Program

ACCESS PhD Student and Post-Doc Workshop 2012

KTH Royal Institute of Technology
Stockholm, Sweden
6 September, 2012

Agenda

10:00	Registration
10:30	Welcome by Workshop Organizers
10:40	Overview of ACCESS by Karl Henrik Johansson
11:00	Keynote Speech by David Zhao from Skype
12:00	Lunch
13:00	Group Session 1 (Warm-up and Introduction)
13:45	Break
14:00	Group Session 2 (Research Problems)
15:00	Coffee Break
15:30	Group Session 3 (Applications)
17:00	Break
17:15	Plenary Session (Presentation of Results)
18:00	Poster Session 1
18:45	Poster Session 2
19:30	Dinner

Contents

Morning Session

10:30 – 10:40 Welcome by Workshop Organizers

10:40 – 11:00 Introduction

A Short Overview of ACCESS

Karl H. Johansson
Director of the ACCESS Linnaeus Centre (KTH, Sweden)

11:00 – 11:45 Key Note

Collaboration in Agile Development – A Skype Perspective

David Zhao
Principal Software Development Engineer at Microsoft, Skype Division

Founded in 2003 and used today in 25% of international calls, Skype is a great example of how technological innovation has rapidly changed the world. This talk will take you behind the scenes on how Skype has been developed in the agile way, and from Skype's perspective, how collaboration has contributed largely to the success.

David Zhao received his M.Sc. degree in Information Technology Engineering from Uppsala University, Sweden, in 2003, and his Ph.D. degree in Telecommunications from the Sound and Image Processing Lab at the School of Electrical Engineering, KTH Royal Institute of Technology, Sweden, in 2007. He is now a principal software development engineer at the Skype division of Microsoft. Dr. Zhao received the student paper award on IEEE ICASSP 2006 and a Skype Hero Award in 2011.

Group Sessions

Participants work in six groups on different topics. The group you have been assigned to is shown on your nametag and in the list of participants on page 24. Signposts will guide you to your room.

13:00 – 13:45 Warm-Up and Introduction

The session starts with an introduction to the group topic by one of the group members (10–15 minutes).

Then, each group member has 5 minutes to introduce themselves and their research topic in perspective to the group topic.

14:00 – 15:00 Research Problems

The group members identify open research problems connected to the group topic. These problems should be selected so as to be of interest to most members of the group, and solutions to these problems must be eventually found in cooperation between group members.

Describe the research problems and motivate their relevance. Sketch possible methods of finding solutions. Identify a time-line and distribute tasks among the group members.

15:30 – 17:00 Applications and Presentation

The group members identify possible applications in the fields related to the group topic. If possible, the application should benefit from the research planned in the previous session.

Describe the applications and their potential. Discuss how the applications can be developed in cooperation between group members. Assess the feasibility of the applications and identify difficulties in their implementation.

Prepare a 5 minutes presentation for the subsequent plenary session. Include results from all group sessions. You may use powerpoint slides or other presentation tools available in the plenary room.

Poster Sessions

The posters have been divided into two sessions, to facilitate participants to view posters as well. Please attend to your poster during the session assigned to you. Poster numbers can be used to locate a poster.

18:00 – 18:45 Poster Session 1

#	Submitting Author	Title
1	Assad Alam	Suboptimal Decentralized Controller Design for Chain Structures: Applications to Vehicle Formations
2	Martin Andreasson	Distributed Integral Action
3	Mariette Annergren	An ADMM Algorithm for Solving l_1 Regularized MPC
4	Jose Araujo	An Improved Self-Triggered Implementation for Linear Controllers
5	Musard Balliu	ENCOVER: Symbolic Exploration for Information Flow Security
6	Emil Björnson	Optimal Resource Allocation in Coordinated Multi-Cell Systems
7	Oleksandr Bodriagov	Encryption for Peer-to-Peer Social Networks
8	Rasmus Brandt	Coordinated Beamforming Performance in a Measured Indoor MIMO Network
9	Piergiuseppe Di Marco	Delay Distribution Analysis of Wireless Personal Area Networks
10	Jinfeng Du	Short-Message Noisy Network Coding with Source Cooperation
11	Satyam Dwivedi	UWB Positioning and Communication Systems.
12	Niklas Everitt	Asymptotic Variance Errors for Cascaded Systems
13	Hamed Farhadi	Power Control in Wireless Interference Networks with Limited Feedback
14	Farhad Farokhi	On the Value of Model Information in Decentralized Control Design
15	Oscar Flärdh	Optimal Air Path Control during Load Transients on an SI Engine with VGT and VVT
16	Euhanna Ghadimi	A Metric for Opportunistic Routing in Duty Cycled Wireless Sensor Networks
17	Ioannis Glaropoulos	WLAN Channel Occupancy Modeling and Validation
18	Antonio Gonga	Multi-Channel Communications vs. Adaptive Routing for Reliable Communication in WSNs
19	Benjamin Greschbach	Privacy in Social Network Services
20	Per Hägg	Generation of Excitation Signals with Prescribed Autocorrelation for Input and Output Constrained Systems
21	Erik Henriksson	Self-Triggered Model Predictive Control for Network Scheduling and Control
22	Lirong Huang	Adaptive Experiment Design for ARMAX systems
23	Nicolas Innocenti	Compressed Sensing for Metagenomics
24	Martin Jakobsson	Extensions of Fast-Lipschitz Optimization for Convex and Non-convex Problems
25	Dimitrios Katselis	A Chernoff Convexification for Chance Constrained MIMO Training Sequence Design
26	Kittipong Kittichokechai	Secure Source Coding with Action-dependent Side Information
27	Jeffrey Larson	Increasing Hydrogen Production in Chlamydomonas reinhardtii using Derivative-free Optimization
28	Kuo-Yun Liang	Route optimization with respect to platooning and topography
29	Du Liu	Video Coding with Adaptive Motion-Compensated Orthogonal Transforms
30	Jie Lu	Control of Distributed Convex Optimization

18:45 – 19:30 Poster Session 2

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31	Andreas Lundblad	A Tree Automaton Based Approach for Enforcing Direct Data Flow Policies
32	Klas Magnusson	Segmentation and tracking of cells
33	Samer Medawar	Analog-Digital Converters Calibration
34	Farshad Naghibi	Distributed Source Coding under Adversarial Attacks
35	Nima Najari Moghadam	Correlation of Distortion Noise Between the Branches of MIMO Transmit Antennas
36	Senay Negusse	Joint Estimation of Channel and Phase Noise in OFDM
37	John-Olof Nilsson	OpenShoe – Foot-mounted INS for every foot
38	Valentino Pacifici	Graphical Replication Games as a Model of Content Peering in CCNs
39	Chithrupa Ramesh	Stability Analysis of Multiple State-based Schedulers
40	Pravin Kumar Rana	Depth Pixel Clustering for Consistency Testing of Multiview Depth
41	Guillermo Rodríguez Cano	Modeling Online Social Networks
42	Nicolas Schrammar	Physical Layer Security in Wireless Networks
43	Oliver Schwarz	Verifying a Security Hypervisor
44	Oliver Schwarz	DMA virtualization
45	Nafiseh Shariati	On Robust Training Sequence Design for Correlated MIMO Channel Estimation
46	Guodong Shi	When Do Gossip Algorithms Converge in Finite Time
47	Kin Cheong Sou	An Exact Solution to the Power Networks Security Index Problem and its Generalized Min Cut Formulation
48	Mohammad Sadegh Talebi	Non-Convex Rate Allocation for Streaming Traffic via Sequential Convex Programming
49	Efthymios Tsakonas	Maximum Likelihood based Sparse and Distributed Conjoint Analysis
50	Misbah Uddin	Network Search
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53	Damiano Varagnolo	Distributed estimation of diameter, radius and eccentricities in anonymous networks
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55	Liping Wang	Cooperate or not: the secondary relay's dilemma in spectrum sharing networks
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58	Rerngvit Yanggratoke	Predicting Response Times for the Spotify Backend
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60	Efrain Zenteno	Digital Predistortion of a Multi-carrier Satellite Link

See the following pages for poster abstracts.

