Computational Sciences Lecture Series at UW-Madison

By:

Pascal Vontobel

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C O N N E X I O N S

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Table of Contents

1 CSLS Workshops Overview

1.1 CSLS Workshops Overview . . . 1

2 Workshop 1 (October 30, 2003)

2.1 CSLS Workshop on Computational Vision and Image Analysis . . . 3

3 Workshop 2 (February 19, 2004)

3.1 CSLS Workshop on Graphical Models . . . 5

4 Workshop 3 (October 7, 2004)

4.1 CSLS Workshop on Optimization of Eigenvalues . . . 7

5 Workshop 4 (February 10, 2005)

5.1 CSLS Workshop on Quantum Computation . . . 9

6 Workshop 5 (April 18, 2005)

6.1 CSLS Workshop on Trends in Wireless Communication . . . 11

Index . . . 13

Attributions . . . 14

Chapter 1

CSLS Workshops Overview

1.1 CSLS Workshops Overview[1]

1.1.1 Goal of the CSLS Workshops

The goal of the Computational Sciences Lecture Series (CSLS) is to bring together researchers from mathematics (pure and applied), computer science, physics, and engineering to promote cross-fertilization between these fields and to establish computational science as an active research discipline at UW-Madison. The CSLS will consist of several half-day meetings during each year, each meeting consisting of three lectures by distinguished researchers, grouped around a common theme.

1.1.2 Previous CSLS Workshops

- CSLS Workshop on Computational Vision and Image Analysis[2] (October 30, 2003)
- CSLS Workshop on Graphical Models[3] (February 19, 2004)
- CSLS Workshop on Optimization of Eigenvalues[4] (October 7, 2004)
- CSLS Workshop on Quantum Computation[5] (February 10, 2005)
- CSLS Workshop on Wireless Communication[6] (April 18, 2005)

[1]This content is available online at <http://cnx.org/content/m12740/1.6/>.
[2]http://cnx.rice.edu/content/m12735/latest/
[3]http://cnx.rice.edu/content/m12736/latest/
[4]http://cnx.rice.edu/content/m12737/latest/
[5]http://cnx.rice.edu/content/m12738/latest/
[6]http://cnx.rice.edu/content/m12782/latest/

Chapter 2

Workshop 1 (October 30, 2003)

2.1 CSLS Workshop on Computational Vision and Image Analysis[1]

2.1.1 Workshop Overview

Great advances have been made in the acquisition of image data, from conventional photography, CT scanning, and satellite imaging to the now ubiquitous digital cameras embedded in cell phones and other wireless devices. Although the semantic understanding of the shapes and other objects appearing in images is effortless for human beings, the corresponding problem in machine perception - namely, automatic interpretation via computer programs - remains a major open challenge in modern science. In fact, there are very few systems whose value derives from the analysis rather than collection of image data, and this "semantic gap" impedes scientific and technological advances in many areas, including automated medical diagnosis, robotics, industrial automation, and effective security and surveillance. In this CSLS Workshop, three distinguished experts in the field of Computational Vision and Image Analysis share their thoughts on the current state of the art and future directions in the field.

- Go to the talk on Hierarchical Designs for Pattern Recognition[2] (by Prof. Donald Geman)
- Go to the talk on Modeling and Inference of Dynamic Visual Processes[3] (by Prof. Stefano Soatto)
- Go to the talk on Computational Anatomy and Models for Image Analysis[4] (by Prof. Michael Miller)

Remark: This workshop was held on October 30, 2003 as part of the Computational Sciences Lecture Series (CSLS)[5] at the University of Wisconsin-Madison.

2.1.2 Hierarchical Designs for Pattern Recognition

By Prof. Donald Geman[6] (Dept. of Applied Mathematics and Statistics and Center for Imaging Science, Johns Hopkins University, USA)

Slides of talk [PDF][7] (Not yet available.) | Video [WMV][8] | Video [MPG][9]

ABSTRACT: It is unlikely that complex problems in machine perception, such as scene interpretation, will yield directly to improved methods of statistical learning. Some organizational framework is needed to

[1]This content is available online at <http://cnx.org/content/m12735/1.11/>.
[2]http://cnx.org/content/m12735/latest/#geman_title
[3]http://cnx.org/content/m12735/latest/#soatto_title
[4]http://cnx.org/content/m12735/latest/#miller_title
[5]http://cnx.rice.edu/content/col10277/latest/
[6]http://www.cis.jhu.edu/people/faculty/geman/
[7]http://cnx.org/content/m12735/latest/geman_csls_031030.pdf
[8]http://cnx.org/content/m12735/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS1.wmv
[9]http://www.cae.wisc.edu/~vontobel/csls_video1.mpg

confront the small amount of data relative to the large number of possible explanations, and to make sure that intensive computation is restricted to genuinely ambiguous regions. As an example, I will present a "twenty questions" approach to pattern recognition. The object of analysis is the computational process itself rather than probability distributions (Bayesian inference) or decision boundaries (statistical learning). Under mild assumptions, optimal strategies exhibit a steady progression from broad scope coupled with low power to high power coupled with dedication to specific explanations. Several theoretical results will be mentioned (joint work with Gilles Blanchard) as well as experiments in object detection (joint work with Yali Amit and Francois Fleuret).

