system formed by the repair material and the existing concrete substrate as well as on the proficiency with which the repair works were carried out. Currently, practical application of service life prediction model for real repaired concrete structures is yet limited. Existing service life prediction of repaired concrete structure is partly based on individual's experience, and partly on condition surveys and laboratory studies made in this research sector. Lack of existing scientific models adversely contributes on today's premature failure of concrete repairs since it complicates the selection of well compatible repairing materials and techniques. Therefore, efficient model that can predict the service life of repaired concrete structure is highly desired for optimizing the selection of repairing materials and techniques in turn diminishing economic loss due to premature repaired concrete failure.

Corrosion of reinforcement steel is the leading mode of failure of reinforced concrete structures and is recognized as a major challenge. Degradation process of repaired concrete structure caused by corrosion of reinforcement steel is very complex compared to unrepaired concrete structure since it requires essential understanding of several additional interacting factors. The need to mitigate premature failure of repaired concrete structure had motivated some researchers to develop service life prediction model for repaired concrete structure under chloride environment, however, there are only few such models. These existing models use numerical methods to simulate the corrosion processes of reinforcement steel in concrete which is induced by ingress of chloride ions. In these models, the effect of continuing corrosion is not taken into consideration; in addition the models rely on unique chloride threshold value to define the corrosion resistance of the reinforcement steel in the repaired concrete structure. But chloride threshold value cannot be a unique value as it is a function of various factors which are interconnected and variable with time. Existing models assumed perfect bonding between the original concrete and the repair material and the effect of the

interfacial zone between the repair and substrate concrete were also neglected. The combination of such assumptions, simplifications and generalizations compounded with complex behavior of repaired concrete structure leads to a considerable uncertainty in the output of the service life prediction model. Hence, an efficient model which takes into account these and other emerging issues is highly desired for optimizing selection of repairing materials and techniques in turn diminishing economic loss due to premature repaired concrete failure.

The aim of this research is to investigate the effect of the ingress of aggressive substances on repaired concrete in the presence of service and environmental loads with time. The study will emphasize on concrete structure which is repaired using recasting with concrete method and exposed to chloride environment. The objective of the research is to develop comprehensive service life prediction model that can predict the remaining service life of repaired concrete structure with a better accuracy. The developed model will assist the repair designer to rationalize the repair options, which in turn allow achieving both technical and economical benefits.

Conducting experimental/field tests and finding already collected long-term field data on repaired concrete structures are vital steps for this research. The gathered data will be analyzed using Artificial Neural Network (ANN) to figure out the relationships between interacting deterioration factors. ANN provides a non-parametric, self-adaptive approach to data processing and is powerful in tracking complex non-linear problems. The model will provide new knowledge (relationship and degree of impact of each deterioration factors) that eliminates a number of assumptions, simplifications and generalizations while reducing the complexity of deterioration modeling in finite element method which will follow next.

A new generation of finite element based tool which handles coupled multiple transport mechanisms will be used to model the full extent of the deterioration. The knowledge gained from the artificial neural network and experimental data will be used during modeling. The model will demonstrate the extent of deterioration caused by the interaction of the ingress of aggressive substances in the presence of service and environmental loads with time in repaired concrete structures. The verification of the developed deterioration model will be performed using experimental data gathered from laboratory and field. After the verification process is completed successfully, the validation phase will follow.

The final deliverable of this research is service life prediction model which is developed using ANN. The model will be trained with the data output of the deterioration model. Rigorous training is necessary to ensure the accuracy of the prediction.

Subsidence and Soil Compaction Caused by Groundwater Level Changes in Clay Deposits Characteristic to the Helsinki Metropolitan Area

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One of the factors influencing the scale of deformation and subsidence in clay deposits is the groundwater and the variation of its level. In addition to natural seasonal variation, the groundwater levels are influenced by changes in land use, underground construction, changes in climate, and geological uplift.

The aim of this study is to use various modelling approaches to examine the influence of groundwater level changes and other factors influencing subsidence and soil compaction in clay deposits characteristic to the Helsinki metropolitan area in Finland. The purpose of the modelling is to find correlations between the local area geology, hydro-geological properties, and geotechnical deformation characteristics. The ultimate goal of the study is to develop cis and cad tools to support planning of land use and decision making in engineering geology.