Abstracts of Posters

Poster Session 1

1 – Suboptimal Decentralized Controller Design for Chain Structures: Applications to Vehicle Formations

Assad Al Alam, Ather Gattami, and Karl H. Johansson

The traffic intensity is escalating in most parts of the world, making traffic congestion a growing issue. In parallel, the demand for transportation services is increasing. Vehicle platoons, convoys, have become an active research area to address these issues. A 4.7-7.7% fuel reduction can be obtained by utilizing the air drag reduction that occurs when driving HDVs closely spaced. However, a decentralized control strategy is crucial for practical implementation.

2 – Distributed Integral Action

Martin Andreasson, Henrik Sandberg, Dimos V. Dimarogonas and Karl H. Johansson

This paper analyzes distributed proportional-integral controllers. We prove that integral action can be successfully applied to consensus algorithms, where attenuation of static disturbances is achieved. These control algorithms are applied to decentralized frequency control of electrical power systems. We show that the proposed algorithm can attenuate step disturbances of power loads. We provide simulations of the proposed control algorithm on the IEEE 30 bus test system that demonstrate its efficiency.

3 – An ADMM Algorithm for Solving l_1 Regularized MPC

Mariette Annergren, Anders Hansson, and Bo Wahlberg

We present an Alternating Direction Method of Multipliers (ADMM) algorithm for solving optimization problems with an l_1 regularized least-squares cost function subject to recursive equality constraints. The optimization problem has applications in control, such as l_1 regularized MPC,

4 – An Improved Self-Triggered Implementation for Linear Controllers

José Araújo, Hamza Fawzi, Manuel Mazo Jr., Paulo Tabuada,
and Karl Henrik Johansson

Research in networked control systems raised the importance of understanding what are the timing requirements for control. In recent years this problem has been attacked from multiple angles including the computation of Maximal Allowable Transmission Intervals, event-triggered, and self-triggered controller implementations. In a self-triggered implementation the controller is responsible for computing the next time instant at which the actuator values should be updated by evaluating the control law on fresh sensor measurements. One of the main challenges in self-triggered control is how to perform the exact calculation of the time at which these updates should take place. In this paper we present a new technique to compute lower bounds on the self-triggered update times in a computationally light manner. We evaluate the algorithm on numerical examples and we observe that the algorithm performs well when compared to other existing methods and provides tight lower bounds on the exact update times. Additionally, we propose a Semidefinite Programming-based technique that produces triggering conditions that are less conservative than the existing ones and for which the update times are larger.

5 – ENCOVER: Symbolic Exploration for Information Flow Security

Musard Balliu, Mads Dam, and Gurvan Le Guernic

Epistemic temporal logic is a well-established framework for expressing agents knowledge and how it evolves over time. Within language-based security these are central issues, for instance in the context of declassification. We propose to bring these two areas together. First we present a computational model and an epistemic temporal logic used to reason about knowledge acquired by observing program outputs. This approach is shown to elegantly capture standard notions of noninterference and declassification in the literature as well as information flow properties where sensitive and public data intermingle in delicate ways.

Second we address the problem of program verification for information flow policies by means of symbolic execution and model checking. We show how the policies can be accurately verified using a combination of concolic testing and SMT solving. As we demonstrate, many scenarios considered tricky in the literature can be solved precisely using the proposed approach. This is confirmed by experiments performed with ENCOVER, a tool based on Java PathFinder and Z3, which we have developed for epistemic noninterference concolic verification.

6 – Optimal Resource Allocation in Coordinated Multi-Cell Systems

Emil Björnson and Eduard Jorswieck

The use of multiple antennas at base stations is a key component in the design of cellular communication systems that can meet high capacity demands. The downlink transmission from base stations to users is particularly limiting, both from a theoretical and a practical perspective. The performance of these multi-cell systems depends on how the available time, power, frequency, and spatial resources are divided among the users, which is known as resource allocation. The interdependence between these design parameters and the system performance is complicated, but the throughput, user satisfaction, and revenue can be greatly improved if we understand the nature of resource allocation and how to optimize it for high spectral efficiency. This poster provides an outline of the tutorial "Optimal Resource Allocation in Coordinated Multi-Cell Systems" that is currently under review for publication in Foundations and Trends in Communications and Information Theory. This monograph provides the fundamentals of resource allocation in multi-cell systems, along with recent advances in signal processing that enable robustness to channel uncertainty, distributed optimization, and mitigation of transceiver impairments.

7 – Encryption for Peer-to-Peer Social Networks

Oleksandr Bodriagov

Peer-to-peer (P2P) online social networks do not rely on centralized storage of user data. Data can be stored not only on a profile owner's computer but almost anywhere. Because external storage is often untrusted or only semi-trusted, encryption plays a fundamental role in the security of P2P social networks. Encryption adds some overhead in both the time and space domains. To be scalable, a system that relies heavily on encryption should use as efficient algorithms as possible. It also needs to provide the functionality of changing access rights at reasonable cost, and it has to protect information about users' access rights and mitigate traffic analysis threats.

Current P2P architectures for social networks either rely on trust, require constantly running servers for each user, use expensive encryption, or fail to protect the privacy of access information. In a search for solutions we found that some broadcast encryption (BE) and predicate encryption (PE) schemes exhibit several desirable properties.

If encryption /decryption operations take reasonable time (usability perspective), then the corresponding scheme should be considered as a suitable candidate. Eventually, the aim is to describe how typical operations of social networks are performed in the decentralized setting using a PE or a BE scheme and simulate these operations.

8 – Coordinated Beamforming Performance in a Measured Indoor MIMO Network

Rasmus Brandt, Per Zetterberg, and Mats Bengtsson

Coordinated beamforming is a promising technique for improving performance in interference-limited MIMO communication networks. In this work, we use recently obtained measurement data of an indoor scenario for performance evaluation of coordinated beamforming. An 8-by-8 MIMO channel was measured in an office building over a bandwidth of 18 MHz at a 2.7 GHz carrier frequency. Two emulated multiuser settings are investigated, where the channels are drawn from the measured data set. The results show a significant benefit of coordinated beamforming over traditional approaches. Furthermore, the results indicate a minor performance increase by performing space-frequency precoding, as opposed to forming independent precoders over the subcarriers.