2.1.3 Modeling and Inference of Dynamic Visual Processes

By Prof. Stefano Soatto[10] (Department of Computer Science, University of California Los Angeles, USA)

Slides of talk [PDF][11] (Not yet available.) | Video [WMV][12]

ABSTRACT: "We see in order to move, and we move in order to see." In this expository talk, I will explore the role of vision as a sensor for interaction with physical space. Since the complexity of the physical world is far superior to that of its measured images, inferring a generic representation of the scene is an intrinsically ill-posed problem. However, the task becomes well-posed within the context of a specific control task. I will display recent results in the inference of dynamical models of visual scenes for the purpose of motion control, shape visualization, rendering, and classification.

2.1.4 Computational Anatomy and Models for Image Analysis

By Prof. Michael Miller[13] (Director of the Center for Imaging Science, The Seder Professor of Biomedical Engineering, Professor of Electrical and Computer Engineering, Johns Hopkins University, USA)

Slides of talk [PDF][14] (Not yet available.) | Video [WMV][15]

ABSTRACT: University Recent years have seen rapid advances in the mathematical specification of models for image analysis of human anatomy. As first described in "Computational Anatomy: An Emerging Discipline" (Grenander and Miller, Quarterly of Applied Mathematics, Vol. 56, 617-694, 1998), human anatomy is modelled as a deformable template, an orbit under the group action of infinite dimensional diffeomorphisms. In this talk, we will describe recent advances in CA, specifying a metric on the ensemble of images, and examine distances between elements of the orbits, "Group Actions, Homeomorphisms, and Matching: A General Framework" (Miller and Younes, Int. J. Comp. Vision Vol. 41, 61-84, 2001), "On the Metrics of Euler-Lagrange Equations of Computational Anatomy (Annu. Rev. Biomed. Eng., Vol. 4, 375-405, 2002). Numerous results will be shown comparing shapes through this metric formulation of the deformable template, including results from disease testing on the hippocampus, and cortical structural and functional mapping.

[10]http://www.cs.ucla.edu/%7Esoatto
[11]http://cnx.org/content/m12735/latest/soatto_csls_031030.pdf
[12]http://cnx.org/content/m12735/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS2.wmv
[13]http://www.cis.jhu.edu/people/faculty/mim/
[14]http://cnx.org/content/m12735/latest/miller_csls_031030.pdf
[15]http://cnx.org/content/m12735/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS3.wmv

Chapter 3

Workshop 2 (February 19, 2004)

3.1 CSLS Workshop on Graphical Models[1]

3.1.1 Workshop Overview

A graphical model, or Bayesian network, encodes probabilistic relationships among variables. Techniques based on these models are becoming increasingly important in data analysis applications of many types. In areas such as foreign-language translation, microchip manufacturing, and drug discovery, the volume of data can slow progress because of the difficulty of finding causal connections or dependencies. The new Bayesian methods enable these tangled interconnections to be sorted out and produce useful tools for handling large data sets. Google is already using these techniques to find and take advantage of patterns of interconnections between Web pages, and Bill Gates has been quoted as saying that expertise in Bayesian networks is an essential part of Microsoft's competitive advantage, particularly in such areas as speech recognition. (Bayesian networks now pervade Microsoft Office.) Recently, the MIT Technology Review named Bayesian networks as one of the top ten emerging technologies.

- Go to the talk on An Introduction to Probabilistic Graphical Models and Their Lyapunov Functions and Algorithms for Inference and Learning[2] (by Prof. Brendan J. Frey)
- Go to the talk on Graphical Models for Linear Systems, Codes and Networks[3] (by Prof. Ralf Koetter)
- Go to the talk on Graphical Models, Exponential Families and Variational Inference[4] (by Prof. Michael I. Jordan)

Remark: This workshop was held on February 19, 2004 as part of the Computational Sciences Lecture Series (CSLS)[5] at the University of Wisconsin-Madison.