The research area is Perkkaa in Espoo, Finland, located in Helsinki metropolitan area in coastal area of Southern Finland. The size of the research area is approximately 2,7 km2. The study is based on the comprehensive Espoo municipality data on soil investigations, long-term historical groundwater level observations, and long-term deformation measurements made in the Perkkaa area. Based on the soil investigation data and general geological maps, it has been possible to create an overall 3D model of the geological environment of the research area.

The surface of the studied area is mostly covered by clay, with a thickness varying between 5 to 15 meters. In the southern and middle parts of the area, the soft soil layer can be over 20 meters thick. The minimum shear strength of the clay is 7 kN/m2, and the water content varies considerably, mostly being between 70 % and 140 %. A couple of meters thick silt and sand layer can be commonly found beneath the clay deposits, overlying a layer of 1 to 5 meters thick till overlying the bedrock. The studied area is bordered by a fill area to the east, a silt/sand moraine area to the west, and a moraine/bedrock area to the north and south. Most of the area is elevated less than 2 meters above the Baltic Sea level. In the northern part of the area, at the moraine and exposed bedrock areas, the elevation varies, being 10 meters at its highest. The research area is a part of well-defined catchment area, which provides good boundaries for modelling the flow of groundwater and the changes in its level.

The development of the Perkkaa area began in the beginning of 1970's. The buildings of the area consists mainly of apartment buildings and office buildings. The development history of the area is well known, which allows to study the effect of construction to the groundwater flow in the area. The hydrogeological environment in the area has been considerably altered by construction, and it has also led to lowering of the groundwater levels. As a result, there are large deformations, especially on the streets and yards. The largest measured deformations are up to 0,5 meters. In addition to the Espoo municipality monitored subsidence of infrastructure, the Finnish Geodetical Institute will provide geodetical SAR images that have been used to track ground level deformations.

The soil investigation data has been processed using a database software suite. A 3D-model of the bedrock contours and soil layers has been compiled in order to model groundwater flow and the distribution of geomechanical and engineering geological properties of the soil. Multi-physical modelling programs will be used to model the deformations. These methods will be used to delineate risk area where major deformation can be achieved. Although the constitutive models of soil deformation have been developed over the years, the calculation models applied are commonly used in practical geotechnical design and are based on a manageable amount of parameters. The use of the simplified models and limited amount of variables is also justified by the scale and the risk-based approach of the study aiming to provide conservative delineation of subsidence risks for land use planning.

Innovating with Impact in the European Union Public Private Partnership Programmes

Petra Turkama, Aalto BIZ

The Center for Knowledge and Innovation Research (CKIR) at Aalto School of Business is an independent, international and multidisciplinary research center focused on innovation and knowledge management at the Aalto University School of Economics. The center was established already 15 years ago in 1999 by leading Finnish companies to promote interdisciplinary research on sustainable, open and human-centric knowledge and innovation networks. The applied research approaches range from organizational, management and social sciences to economic and technical disciplines. CKIR operates solely on external funding from the European Union and Tekes with no co-funding from Aalto University in 2013.

Innovation research is by nature multi-disciplinary, and conducted in collaboration with academia, companies and public sector. Thus the research is for the most part applied, drawing from classical theories and approaches, and combining them in experimental way. The projects are typically organized in short cycles or phases, which make it rewarding for the researchers, and quite fitting for theses work. CKIR has engaged tens of Masters' Level and Doctoral students in the research projects over the years, and regularly scored top scores in the employee satisfaction in Aalto University surveys. The impact of the research and development projects are measured both in epistemic and practical measures. The applied approach typically depends on the problem that the project is set up to solve, and the type of organisations involved.

CKIR is focused on transformative, international and large-scale innovation projects in public-private interface. This involves research on management models, organizational and structural change processes, business models and user-experience. A typical CKIR innovation project starts with a challenge, posted by either public or private sector organization. Project leader then collects together an international consortium to plan the project and the research questions in a way that addresses each stakeholders' needs and concerns. Most CKIR projects involve an ICT component, and thus the funding is applied mostly through the European Union Directorate General 'Connect'.

A representative example of CKIR research is the 5-year Future Internet Public Private Partnership Programme (FI PPP) www.fi-ppp.eu , which is a 600 Million Euro industry lead initiative aimed at developing Future Internet enabled business models, standards, business models and policy recommendations. The FI-PPP vision is to enhance the future competitiveness of Europe's scientific and technology base on ICT, establishing its global leadership, and being a catalyser for the evolution of the EU and other key economies towards the innovation and integration of advanced Internet-based smart services and networked applications that meet societal and industry challenges.