9 – Delay Distribution Analysis of Wireless Personal Area Networks

Piergiuseppe Di Marco, Pangun Park, Carlo Fischione, and Karl Henrik Johansson

Characterizing the network delay distribution is a fundamental step to properly compensate the delay of Networked Control Systems (NCSs). Due to the random backoff mechanism employed by Wireless Personal Area Network (WPAN) protocols, it is difficult to derive such a distribution. Our analysis uses a moment generating function method based on a Markov chain model that gives an accurate explicit expression of the delay distribution. We show that the probability distribution of the delay is significantly different from existing network models used for NCS design. Furthermore, the communication protocol parameters result to be critical for the stability of control systems.

10 – Short-Message Noisy Network Coding with Source Cooperation

Jinfeng Du, Ming Xiao, Mikael Skoglund, and Shlomo Shamai (Shitz)

Short-message noisy network coding (SNNC) has been proved to achieve the same rate region as NNC for independent sources but with significantly reduced encoding delay and decoding complexity. In this paper, we show that when partial cooperation between source nodes is possible, by performing rate-splitting, message exchange, and superposition coding at the source nodes, SNNC can achieve a strictly larger rate region than NNC. The gain comes from coherent combining at receiving nodes.

11 – UWB Positioning and Communication Systems.

Alessio De Angelis, Satyam Dwivedi, Vijaya Yajnanarayana, and Peter Händel

Our poster will demonstrate the ongoing work on Ultra wideband (UWB) systems in the group. The work involves hardware development of UWB node and its application in indoor positioning and communication. We have in house developed UWB node with ranging capability around 15 meters and accurary upto 30 cm. We have developed a cooperative positioning scheme by scheduled pulse transmissions in the network. This scheme avoids usage of any broadcast for cooperation. This scheme can provide high update rate with minimal hardware. We are developing a methodology to estimate clock error between two nodes, suppose to be running on same clock frequency. We have recently started investigation in using the in house nodes as high data reta communication device.

12 – Asymptotic Variance Errors for Cascaded Systems

Niklas Everitt, Håkan Hjalmarsson, and Cristian Rojas

This work is part of an ongoing effort to quantify variance errors in the estimation of frequency response functions for interconnected dynamical systems. The identification problem considered here is the quantification of variance errors when the systems are in a cascaded structure. We present some results on the asymptotic covariance of an estimated frequency function of the first system in a setting of two cascaded dynamical systems and illustrate by a small example. The true systems considered are restricted to discrete time LTI system with FIR structure, where the first system has a zero on the unit circle.

13 – Power Control in Wireless Interference Networks with Limited Feedback

Hamed Farhadi, Chao Wang, and Mikael Skoglund

In this poster we present a power control technique for a wireless time-varying K-user interference network. Each transmitter intends to communicate to its desired receiver at a fixed rate. Quantized channel gains are globally available through limited feedback signals. To eliminate multi-user interference, interference alignment scheme is performed based on the imperfect channel knowledge. The communication quality is affected by the channel quantization errors and interference leakage.We propose a power control algorithm, aiming to guarantee successful transmissions of each user while minimizing the transmission power of the network. Our results show that even with limited number of feedback bits, by performing power control the considered interference alignment scheme can outperform the conventional time-division-multiple-access scheme.

14 – On the Value of Model Information in Decentralized Control Design

Farhad Farokhi, Cedric Langbort, and Karl H. Johansson

We introduce the family of limited model information control design methods, which construct controllers by accessing the plant's model in a constrained way, according to a given design graph. We investigate the closed-loop performance achievable by such control design methods for fully-actuated discrete time linear time-invariant systems, under a separable quadratic cost. We restrict our study to control design methods with structured static state feedback controllers, where each subsystem's controller can access at least the state measurement of those subsystems that can affect its corresponding subsystem. We find the optimal control design strategy (in terms of the competitive ratio and domination metrics) when the control designer has access to the local model information and the global interconnection structure of the plant-to-be-controlled. At last, we study the trade-off between the amount of model information exploited by a control design method and the best closed-loop performance (in terms of the competitive ratio) of controllers it can produce.

15 – Optimal Air Path Control during Load Transients on an SI Engine with VGT and VVT

Oscar Flärdh, Jonas Mårtensson

In recent years, the aim to reduce fuel consumption has been the main goal for the automotive industry. Downsizing is a promising way to achieve this which has shown success. Downsized, turbocharged engines do however suffer from slow transient torque response. This slow response is due to the slow dynamics of the turbocharger. This paper investigates the torque response of an si engine with vvt and vvt. Optimal open loop trajectories for the overlap and the vgt position for a fast transient response are found. This optimization is based on a one-dimensional simulation model. Based on this optimization, a generic feedback strategy for controlling the vgt is found. This strategy is implemented and evaluated on an engine and shows good performance.

16 – A Metric for Opportunistic Routing in Duty Cycled Wireless Sensor Networks

Euhanna Ghadimi, Olaf Landsiedel, Pablo Soldati, and Mikael Johansson

Opportunistic routing is widely known to have substantially better performance than traditional unicast routing in wireless networks with lossy links. However, wireless sensor networks are heavily duty-cycled, i.e. they frequently enter deep sleep states to ensure long network life-time. This renders existing opportunistic routing schemes impractical, as they assume that nodes are always awake and can overhear other transmissions. In this work, we introduce a novel opportunistic routing metric that takes duty cycling into account. Analytical performance modeling and simulations show that our routing scheme results in significantly reduced delay and improved energy efficiency compared to traditional unicast routing.

17 – WLAN Channel Occupancy Modeling and Validation

Ioannis Glaropoulos, Viktoria Fodor, Alexandre Vizcaino Luna, and Maria Papadopouli

Efficient WSN communication in the ISM band under WLAN coexistence requires the sensor network be aware of the WLAN channel occupancy model, in order to adapt is communication protocols accordingly. In this work we aim at investigating whether a previously proposed WLAN occupancy model can accurately describe the active and idle period durations in real WLAN cases; for that we consider a measurement-based multi-layer traffic workload model of a campus-wide WLAN. Extensive simulation results indicate that the proposed model sufficiently captures the behaviour of the WLAN channel occupancy and can, therefore, be considered for developing cognitive WSN access protocols, that are based on channel usage prediction.

18 – Multi-Channel Communications vs. Adaptive Routing for Reliable Communication in WSNs

Antonio Gonga, Olaf Landsiedel, Pablo Soldati, and Mikael Johansson

Interference and link dynamics degrade sensor network protocol performance. We evaluate and compare two alternatives for mitigating these effects: channel-hopping and adaptive routing. Side-by-side comparisons of per-link burst losses and end-to-end delay and reliability highlight strengths and weaknesses of the approaches.

19 – Privacy in Social Network Services

Benjamin Greschbach

Today's popular Social Network Services (SNS), such as Facebook or Twitter, have an infamous history of privacy breaches. The massive accumulation of private user data at one single provider is prone to leakages and misuse, constituting a major threat to the users' privacy. Decentralized Online Social Networks (DOSN) are evolving as a promising approach to mitigate this design-inherent privacy flaw of the logically centralized services. When decentralizing the system, however, new challenges to protect the users' privacy arise. We analyze adversary models for these systems and the privacy threat arising from metadata of content storage, access control mechanisms and communication flows.