3.1.2 An Introduction to Probabilistic Graphical Models and Their Lyapunov Functions and Algorithms for Inference and Learning

By Prof. Brendan J. Frey[6] (Probabilistic and Statistical Inference Group, Electrical and Computer Engineering, University of Toronto, Canada)

Slides of talk in PDF[7] | Video [WMV][8]

[1] This content is available online at <http://cnx.org/content/m12736/1.4/>.
[2] http://cnx.org/content/m12736/latest/#frey_title
[3] http://cnx.org/content/m12736/latest/#koetter_title
[4] http://cnx.org/content/m12736/latest/#jordan_title
[5] http://cnx.rice.edu/content/col10277/latest/
[6] http://www.psi.toronto.edu/%7Efrey/
[7] http://cnx.org/content/m12736/latest/frey_csls_040219.pdf
[8] http://cnx.org/content/m12736/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS4.wmv

ABSTRACT: Many problems in science and engineering require that we take into account uncertainties in the observed data and uncertainties in the model that is used to analyze the data. Probability theory (in particular, Bayes rule) provides a way to account for uncertainty, by combining the evidence provided by the data with prior knowledge about the problem. Recently, we have seen an increasing abundance of data and computational power, and this has motivated researchers to develop techniques for solving large-scale problems that require complex chains of reasoning applied to large datasets. For example, a typical problem that my group works on will have 100,000 to 1,000,000 or more unobserved random variables. In such large-scale systems, the structure of the probability model plays a crucial role and this structure can be easily represented using a graph. In this talk, I will review the definitions and properties of the main types of graphical model, and the Lyapunov functions and optimization algorithms that can be used to perform inference and learning in these models. Throughout the talk, I will use a simple example taken from the application area of computer vision, to demonstrate the concepts.

3.1.3 Graphical Models for Linear Systems, Codes and Networks

By Prof. Ralf Koetter[9] (Coordinated Science Laboratory and Department of Electrical Engineering, University of Illinois, Urbana-Champaign, USA)

Slides of talk in PDF[10] | Video [WMV][11]

ABSTRACT: The use of graphical models of sytems is a well established technique to characterize a represented behavior. While these models are often given by nature in some cases it is possible to choose the underlying graphical framework. If in addition the represented behavior satisfies certain linearity requirements, surprising structural properties of the underlying graphical models can be derived. We give an overview over a developing structure theory for linear systems in graphical models and point out numerous directions for further research. Examples of applications of this theory are given that cover areas as different as coding, state space models and network information theory.

3.1.4 Graphical Models, Exponential Families and Variational Inference

By Prof. Michael I. Jordan[12] (Department of Computer Science, University of California Berkeley, USA)

Slides of talk in PDF[13] | Video [WMV][14]

ABSTRACT: The formalism of probabilistic graphical models provides a unifying framework for the development of large-scale multivariate statistical models. Graphical models have become a focus of research in many applied statistical and computational fields, including bioinformatics, information theory, signal and image processing, information retrieval and machine learning. Many problems that arise in specific instances—including the key problems of computing marginals and modes of probability distributions—are best studied in the general setting. Exploiting the conjugate duality between the cumulant generating funciton and the entropy for exponential families, we develop general variational representations of the problems of computing marginals and modes. We describe how a wide variety of known computational algorithms—including mean field, sum-product and cluster variational techniques—can be understand in terms of these variational representations. We also present novel convex relaxations based on the variational framework. We present applications to problems in bioinformatics and information retrieval. [Joint work with Martin Wainwright]

[9]http://www.comm.csl.uiuc.edu/%7Ekoetter
[10]http://cnx.org/content/m12736/latest/koetter_csls_040219.pdf
[11]http://cnx.org/content/m12736/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS5.wmv
[12]http://www.cs.berkeley.edu/%7Ejordan/
[13]http://cnx.org/content/m12736/latest/jordan_csls_040219.pdf
[14]http://cnx.org/content/m12736/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS6.wmv

Chapter 4

Workshop 3 (October 7, 2004)

4.1 CSLS Workshop on Optimization of Eigenvalues[1]

4.1.1 Workshop Overview

A wealth of interesting problems in engineering, control, finance, and statistics can be formulated as optimization problems involving the eigenvalues of a matrix function. These very challenging problems cannot usually be solved via traditional techniques for nonlinear optimization. However, they have been addressed in recent years by a combination of deep, elegant mathematical analysis and ingenious algorithmic and software development. In this workshop, three leading experts will discuss applications along with the theoretical and algorithmic aspects of this fascinating topic.