The FI-PPP drives the further integration and harmonisation of the relevant policy, legal, political, standardisation and regulatory frameworks to overcome fragmentation and to develop enabling market conditions related to smart infrastructures markets for the European ICT companies following the Digital Agenda objectives for realizing a European online Digital Single Market (DSM) and European Knowledge Society goals. As a funding instrument, the FI-PPP supports investments in long term cooperation of European industries, in areas of important societal and business challenges. This is ensured by the participation of nearly 200 European companies and

universities, including all major players. In this type of collaboration, effective management and governance of activities, processes and knowledge is the key to success.

The role of Aalto University and CKIR is to design and implement this management structure and processes for the Programme. CKIR coordinates the 6 Million euro 'Facilitation and Support Action', which involves coordinating the work of various management boards and thematic working groups with representatives of the participating companies. The Programme provides CKIR an exceptional platform for experimenting and validating management models and approaches developed in earlier projects and initiatives. It also allows participating researchers to approach the Programme as a phenomena of collaborative cross-disciplinary innovation ecosystem, and study the development of discourses, trust, interactions and conflicts within.

The FI PPP Programme will soon reach its' half-way mark. As a first of its' kind European Union Programme, the past two years have marked a steep learning curve for everyone involved. For CKIR the management of such a massive undertaking has proven even more challenging than expected. Interestingly, the most challenges have not emerged from regulatory or contractual grounds, but rather from cultural and cognitive factors. The main learning for CKIR has been to first identify each participants' motives and objectives as an organization, and thus better understand their position and resistance to certain propositions in the Programme. Also the articulation of shared vision and mission for the Progarmme has proved surprisingly difficult. CKIR has used the metaphor of blind men touching an elephant, and interpreting what it is based on their earlier experiences and assumptions. Thus the collaboration has been started from the very basics of defining goals, the rules of engagement and means to govern and measure activities and outcomes. For CKIR the journey itself is as important a learning experience as the final outcome of the Programme.

Innovation research was a new phenomenon 15 years ago. During the past few years innovation research has matured and specialized significantly. CKIR has followed the trends in the field, and re-defined and further focused its' research agenda on transformative innovations with societal and economic impact. In terms of societal impact CKIR can be proud of tangible results in terms of contributions to National innovation strategies and Tekes' strategic research agendas, as well as added intelligence to numerous public services. In the future CKIR foresees further integration with different faculties within Aalto School of Business, as well as with other groups specialized in innovation research within Aalto University. To this front, CKIR has been actively involved in the Aalto Factories and Energy related Aalto initiatives. In terms of dissemination of knowledge, CKIR still needs to further strengthen and articulate the value proposition it brings to cross-disciplinary initiatives, as well as its' academic output in terms of publications with high impact factors.

Power Management Unit for Future Wearable Electronics

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As the costs of electronic systems continue to shrink, they are becoming more ubiquitous in our everyday lives. The ability for humans to "wear" electronic systems can provide enormous benefits in communication, entertainment, and especially in terms of health care. Wearable electronic systems, for example, have already shown a low-cost solution to monitoring a vast array of physiological data such as heart rate, brain waves, temperature, muscle activity, etc. Wearable electronic systems have also been used for muscle stimulation. Both the monitoring of physiological data and the stimulation of muscles could be coupled into a body-area-network composed of other devices such as pacemakers, glucose sensors, etc. Through an internet-connection, this information could provide real-time health monitoring.

The basic elements required in an wearable electronic system are a power management unit, a microprocessor, sensors, and communication radios. The power management unit typically consists of a battery and DC-DC converters to ensure stable voltage levels for the microprocessor, sensor, and radios. All of these elements must be extremely energy-efficient and be low-cost. Our proposed power management unit includes a new Lithium-ion battery and a state-of-the-art DC-DC converter for an ultra-low-power microprocessor. This paper will discuss the new Li-ion battery, the new DC-DC converter, and show the potential benefits of using them together.