20 – Generation of Excitation Signals with Prescribed Autocorrelation for Input and Output Constrained Systems

Christian Larsson and Per Hägg

This paper considers the problem of realizing an input signal with a desired autocorrelation sequence satisfying both input and output constraints for the system it is to be applied to. This is a important problem in system identification, firstly, the properties of the identified model is highly dependent on the used excitation signal during the experiment and secondly, on real processes, due to actuator saturation and safety considerations, it is important to constraint the input and output from the process. The proposed method corresponds to a nonlinear model predictive control problem. In general this corresponds to solving a non-convex optimization problem. Here we show how this can be solved in one particular case. For this special case convergence is established for generation of pseudo-white noise. The performance of the algorithm is successfully verified by simulations for a few different autocorrelation sequences, with and without input and output constraints.

21 – Self-Triggered Model Predictive Control for Network Scheduling and Control

Erik Henriksson, Daniel E. Quevedo, Henrik Sandberg, and Karl Henrik Johansson

We present an algorithm for controlling processes using an adaptive sampling interval where the controller at every sampling instant not only computes the new control command but also decides the time interval to the next sample. The approach relies on MPC where the cost function depends on the control performance as well as the cost for sampling. Methods for synthesizing this predictive controller are given and it is shown to be stabilizing under mild assumptions. The resulting optimization problem may be solved off-line and the controller may be implemented as a lookup table of state feedback gains. Simulation results show that the presented control law may help reducing the required amount of communication.

22 – Adaptive Experiment Design for ARMAX systems

Lirong Huang, Håkan Hjalmarsson, Laszlo Gerencser

A key problem in optimal input design is that the optimal input depends on some unknown system parameters that are to be identified. Adaptive design is one of the fundamental routes to handle this problem. This paper proposes an adaptive input design method for ARMAX systems based on the general stochastic framework outlined in a reference.

23 – Compressed Sensing for Metagenomics

N. Innocenti, S. Dong, S. Chatterjee, and E. Aurell

A common problem in metagenomics is Bacterial Community Reconstruction (BCR), targeting the identification of bacterial species present in a sample together with their respective frequencies. Usually, this identification is carried on trough sequencing of the 16s ribosomal RNA gene. Compressed Sensing (CS) targets the reconstruction of sparse solutions to underdetermined systems of equations. Sparsity appears naturally in BCR because the number of species in any studied sample (a few tens or hundreds) is always small compared to the number of species for which the 16S rRNA sequence is known (tens of thousands), or ultimately compared to the number of bacterial species on earth. Very accurate methods based on bayesian learning exist to solve the BCR problem, but are very expensive in term of computing time. The aim of the project is to design novel algorithm for BCR based on methods used in CS that will be extremely fast, possibly at the cost of a slightly lower accuracy.

24 – Extensions of Fast-Lipschitz Optimization for Convex and Non-convex Problems

Martin Jakobsson and Carlo Fischione

The recently proposed framework of Fast-Lipschitz (FL) optimization offers a computationally simple and easily distributed way to solve certain problems with monotonic cost function and contractive constraints. Problems are assured to have these qualities through sets of Qualifying Conditions. This work presents an extension of the Qualifying Conditions, so that more problems can be solved with the FL framework. The ideas are illustrated by solving a simple (but non-convex) problem.

25 – A Chernoff Convexification for Chance Constrained MIMO Training Sequence Design

Dimitrios Katselis, Cristian R. Rojas, Håkan Hjalmarsson, and Mats Bengtsson

In this paper, multiple input multiple output (MIMO) channel estimation formulated as a chance constrained problem is investigated. The chance constraint is based on the presumption that the estimated channel can be used in an application to achieve a given performance level with a prescribed probability. The aforementioned performance level is dictated by the particular application of interest. The resulting optimization problem is known to be nonconvex in most cases. To this end, convexification is attempted by employing a Chernoff inequality. As an application, we focus on the estimation of MIMO wireless channels based on a general L-optimality type of performance measure.

26 – Secure Source Coding with Action-dependent Side Information

Kittipong Kittichokechai, Yeow Khiang Chia, Tsachy Weissman, Tobias J. Oechtering, and Mikael Skoglund

We consider a secure lossy source coding problem with the presence of a passive eavesdropper who has access to the public part of the source description. An encoder wants to compress the source in such a way that the intended decoder can reconstruct the source sequence and satisfy a distortion criterion, while revealing only limited knowledge about the source to the eavesdropper. In our system an action sequence is generated based on the public source description with some costs to influence the side information available to the intended decoder and the eavesdropper. We provide a complete characterization of the rate-distortion-cost-equivocation region for a discrete source with correlated action-dependent side information at the decoders. The result serves as a fundamental limit for example in secure sensor networking. Potential extension to the case of randomized action encoder is also discussed.

27 – Increasing Hydrogen Production in Chlamydomonas reinhardtii using Derivative-free Optimization

Jeffrey Larson

Chlamydomonas reinhardtii is a single cell algae which produces hydrogen instead of oxygen under certain conditions. Researchers, using computer simulations of the organism's metabolic pathway, attempt to maximizing the amount of hydrogen produced in hopes of creating a viable source of clean energy. This poster presents information on Chlamydomonas reinhardtii and outlines an algorithm to optimize simulations, for example, code used to model this algae.

28 – Route optimization with respect to platooning and topography

Kuo-Yun Liang, Karl Henrik Johansson, and Jonas Mårtensson

Closely related to the increasing wealth of the world is the increasing demand for road transport, which leads to increased fuel consumption and greenhouse emissions. The project aims to develop a framework, which can be used for long haulage planning, to be able to predict and simulate the most optimal route with regards to fuel efficiency and time constraints. The framework is currently at an early phase.

29 – Video Coding with Adaptive Motion-Compensated Orthogonal Transforms

Du Liu and Markus Flierl

Well-known standard hybrid coding techniques utilize the concept of motion-compensated predictive coding in a closed-loop. The resulting coding dependencies are a major challenge for packet-based networks like the Internet. On the other hand, subband coding techniques avoid the dependencies of predictive coding and are able to generate video streams that better match packet-based networks. An interesting class for subband coding is the so-called motion-compensated orthogonal transform. It generates orthogonal subband coefficients for arbitrary underlying motion fields. In this paper, a theoretical signal model based on Gaussian distributions is discussed to construct a cost function for efficient rate allocation. Additionally, a rate-distortion efficient video coding scheme is developed that takes advantage of motion-compensated orthogonal transforms. The scheme combines multiple types of motion-compensated orthogonal transforms, variable block sizes, and half-pel accurate motion compensation. The experimental results show that this adaptive scheme outperforms individual motion-compensated orthogonal transforms by up to 2 dB.

30 – Control of Distributed Convex Optimization

Jie Lu

This poster presents an efficient distributed asynchronous algorithm for solving a class of unconstrained convex optimization problems over wireless networks. The algorithm, referred to as Controlled Hopwise Equalizing (CHE), attempts to make the most out of each iteration by fully exploiting the broadcast nature of wireless medium and incorporating decentralized feedback control of when to initiate an iteration. The latter feature, enabled by a common Lyapunov function constructed based on the first-order convexity condition, is novel among existing schemes and represents a new way to apply Lyapunov stability theory. Via extensive simulation on wirelessly connected random geometric graphs, it is shown that CHE is significantly more efficient than several existing subgradient algorithms, in the sense that it requires far less communications to solve the problem.

Poster Session 2

31 – A Tree Automaton Based Approach for Enforcing Direct Data Flow Policies

Mads Dam, Gurvan Le Guernic, and Andreas Lundblad

Current approaches to security policy monitoring are based on linear control flow constraints such as "'runQuery' may be evaluated only after 'sanitize'". However, realistic security policies must be able to conveniently capture data flow constraints as well. An example is a policy stating that "arguments to the function 'runQuery' must be either constants, outputs of a function 'sanitize', or concatenations of any such values".

We present a novel approach to security policy monitoring that uses tree automata to capture constraints on the way data is processed along an execution. We present a lambda-calculus based model of the framework, investigate some of the models meta-properties, and show how it can be implemented using labels corresponding to automaton states to reflect the computational histories of each data item. We show how a standard denotational semantics induces the expected monitoring regime on a simple "while" language. Finally we implement the framework for the Dalvik VM using TaintDroid as the underlying data flow tracking mechanism, and evaluate its functionality and performance on five case studies.

32 – Segmentation and tracking of cells

Klas Magnusson and Joakim Jaldén

We are developing a system for automated analysis of cells in microscope image sequences. Our goals are to: a) Create a single system that all cell biologists can use. b) Enable analysis of how cells behave in different culture conditions and how cells respond to different treatments. c) Automate tasks that are done manually today. d) Enable analysis of parameters that have not been analyzed before. We are working mostly on segmentation algorithms that find the outlines of cells in microscope images and on tracking algorithms that track the cells over time.

33 – Analog-Digital Converters Calibration

S. Medawar, P. Händel, N. Björsell, and M. Jansson

An essential component of modern radio communication systems is the analog-digital converter (ADC). The ADC integral nonlinearity (INL) is a measure how a practical ADC differ from a static ideal quantization staircase. Dynamic INL modeling is performed to construct a compensation block that calibrates the ADC in real time. Significant ADC performance improvements in terms of SFDR (enhancement) and IMD (reduction) are obtained.

34 – Distributed Source Coding under Adversarial Attacks

F. Naghibi, R. Thobaben, S. Salimi, and M. Skoglund

We consider the problem of code design for compression of correlated sources under adversarial attacks. A scenario with three correlated sources is considered in which at most one source is compromised by an adversary. The theoretical minimum achievable sum-rate for this scenario was derived by Kosut and Tong. We design layered LDPC convolutional codes for this problem, assuming that one of the sources is available at the common decoder as side information. We demonstrate that layered LDPC convolutional codes constitute a sequence of nested codes where each sub-code is capacity-achieving for the binary symmetric channels used to model the correlation between sources, and therefore, can ideally achieve the theoretical minimum sum-rate. Simulated performance results for moderate block length show a small gap to the theoretical limit, and as the block length increases the gap vanishes.

35 – Correlation of Distortion Noise Between the Branches of MIMO Transmit Antennas

N. N. Moghadam, P. Zetterberg, P. Händel, and H. Hjalmarsson

Despite the tremendous research effort spent on MIMO systems - very few papers address the impact of hardware imperfections. Here, we analyze the distortion noise of the transmitter branches of a MIMO transmitter. In particular we analyze the cross-correlation of the distortion noises for the case that the transmitted signals are correlated. This case arises when there is just a single stream being transmitted with beamforming or in the case of multiple streams and linear precoding. We analyze the problem in two ways: using analytical derivations and using measurements on our testbed. In the analytical case we assume a transmitter impaired by a 3rd order non-linearity. For this scenario we find that the absolute correlation coefficient of the distortion noises is given by the absolute value of the correlation coefficients of the input signals to the power of three, while the phase is the same as that of the input signal. Our measurements also show good agreement between measurements and analytical results. It seems to suggest that the distortion noises can be regarded as practically independent whenever there are two or more modulation streams being transmitted (spatial multiplexing). In a single-stream scenario, the distortion noise will tend to have the same spatial distribution as the desired signal.

36 – Joint Estimation of Channel and Phase Noise in OFDM

Senay Negusse

we present a robust technique based on cost reference particle filter (CRPF) for combined channel impulse response (CIR) estimation and phase noise (PN) tracking in OFDM systems without any priori information regarding the noise in the state and measurement equation. Contrary to previous works, no assumption is held regarding the magnitude of the PN variance and hence no approximation is made to simplify the model. The algorithm employs CRPF along with a Rao-Blackwellization technique for CIR estimation assuming static channel state over a number of OFDM symbols. Numerical result is given to demonstrate the performance of the algorithm based on mean squared error (MSE) of the CIR estimate.

37 – OpenShoe – Foot-mounted INS for every foot

John-Olof Nilsson and Isaac Skog

We have developed an open-source embedded foot-mounted INS implementation. All processing is run on a microcontroller which is integrated together with an inertial measurement unit in the sole of a shoe. The hardware can easily be produced by any standard PCB printing and 3D prototyping services. The use of the system include pedestrian positioning and gait analysis.

38 – Graphical Replication Games as a Model of Content Peering in CCNs

Valentino Pacifici and György Dán

As a model of the problem of content placement in computer and communication systems, we consider graphical replication games played over a social graph. The social graph models limited interaction between the players due to, e.g., the network topology: the payoff that a replicated content yields to a player depends on the replication strategies of her neighbors on the graph. We prove that a NE always exists in graphical replication games and we provide a linear time algorithm to compute equilibria. We show that if all nodes follow a myopic strategy to update their content placements then they might cycle arbitrarily long before reaching an equilibrium. We propose an efficient distributed algorithm to reach an equilibrium over an arbitrary graph and we illustrate its performance on different random graph topologies. As an application of replication games we consider a content-centric network where ASs maintain peering agreements with each other for mutual benefit and engage in content-level peering. We address the question of whether the interaction needs to rely on explicit announcements of content reachability in order to achieve stable and efficient content-level peering. We show that lack of coordination can lead to stable but inefficient cache configurations. For the case of coordination we propose two distributed algorithms that, with a low degree of synchronization, efficiently reach a stable cache configuration.

39 – Stability Analysis of Multiple State-based Schedulers

Chithrupa Ramesh, Henrik Sandberg, and Karl H. Johansson

In this paper, we identify sufficient conditions for Lyapunov Mean Square Stability (LMSS) of a contention-based network of first-order systems, with state-based schedulers. The stability analysis helps us to choose policies for adapting the scheduler threshold to the delay from the network and scheduler. We show that three scheduling laws can result in LMSS: constant-probability laws and additively increasing or decreasing probability laws. Our results counter the notions that increasing probability scheduling laws alone can guarantee stability of the closed-loop system, or that decreasing probability scheduling laws are required to mitigate congestion in the network.

40 – Depth Pixel Clustering for Consistency Testing of Multiview Depth

Pravin Kumar Rana and Markus Flierl

This poster proposes a clustering algorithm of depth pixels for consistency testing of multiview depth imagery. The testing addresses the inconsistencies among estimated depth maps of real world scenes by validating depth pixel connection evidence based on a hard connection threshold. With the proposed algorithm, we test the consistency among depth values generated from multiple depth observations using cluster adaptive connection thresholds. The connection threshold is based on statistical properties of depth pixels in a cluster or sub-cluster. This approach can improve the depth information of real world scenes at a given viewpoint. This allows us to enhance the quality of synthesized virtual views when compared to depth maps obtained by using fixed thresholding. Depth-image-based virtual view synthesis is widely used for upcoming multimedia services like three-dimensional television and free-viewpoint television.