Semiautomatic Characterization of Rock Masses Using Photogrammetry, 3D Printing Technology and Ground Penetrating Radar

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Rock mass characterization is a way to classify rock mass for scientific, ore prospecting or construction purposes. Currently (2013) rock mass characterization is mainly done using traditional empirical methods in Finnish tunnels and mines. More advanced technologies have existed for some time and they have evolved into affordable, robust and easy to use tools. One example of such technology is photogrammetry which uses multiple 2D photographs to calculate a 3D geometry from the rock surface. This geometry can then be used to determine parameters in a safe environment manually, semiautomatic or fully automatically. One of the benefits in the automatic method is removing the subjectivity from the characterization and increasing the reliability of the analysis. Joint roughness and joint surface alteration are important parameters when considering the joint friction and potential risk of falling wedges or rock blocks. The resolution of the photographic technology is not yet sufficient in the sub-millimeter range and form feeler or similar surface replicating apparatus can be used to capture the joint roughness profile. 3D printing technologies enable production of surface replicas which may be used to study the mechanical parameters of the joint or to manufacture a laboratory testing series. Geophysical methods such as ground penetrating radar (GPR) can be used to assist with the rock mass characterization. The GPR is a versatile subsurface imaging method applied in many geological, geophysical and civil engineering applications. The radar emits electromagnetic impulses which reflect from discontinuities such as bedrock surface, rock joints, ground water level or pipes. It is a non-destructive method, so the studied rock mass remains intact. With the GPR, rock joints can be detected and located inside the rock mass. Furthermore, the GPR can be used to characterize the aperture and filling materials of joints as studied lately.

Geodetic VLBI Analysis at Metsähovi Radio Observatory

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In Very Long Baseline Interferometry (VLBI) the amount of data is huge. The data recorded in a geodetic VLBI 24-hour long experiment can reach almost one tera byte. The data is either recorded on a module, which consists of eight hard disks, or is transferred via Internet. In addition to 24-hour sessions also so-called intensive sessions, which have a duration of one hour are measured.

The experiments are coordinated by the International VLBI Service for geodesy and astrometry (IVS). Two of the Earth Orientation Parameters essential for the research conducted are dUT1 and polar motion. dUT1 is the time difference between UT1 time, which is defined by the Earth's rotation, and UTC time, which is defined by atomic clocks. Polar motion is the movement of the Earth's rotational axis across its surface.

Radiometric Determination of the Junction Temperature of an LED

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Overall lifetime of an LED component substantially depends on its junction temperature T_j. It is usually not recommended to drive LEDs at junction temperatures exceeding 125 °C, because heat together with electrical current may damage their structures. In addition, it is difficult to measure the junction temperature directly, because a thermocouple or some other temperature sensor would change the temperature properties of the LED, generally lowering the junction temperature. In assembled luminaires, wires are not accessible, so electrical measurement of T_j is not feasible either. Thus, we have studied the possibility of determining T_j optically from the spectral shape of the LEDs.

The spectra of bulk LEDs are expected to follow the Maxwell-Boltzmann distribution. Temperature affects the high-energy side of the spectral peak, which could in principle be used to derive junction temperatures optically. However, this only works accurately for red AlInGaP LEDs that have thick active layers. With red LEDs, optically derived characteristic temperatures T_c are constantly ~6 K below the measured junction temperatures over a wide temperature range. For blue InGaN LEDs, the Maxwell-Boltzmann distribution does not apply anymore due to their quantum-well structure. [1] However, Vaitonis et al [1] showed that the inaccuracies can be accounted for by calibrating the relationship between the optically derived inverse derivative temperature T_{ID} and the junction temperature T_j. Brody et al [2] repeated the experiment by calculating the T_c's for some color LEDs. They also noted that the T_{ID}'s and T_c's are significantly higher than the actual T_j's except for the red LEDs.

We have studied red, blue and white LEDs [3]. Several specimens of each LED type have been measured to see possible variations due to variations in the layer structures. Although the Maxwell-Boltzmann distribution by itself may not be sufficiently accurate for determining the temperature of the blue quantum well LEDs, we have studied the possibility of calibrating the measurements to enable accurate determination of the junction temperature even with blue and white phosphor LEDs. The white LEDs consist of blue LEDs with a thin phosphor coating that deforms the spectrum, but in general does not significantly affect the high energy tail of the spectrum.