41 – Modeling Online Social Networks

Guillermo Rodríguez Cano

Social networks are a popular topic in many areas of research. From the human and behavioral perspective that social science investigates in general, and sociology focuses in particular, to the mathematical and algorithmic side that computer science considers. These networks often are, if not primarily, mathematically modeled as graphs, one of the most known and used combinatorial structures in computer science. However, the inner essence of the individuals interacting in these systems and the information exchanged over time might not be truly depicted with one-to-one relationships. The semantics of the formation of relationships between individuals, but also the information exchanged, go beyond the limitations of these associations, which current implementations overcome, for instance, by replicating relationships when an individual is associated with various others at once. When moving to a digital world, Online Social Networks (OSNs), such as Facebook, with almost a billion individuals, performance and scalability but also efficiency in storage becomes important when modeling such large graph. In this work we propose an alternative model for OSNs based on hyper-graphs, a generalization of graphs, aiming at representing more coherently the one-to-many and many-to-many associations occurring in these networks. We also take advantage of some Social Network Analysis (SNA) centrality metrics for a finer understanding of the communities formed in the network. Lastly, we look into the depiction of nodes and edges in OSNs as the rapidly increasing types of data suggests that the typical association of nodes with individuals and edges with their relationships might not be sufficiently expressive for a large scale OSN.

42 – Physical Layer Security in Wireless Networks

Nicolas Schrammar and Mikael Skoglund

We analyze physical layer security in the discrete superposition model (DSM). The DSM is a simplified, deterministic model for wireless networks. For a range of topologies, the capacity in the DSM is a constant-gap approximation to the capacity in the corresponding additive-white Gaussian noise (AWGN) model. Our first contribution is to extend this correspondence to the wiretap channel, which is the simplest instance of physical layer security. Secondly, we determine the secrecy capacity of the DSM wiretap channel within a constant gap. Those are the fist two steps towards the analysis of arbitrary relay networks with secrecy constraints.

43 – Verifying a Security Hypervisor

Mads Dam, Roberto Guanciale, Narges Khakpour, Hamed Nemati, and Oliver Schwarz

Embedded systems such as in mobile phones are not only a more and more popular target for attackers, they are also getting more and more complex, which makes it hard to get assurance about their security. With the help of virtualization one can reduce the trusted computing base. The resulting solution, a so called hypervisor, can isolate different software from each other and is itself sufficient small to be subject to formal verification. With this poster we give an overview about the verification of our hypervisor, including the formal goals, tools used and steps taken. The discipline of formally verifying software is still quite young, especially when it comes to system software. Therefore we believe that a discussion on this project will be worth a visit at our poster for every ACCESS student. Välkomna!

44 – DMA virtualization

Mads Dam, Oliver Schwarz, Christian Gehrmann

DMA support is essential in modern systems, even in embedded ones. However, dealing with it in a virtualized environment is not trivial. Most solutions require the existence of an IOMMU which is not always available. Our approach takes a different way to enable DMA on a hypervisor on ARM. We are going to demonstrate characteristics of the ARM memory management, a corresponding virtualization scheme and an adequate scheduling.

45 – On Robust Training Sequence Design for Correlated MIMO Channel Estimation

Nafiseh Shariati, Jiaheng Wang, and Mats Bengtsson

The problem of robust training sequence design for the purpose of multiple-input multiple-output (MIMO) channel estimation is considered. In particular, we aim to minimize the worst-case mean squared error of channel estimates which is formulated as a minimax optimization problem. Such problem is addressed efficiently using extended barrier method under a general assumption of any compact convex uncertainty set. Moreover, assuming a Kronecker MIMO channel and a unitarily invariant uncertainty set, the robust design problem is diagonalized which significantly lowers the dimensionality of the optimization problem.

46 – When Do Gossip Algorithms Converge in Finite Time

Guodong Shi, Mikael Johansson, and Karl Henrik Johansson

We show that there exists a gossip algorithm that converges in finite time if and only if the number of network nodes is a power of two. In addition, an "all-or-nothing theorem is established on the finite-time convergence of distributed averaging algorithms: for a class of averaging algorithms defined by matrix sequences selected from a countable set of stochastic matrices, finite-time convergence either holds for all initial conditions, or fails for almost all initial conditions.

47 – An Exact Solution to the Power Networks Security Index Problem and its Generalized Min Cut Formulation

Kin Cheong Sou

The resilience of Supervisory Control and Data Acquisition (SCADA) systems for electric power networks for certain cyber-attacks is considered. In particular, we study the robustness of the observability properties of the network to the loss of some measurements. It was recently shown, under the full measurement assumption, that the problem can be cast as a generalization of the minimum cut problem involving costly nodes. In this paper, we show that it can be reformulated as a standard minimum cut problem (without costly nodes) on a modified graph of proportional size. An important consequence of this result is that the observability problem can be solved efficiently. Our approach provides the first exact efficient algorithm for this problem. It is illustrated on a numerical example.

48 – Non-Convex Rate Allocation for Streaming Traffic via Sequential Convex Programming

M. S. Talebi, A. Sehati, A. Khonsari

Recently, there has been an increasing demand for ubiquitous streaming like applications in data networks. We concentrate on NUM-based rate allocation for streaming applications with the so-called S-curve utility functions. Due to non-concavity of such utility functions, the underlying NUM problem would be non-convex for which dual methods might become quite incompetent. To tackle non-convexity, we make the utility of the network concave using elementary techniques. This results in reverse-convex constraints which make the problem non-convex. We then leverage Sequential Convex Programming (SCP) approach to approximate the non-convex problem by a series of convex ones. Based on this approach, we propose a distributed rate allocation algorithm which under mild conditions converges to a KKT point of the original NUM. Numerical results validate the effectiveness of the proposed rate allocation algorithm.

49 – Maximum Likelihood based Sparse and Distributed Conjoint Analysis

Efthymios Tsakonas, Joakim Jaldén, Nikos Sidiropoulos and Björn Ottersten

A new statistical model for choice-based conjoint analysis is proposed. The model uses auxiliary variables to account for outliers and to detect the salient features that influence decisions. Unlike recent classification-based approaches to choice-based conjoint analysis, a sparsity-aware maximum likelihood (ML) formulation is proposed to estimate the model parameters. The proposed approach is conceptually appealing, mathematically tractable, and is also well- suited for distributed implementation. Its performance is tested and compared to the prior state-of-art using synthetic as well as real data coming from a conjoint choice experiment for coffee makers, with very promising results.

50 – Network Search

Misbah Uddin, Rolf Stadler, and Alexander Clemm

While networked systems hold and generate vast amounts of configuration and operational data, this data is not accessible through a simple, uniform mechanism. Rather, it must be gathered using a range of different protocols and interfaces. Our vision is to make all this data available in a simple format through a realtime search process which runs within the network and aggregates the data into a form needed by applications – a concept we call network search. We believe that such an approach, though challenging, is technically feasible and will enable rapid development of new management applications and advanced network functions. The paper motivates and formulates the concept of network search, compares it to related concepts like web search, outlines a search architecture, describes the design space and research challenges, and reports on a testbed implementation with management applications built for exploratory purposes of this new paradigm.

51 – Performance analysis of identification algorithms

P.E. Valenzuela, H. Hjalmarsson and C.R. Rojas

This article presents a first attempt to compare the performance of different identification algorithms found in the literature. The comparison is made for discrete time, LTI single input, single output (SISO) systems, when the true system has a Box-Jenkins structure. The performance is computed by using the 2 norm of the difference between the true system and the identified model. Box-plots of the performance for each algorithm are plotted and conclusions are drawn.

52 – Asynchronous Newton-Raphson Consensus for Distributed Convex Optimization

Filippo Zanella, Damiano Varagnolo, Angelo Cenedese, Gianluigi Pillonetto, and Luca Schenato

We consider the distributed unconstrained minimization of separable convex cost functions, where the global cost is given by the sum of several local and private costs, each associated to a specific agent of a given communication network. We specifically address an asynchronous distributed optimization technique called Newton-Raphson Consensus. Beside having low computational complexity, low communication requirements and being interpretable as a distributed Newton-Raphson algorithm, the technique has also the beneficial properties of requiring very little coordination and naturally supporting time-varying topologies. In this work we analytically prove that under some assumptions it shows either local or global convergence properties, and corroborate this result by the means of numerical simulations.

53 – Distributed estimation of diameter, radius and eccentricities in anonymous networks

Federica Garin, Damiano Varagnolo, and Karl H. Johansson

We consider how a set of collaborating agents can distributedly infer some of the properties of the communication network that they form. We specifically focus on estimating quantities that can characterize the performance of other distributed algorithms, namely the eccentricities of the nodes, and the radius and diameter of the network. We propose a strategy that can be implemented in any network, even under anonymity constraints, and has the desirable properties of being fully distributed, parallel and scalable. We analytically characterize the statistics of the estimation error, and highlight how the performance of the algorithm depends on a parameter tuning the communication complexity.

54 – Network-aware Mitigation of Attacks on Power System State Estimation

Ognjen Vuković, Kin Cheong Sou, György Dán, Henrik Sandberg

Critical power system applications like contingency analysis and optimal power flow calculation rely on the power system state estimator. Hence the security of the state estimator is essential for the proper operation of the power system. In the future more applications are expected to rely on it, so that its importance will increase. Based on realistic models of the communication infrastructure used to deliver measurement data from the substations to the state estimator, in this work we investigate the vulnerability of the power system state estimator to attacks performed against the communication infrastructure. We define security metrics that quantify the importance of individual substations and the cost of attacking individual measurements. We use the metrics to show how various network layer and application layer mitigation strategies, like single and multi-path routing and data authentication, can be used to decrease the vulnerability of the state estimator. We illustrate the efficiency of the algorithms on the IEEE 118 and 300 bus benchmark power systems.

55 – Cooperate or not: the secondary relay's dilemma in spectrum sharing networks

Liping Wang and Viktoria Fodor

We consider a spectrum sharing network consisting of a primary and a cognitive secondary source-destination pairs, where the secondary source can cooperatively relay primary traffic. If the secondary source chooses not to cooperate, it can transmit packet only when the shared channel is sensed to be idle. Otherwise, it need to relay primary packet, but can send its own packet immediately as a reward. So cooperation may reduce the packet delay but increase the energy cost of the secondary source for relaying primary packet. To solve this dilemma, we assume the secondary source can choose dynamically between the two access schemes. We derive the bounds of the stable-throughput region, and then formulate the problem as a Markov decision process (MDP). We prove there exists a stationary policy that is average cost optimum. Numerical results for the case with finite queues show that the optimum dynamic secondary access policy can trade off between the reward and the cost of cooperation. The performance gain is significant if the traffic load at the primary is heavy, and that at the secondary is not low.

56 – Performance Management for an OpenStack Cloud

Fetahi Wuhib, Rolf Stadler, and Hans Lindgren

We report on design, implementation and evaluation of a resource management system that builds upon OpenStack, an open-source cloud platform for private and public clouds that is rapidly gaining acceptance in industry. Our implementation supports an Infrastructure-as-a-Service (IaaS) cloud and currently provides allocation for computational resources in support of interactive as well as computationally intensive applications. The design supports an extensible set of management objectives between which the system

can switch at runtime. We demonstrate through examples how management objectives related to load-balancing, energy efficiency and service differentiation can be mapped onto the controllers of the resource allocation subsystem, which attempts to achieve an activated management objective at all times. The design is extensible in the sense that additional objectives can be introduced by providing instantiations for generic functions in the controllers. Our implementation monitors the fulfillment of the relevant management metrics in real time. Testbed evaluation demonstrates the effectiveness of our approach in a dynamic environment. It further illustrates the trade-off between closely meeting a specific management objective and the associated cost of VM live-migration.

57 – Model Based Peer-to-Peer Estimator over Wireless Sensor Networks

Yuzhe Xu, Carlo Fischione, Alberto Speranzon

A peer-to-peer estimator computes local estimates at each node by combining the information from neighboring nodes without the need of central coordination. Although more flexible and scalable, peer-to-peer minimum variance estimators are difficult to design because of message losses and lack of network coordination. In this paper, we propose a new peer-topeer estimator that allows to recover a time-varying scalar signal from measurements corrupted by an unknown non-zero mean independent noise or disturbances. Message losses occurring over the network and absence of central coordination are considered. Novel theoretical solutions are developed by taking advantage of a model of the signal dynamics. The proposed approach simultaneously guarantees a bounded mean value and minimum variance of the estimation error. Simulation results illustrate the performance of the proposed method.

58 – Predicting Response Times for the Spotify Backend

Rerngvit Yanggratoke, Gunnar Kreitz, Mikael Goldmann, Rolf Stadler

We model and evaluate the performance of a distributed key-value storage system that is part of the Spotify backend. Spotify is an on-demand music streaming service, offering low-latency access to a library of over 16 million tracks and serving over 10 million users currently. We first present a simplified model of the Spotify storage architecture, in order to make its analysis feasible. We then introduce an analytical model for the distribution of the response time, a key metric in the Spotify service. We parameterize and validate the model using measurements from two different testbed configurations and from the operational Spotify infrastructure. We find that the model is accurate—measurements are within 11% of predictions—within the range of normal load patterns. We apply the model to what-if scenarios that are essential to capacity planning and robustness engineering. The main difference between our work and related research in storage system performance is that our model provides distributions of key system metrics, while related research generally gives only expectations, which is not sufficient in our case.

59 – Dynamic Subspace Pursuit

Dave Zachariah, Saikat Chatterjee, and Magnus Jansson

For compressive sensing of dynamic sparse signals, we develop an iterative greedy search algorithm based on subspace pursuit (SP) that can incorporate sequential predictions, thereby taking advantage of its low complexity while improving recovery performance by exploiting correlations described by a state space model. The algorithm, which we call dynamic subspace pursuit (DSP), is presented and experimentally validated. It exhibits a graceful degradation at deteriorating signal conditions while capable of yielding substantial performance gains as conditions improve.

60 – Digital Predistortion of a Multi-carrier Satellite Link

Efrain Zenteno, Daniel Rönnow and Peter Händel

The need for higher capacity in satellite networks has initiated the use of multiple communications in a single satellite link. However, the impact of channel distortion degrade the performance of such links compared to single carrier transmissions. Hence, it is desired to optimized the operation of a satellite link in multi-carrier operation, using only resources alocated in terrain stations and avoiding extremely costly operations in already existing satellite station architecture. Thus, digital Pre-distortion (DPD) becomes an attractive technique in this scenario. This work describes the main challenges, problems, limitations and possible approaches to improve the link performance of a satellite link.