Studied LEDs were extracted from commercial solid state lamps: Philips Masterled lamp, Osram Par 16 lamp, Osram Parathom Classic A60 lamp, and Osram Parathom Classic A80 lamp. The LEDs were mainly kept on their circuit boards, and the circuit boards were rewired to operate the LED specimens individually. The junction temperature - voltage characteristics of the LEDs submerged in an oil bath were determined over a wide temperature range from 303 K to 423 K [4]. The LEDs were set at precisely known temperatures by heating the oil. A short current pulse was

fed to the LED and the forward voltage across the LED was measured. The width of the current pulses used was kept short in order to avoid heating of the LED. Measurements were repeated over various current levels.

We found that the relationships between the junction temperature and the forward voltage vary considerably among LED types, and even between different specimens of the same LED type. The same appears with the relationships between the optically determined inverse derivative temperature and the junction temperature. However, with all of the LEDs studied, the relationships between the temperatures were linear. A linear relationship was also found between the junction temperature and the forward voltage. This implies that four measurements can describe the relationship between the junction temperature and the output spectrum of an LED over the temperature region studied. Measuring the forward voltage of the LED at the preferred current level at two known temperatures calibrates the LED to obtain temperatures from the measured forward voltages. Spectral measurements at two known temperatures further fix the relationship between the optically determined inverse derivative temperature and the junction temperature. Knowing these relationships provides a way of determining the junction temperature of the LED from a measured spectrum.

In the linear relationship between the inverse derivative temperature and the junction temperature, the variation in the slope was less than 5 % among different LED specimens with all the five LED types studied, provided that the current was the same. Only the offset term varied. This may be of use if various samples of a certain LED type are characterized, because it reduces the number of measurements needed to two only. These may be, e.g., a forward voltage measurement at the room temperature using a short current pulse, and a spectral measurement at a known temperature. The latter may be obtained by cooling the emitting LED so that the forward voltage implies the junction temperature to be the ambient temperature previously measured. With the blue and the red LEDs, the effect of current on the slope was less than 2 %. With white LEDs, increasing the current changed the slope systematically by 5 %, indicating probably nonlinear behavior of the phosphor coating.

[1]   Z. Vaitonis, P. Vitta, and A. Žukauskas, "Measurement of the junction temperature in high-power light-emitting diodes from the high-energy wing of the electroluminescence band," J. Appl. Phys., 103, 9, 093110 1–093110 7, May 2008.

[2]   J. Brody, D. Weiss, and P. Young, "Observing the Maxwell Boltzmann distribution in LED emission spectra," Am. J. Phys., 78, 9, 933–935, September 2010.

[3]   A. Vaskuri, P. Kärhä, H. Baumgartner, J. Oksanen, L. Riuttanen, G. Andor, and E. Ikonen, "Radiometric determination of the junction temperature of light-emitting diodes," Proceedings of the CIE conference Paris, April 2013 (Submitted).

[4]   F. Xi, and E. F. Schubert, "Junction-temperature measurement in GaN ultraviolet light-emitting diodes using diode forward voltage method," Appl. Phys. Lett., 85, 12, 2163–2165, September 2004.

Life Cycle Assessment of Different Sponge Nickel Types for Use as Alkaline Hydrogen Fuel Cell Electrodes

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Introduction

Over the past twenty years fuel cell technologies have come to be regarded as one of the most promising alternative power sources due to their potential for high efficiency electricity generation and low environmental impact [1-4]. However, more recently with increasing legislation and enhanced environmental awareness efforts have been made to subject various fuel cell systems and applications to life cycle assessment. These assessments have embraced a wide range of aspects including the systematic development of the necessary tools for life cycle assessment of fuel cell powered vehicles [5]. In addition, such investigations have also concerned themselves with the fundamental question of fuel sources for the next generation of automotive propulsion like biofuels [6] as part of a holistic approach towards the environmental impact of fuel cell technologies. In contrast other researchers have focussed more on specific fuel cell types including SOFC [7], polymer electrolyte membrane, (PEM) [8] and microbial [9]. Alkaline Fuel Cell (AFC) type fuel cells have themselves been the subject of a comprehensive LCA [10] which assessed the impact of including an AFC as part of a combined heat-power (CHP) system.