List of Participants

First name	Last name	E-mail	Department	Group
Assad	Alam	assada@kth.se	EE, Automatic Control	A
Martin	Andreasson	mandreas@kth.se	EE, Automatic Control	A
Mariette	Annergren	marann@kth.se	EE, Automatic Control	A
Jose	Araujo	araujo@kth.se	EE, Automatic Control	W
Musard	Balliu	musard@kth.se	CSC, Theoretical Computer Sc.	S
Emil	Björnson	emilbjo@kth.se	EE, Signal Processing	W
Ricardo	Blasco Serrano	ricardo.blasco@ee.kth.se	EE, Communication Theory	I
Oleksandr	Bodriagov	obo@kth.se	CSC, Theoretical Computer Sc.	S
Rasmus	Brandt	rabr5411@kth.se	EE, Signal Processing	I
Themistoklis	Charalambous	themisc@kth.se	EE, Automatic Control	N
Kin	Cheong Sou	sou@kth.se	EE, Automatic Control	A
Piergiuseppe	Di Marco	pidm@kth.se	EE, Automatic Control	W
Jinfeng	Du	jinfeng@kth.se	EE, Communication Theory	W
Satyam	Dwivedi	dwivedi@kth.se	EE, Signal Processing	O
Niklas	Everitt	neveritt@kth.se	EE, Automatic Control	A
Hamed	Farhadi	farhadih@kth.se	EE, Communication Theory	A
Farhad	Farokhi	farokhi@ee.kth.se	EE, Automatic Control	N
Oscar	Flärdh	flardh@kth.se	EE, Automatic Control	O
Frederic	Gabry	gabry@kth.se	EE, Communication Theory	S
Majid	Gerami	gerami@kth.se	EE, Communication Theory	O
Euhanna	Ghadimi	euhanna@kth.se	EE, Automatic Control	N
Maskym	Girnyk	mgyr@kth.se	EE, Communication Theory	W
Ioannis	Glaropoulos	ioannisg@kth.se	EE, Communication Networks	W
Antonio	Gonga	gonga@kth.se	EE, Automatic Control	N
Benjamin	Greschbach	bgre@kth.se	CSC, Theoretical Computer Sc.	N
Roberto	Guanciale	robertog@kth.se	CSC, Theoretical Computer Sc.	I
Meng	Guo	mengg@kth.se	EE, Automatic Control	A
Per	Hägg	pehagg@kth.se	EE, Automatic Control	A
Erik	Henriksson	erike02@kth.se	EE, Automatic Control	N
Lirong	Huang	lirong@kth.se	EE, Automatic Control	A
Nicolas	Innocenti	njain@kth.se	CSC, Computational Biology	O
Martin	Jakobsson	mjakobss@kth.se	EE, Automatic Control	A
Dimitrios	Katselis	dimitrik@kth.se	EE, Automatic Control	I
Narges	Khakpour	nargeskh@kth.se	CSC, Theoretical Computer Sc.	S
Kittipong	Kittichokechai	kki@kth.se	EE, Communication Theory	S
Sylvia	Kouyoumdjieva	stkou@kth.se	EE, Communication Networks	W
Jeffrey	Larson	jeffrey.larson@ucdenver.edu	EE, Automatic Control	O
Christian	Larsson	christian.larsson@ee.kth.se	EE, Automatic Control	A
Haopeng	Li	haopeng@kth.se	EE, Sound and Image Processing	I
Nan	Li	nanli2@kth.se	EE, Communication Theory	W
Kuo-Yun	Liang	kyliang@kth.se	EE, Automatic Control	A
Du	Liu	dul@kth.se	EE, Sound and Image Processing	I
Jie	Lu	jielu@kth.se	EE, Automatic Control	O
Andreas	Lundblad	landreas@kth.se	CSC, Theoretical Computer Sc.	N
Klas	Magnusson	klasma@kth.se	EE, Signal Processing	O

Samer	Medawar	medawar@kth.se	EE, Signal Processing	W
Ziyang	Meng	panday227@gmail.com	EE, Automatic Control	O
Farshad	Naghibi	farshadn@kth.se	EE, Communication Theory	S
Nima	Najari Moghadam	nimanm@kth.se	EE, Signal Processing	W
Senay	Negusse	negusse@kth.se	EE, Signal Processing	W
Hamed	Nemati	hnnemati@kth.se	CSC, Theoretical Computer Sc.	S
John-Olof	Nilsson	jnil02@kth.se	EE, Signal Processing	A
Ozan	Öktem	ozan@kth.se	SCI, Mathematics	O
Valentino	Pacifici	pacifici@kth.se	EE, Communication Networks	N
Ljubica	Pajevic	ljubica@kth.se	EE, Communication Networks	W
Petko	Petkov	petkov@kth.se	EE, Sound and Image Processing	I
Chithrupa	Ramesh	cramesh@kth.se	EE, Automatic Control	I
Pravin Kumar	Rana	prara@kth.se	EE, Sound and Image Processing	I
Guillermo	Rodríguez Cano	gurc@csc.kth.se	CSC, Theoretical Computer Sc.	N
Nicolas	Schrammar	nisc@kth.se	EE, Communication Theory	S
Oliver	Schwarz	oschwarz@kth.se	CSC, Theoretical Computer	S
Nafiseh	Shariati	nafiseh@kth.se	EE, Signal Processing	W
Guodong	Shi	guodongs@kth.se	EE, Automatic Control	A
Amirpasha	Shirazinia	amishi@ee.kth.se	EE, Communication Theory	N
Mohammad Sadegh	Talebi	mstms@kth.se	EE, Automatic Control	N
Alla	Tarighati	allat@kth.se	EE, Signal Processing	I
André	Teixeira	andretei@kth.se	EE, Automatic Control	S
Efthymios	Tsakonas	tsakonas@kth.se	EE, Signal Processing	O
Philip	Tully	tully@csc.kth.se	CSC, Computational Biology	I
Valerio	Turri	valerioturri87@gmail.com	EE, Automatic Control	O
Abu Hamed	Uddin	ahmmud@kth.se	EE, Communication Networks	S
Patricio Esteban	Valenzuela Pacheco	pva@kth.se	EE, Automatic Control	A
Damiano	Varagnolo	damiano@kth.se	EE, Automatic Control	O
Ognjen	Vukovic	vukovic@ee.kth.se	EE, Communication Networks	S
Chao	Wang	chaowang@kth.se	EE, Communication Theory	I
Liping	Wang	lipingw@kth.se	EE, Communication Networks	N
Zhao	Wang	zhaowang@kth.se	EE, Communication Theory	I
Pradeep Chathuranga	Weeraddana	chatw@kth.se	EE, Automatic Control	W
Fetahi	Wuhib	fetahi@kth.se	EE, Communication Networks	N
Yuzhe	Xu	yuzhe@kth.se	EE, Automatic Control	O
Vijaya	Yajnanarayana	vpy@kth.se	EE, Signal Processing	N
Rerngvit	Yanggratoke	rerng007@gmail.com	EE, Communication Networks	S
Dave	Zachariah	dave.zachariah@ee.kth.se	EE, Signal Processing	O
Ali	Zaidi	zaidi@kth.se	EE, Communication Theory	A
Efrain José	Zenteno Bolanos	zenteno@ee.kth.se	EE, Signal Processing	O
Per	Zetterberg	per.zetterberg@ee.kth.se	EE, Signal Processing	I

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