The aim of this investigation is to carry out a Life Cycle Assessment (LCA) of gas atomized (GA) sponge nickel catalysts and evaluate their performance as fuel cell electrodes against both cast and crush (CC) sponge nickel and platinum. The purpose is to determine whether laboratory scale increases in catalytic activity/performance observed could lead to any significant environmental improvements over the standard platinum electrode.

Methods

 A comparative LCA has been made, accounting for the energy used and emissions throughout the entire life cycle of sponge nickel catalysts - ranging from the upstream production of materials (mainly aluminium and nickel), to the manufacturing, operation and final recycling and disposal. The primary focus was on comparing catalysts for equivalent greenhouse gases generated over their lifetime and their relative global warming potential (GWP), and acidification potential (AP).

Results and discussion

To achieve comparative performance levels, the electrode for the AFC requires different amounts of platinum and Raney nickel catalyst of 0.4g and 1.5g, respectively. Using data from the raw materials and manufacturing process it is possible to calculate the total energy of production for the

different electrode materials. It was determined from the analysis that platinum mining and electrode fabrication has by far the largest energy demand requiring an estimated total calorific energy of 9.3 MJ cf. 1.25 MJ for GA sponge nickel and 0.45 MJ for CC produced sponge nickel. These differing levels energy consumption result in differing Global Warming Potentials (GWP) varying from 0.84 kg CO2-Equivalents for platinum to 0.06 kg CO2-Equivalents for CC sponge nickel.

It was found that the energy and emissions during the operation phase associated with a given catalyst significantly outweigh the primary production, manufacturing and recycling. Primary production of the nickel also has a significant environmental impact in terms of acidification potential but this is offset by operational energy savings over the electrode's estimated lifetime and end of life recyclability.

Finally the impact of activity improvement and lifetime duration of sponge nickel catalysts was determined as both total life cycle energy for operational use with three different hydrogen sources (namely steam reformation, hydrocarbon cracking and electrolysis) and as entire lifecycle energies - Gross Energy Requirement, GER - and emissions - Global Warming Potential, GWP and Acidification Potential, AP.

 Conclusions

It can be concluded that although the production of 1kg of sponge nickel catalyst by a Gas Atomization (GA) route requires only 13.5% of the energy cf. that of the production of 1 kg of platinum. GA sponge nickel offers a comparable catalytic activity and it is this activity level that offers the potential for a reduction of the overall energy consumption, and a significant decrease in greenhouse gas emissions of the fuel cell over the complete lifetime when compared to platinum.

[1] F. Alcaide, P-L Cabot, E. Brillas, J. Power Sources 153 (2006) 47-60.
[2] F. Bidalt, D. J. L. Brett, P. H. Middleton, N. P. Brandon, J. Power Sources 187 (2009) 39-48.
[3] J. Ma, N. A. Choudhury, Y. Sahai Y, Renewable and Sustainable Energy Reviews 14 (2010) 183-199.
[4] C-Y Liu, C-C Sung, J. Power Sources 220 (2012) 348-353.
[5] J. F. Contadini, R. M. Moore, P. L. Mokhtarian, Int. J. LCA 7 (2002) 73 -84.
[6] S. González-García, D. García-Rey, A. Hospido, Int. J. LCA 18 (2013) 61-76.
[7] V. Karakoussis, N. P. Brandon, A. Leach, M. Leach, R. van der Vorst, J. Power Sources 101 (2001)10 -26.
[8] I. Dincer, M. A. Rosen, Energy for Sustainable Development 15 (2011) 137-146.
[9] J. M. Foley, R. A. Rozendal, C. K. Hertle, P. A. Lant, K. Rabaey, Environ. Sci. Technol., 44 (2010) 3629-3637.
[10] I. Staffell, A. Ingram, Int. J. Hydrogen Energy 35 (2010) 2491-2505.

Smart Materials for Drug Delivery Applications

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Introduction

The development of the next generation drugs is aiming to precise targeting and timing of the drug release in an effort to reduce the side effects and increase the drug efficiency. However, from the moment when the drug enters the human body to the moment when the drug has found the right target and can be activated, i.e. during the drug delivery, there are several problems to be overcome. In general, the drug has 1) to be stable until the right target has been found, 2) to overcome several biological barriers and 3) to be activated in the right place at the right time.

One idea is to use smart drug carriers, which - in addition to carrying the drug inside the body – are modified to protect and target the drug. Ideal drug carriers would also help in internalization of the drug into the cell and in timing the drug release.

Summarising, the drug carrier should perform in such a way that the drug will be released only at the right location and at the right time scale. However, despite of decades of efforts by scientific community, the complexity of the drug delivery remains still as a major challenge.

Recently, smart materials –i.e. materials which can react in a controlled way to the changes in their immediate surroundings – have caused increased interest in the fields of material science, pharmaceutics, chemistry and medicine. Especially, polyelectrolyte covered nanocontainers have been suggested for controlled drug release purposes [1-3].

Polyelectrolytes are polymers which contain ionised functional groups in water solutions: the conformation of weak polyelectrolytes is strongly dependent on the degree of ionization which, in turn, can be controlled by pH and ionic strength.[4] Thus, nanocontainers covered by weak polyelectrolyte shell are promising candidates for drug carriers as changing the pH or ionic strength of the surroundings changes also the polyelectrolyte conformation, and this in turn, changes permeability of the shell, resulting in controlled drug release. Groups of Möhwald and Shchukin [5], for example have deposited oppositely charged polyelectrolytes on mesoporous SiO_2 or TiO_2 particles by layer-by-layer (LbL) technique and studied the release properties of the containers.

In this communication, the LbL method is utilised to deposit polyelectrolytes on nanosized particles and the transport properties through the polyelectrolyte multilayers are studied, the latter being an extremely important fact for drug release properties.

Experimental

Cationic polyelectrolyte - poly(allylamine hydrochloride) (PAH, Sigma-Aldrich, p.a) - and anionic polyelectrolyte - poly(styrene sulfonic acid) (PSS, Sigma-Aldrich, p.a.) – were deposited on metal nanoparticles (Ag, Au or Fe) [5].

The effect of pH on the polyelectrolyte covered nanoparticles was analysed by zetasizer (Nanoseries, Malvern Inc.) and the transport through the polyelectrolyte multilayers as a function of pH was studied by the means of rotating disc electrode (RDE, Autolab) and scanning electrochemical microscope (SECM, CHI Potentiostat, CHI Instruments).

Results

Zetapotential of the polyelectrolyte covered Fe based nanoparticles was measured after each layer deposition and it was observed that zetapotential alternates between positive and negative values for cationic and anionic polyelectrolyte layers, respectively. This proves the formation of polyelectrolyte multilayers on the nanoparticle surfaces.

The SECM measurements, on the other hand, show that the transport properties of the polyelectrolyte multilayers can be controlled by pH. When the layer is exposed to the physiological pH = 7.4, the current due to the redox probe transported through the layer is smaller than when the multilayer is exposed to pH = 5.5, demonstrating that the permeability of the layer can be tuned by the biologically meaningful pH values. This is an important fact when designing the new drug carriers as the degree of the drug release has to be rightly timed and quantified in biological pH values. The transport was also studied with a different redox probe by RDE set-up and the results indicate the pH dependence of the multilayer permeability.

Conclusions

If successful, polyelectrolyte covered nanocontainers could be used for targeted, time controlled drug release and as such, they would be a big breakthrough in the field of drug delivery. However, for designing the correct type polyelectrolyte shell, the fundamental concepts of such carriers need to be studied. In this study, the formation and permeability of PAH/PSS covered nanoparticles were studied and the pH dependency of the layers was tuned to the biologically meaningful pH values.

[1] M. Delcea, H. Möhwald, A.G. Skirtach, Stimuli-responsive LbL capsules and nanoshells for drug delivery, Adv. Drug Deliv. Rev. 63 (2011) 730-747.

[2] Y. Liu, J. Yang, Z. Zhao, J. Li, R. Zhang, F. Yao, Formation and characterization of natural polysaccharide hollow nanocapsules via template layer-by-layer self-assembly, J. Colloid Interface Sci. 379 (2012) 130-140.

[3] D.G. Shchukin, H. Mohwald, Smart nanocontainers as depot media for feedback active coatings, Chem.Commun. 47 (2011) 8730-8739.

[4] H. Dautzenberg, W. Jaeger, J. Kötz, B. Philipp, C. Seidel, D. Stscherbina, Polyelectrolytes: formation, characterization and application, Carl Hanser Verlag, Münich, 1994.

[5] D. Shchukin, H. Möhwald, Self-Repairing Coatings Containing Active Nanoreservoirs, Small 3 (2007) 926-943.

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