- Go to the talk on Semidefinite Programming[2] (by Prof. Stephen Boyd)
- Go to the talk on Eigenvalue Optimization: Symmetric versus Nonsymmetric Matrices[3] (by Prof. Adrian Lewis)
- Go to the talk on Local Optimization of Stability Functions in Theory and Practice[4] (by Prof. Michael Overton)

Remark: This workshop was held on October 7, 2004 as part of the Computational Sciences Lecture Series (CSLS)[5] at the University of Wisconsin-Madison.

4.1.2 Semidefinite Programming

By Prof. Stephen Boyd[6] (Stanford University, USA)

Slides of talk [PDF][7] (Not yet available.) | Video [WMV][8] (Not yet available.)

ABSTRACT: In semidefinite programming (SDP) a linear function is minimized subject to the constraint that the eigenvalues of a symmetric matrix are nonnegative. While such problems were studied in a few papers in the 1970s, the relatively recent development of efficient interior-point algorithms for SDP has spurred research in a wide variety of application fields, including control system analysis and synthesis, combinatorial optimization, circuit design, structural optimization, finance, and statistics. In this overview talk I will cover the basic properties of SDP, survey some applications, and give a brief description of interior-point methods for their solution.

[1]This content is available online at <http://cnx.org/content/m12737/1.5/>.
[2]http://cnx.org/content/m12737/latest/#boyd_title
[3]http://cnx.org/content/m12737/latest/#lewis_title
[4]http://cnx.org/content/m12737/latest/#overton_title
[5]http://cnx.rice.edu/content/col10277/latest/
[6]http://www.stanford.edu/%7Eboyd/
[7]http://cnx.org/content/m12737/latest/boyd_csls_041007.pdf
[8]http://cnx.org/content/m12737/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS7.wmv

4.1.3 Eigenvalue Optimization: Symmetric versus Nonsymmetric Matrices

By Prof. Adrian Lewis[9] (Cornell University, USA)

Slides of talk [PDF][10] (Not yet available.) | Video [WMV][11] (Not yet available.)

ABSTRACT: The eigenvalues of a symmetric matrix are Lipschitz functions with elegant convexity properties, amenable to efficient interior-point optimization algorithms. By contrast, for example, the spectral radius of a nonsymmetric matrix is neither a convex function, nor Lipschitz. It may indicate practical behaviour much less reliably than in the symmetric case, and is more challenging for numerical optimization (see Overton's talk). Nonetheless, this function does share several significant variational-analytic properties with its symmetric counterpart. I will outline these analogies, discuss the fundamental idea of Clarke regularity, highlight its usefulness in nonsmooth chain rules, and discuss robust regularizations of functions like the spectral radius. (Including joint work with James Burke and Michael Overton.)

4.1.4 Local Optimization of Stability Functions in Theory and Practice

By Prof. Michael Overton[12] (Courant Institute of Mathematical Sciences New York University, USA)

Slides of talk [PDF][13] (Not yet available.) | Video [WMV][14] (Not yet available.)

ABSTRACT: Stability measures arising in systems and control are typically nonsmooth, nonconvex functions. The simplest examples are the abscissa and radius maps for polynomials (maximum real part, or modulus, of the roots) and the analagous matrix measures, the spectral abscissa and radius (maximum real part, or modulus, of the eigenvalues). More robust measures include the distance to instability (smallest perturbation that makes a polynomial or matrix unstable) and the ϵ pseudospectral abscissa or radius of a matrix (maximum real part or modulus of the ϵ\-pseudospectrum). When polynomials or matrices depend on parameters it is natural to consider optimization of such functions. We discuss an algorithm for locally optimizing such nonsmooth, nonconvex functions over parameter space and illustrate its effectiveness, computing, for example, locally optimal low-order controllers for challenging problems from the literature. We also give an overview of variational analysis of stabiity functions in polynomial and matrix space, expanding on some of the issues discussed in Lewis's talk. (Joint work with James V. Burke and Adrian S. Lewis.)

[9] http://www.orie.cornell.edu/%7Easlewis/
[10] http://cnx.org/content/m12737/latest/lewis_csls_041007.pdf
[11] http://cnx.org/content/m12737/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS8.wmv
[12] http://www.cs.nyu.edu/cs/faculty/overton/
[13] http://cnx.org/content/m12737/latest/overton_csls_041007.pdf
[14] http://cnx.org/content/m12737/latest/mms://www.cae.wisc.edu/video/ece/CSLS/CSLS9.wmv

Chapter 5

Workshop 4 (February 10, 2005)

5.1 CSLS Workshop on Quantum Computation[1]

5.1.1 Workshop Overview

Quantum computation uses quantum mechanical phenomena to perform operations on data measured by qubits. It is part of quantum information processing, which has the potential to revolutionize our methods of securing, processing, storing, retrieving, transmitting and displaying information. A quantum computer can implement new algorithms, to perform e.g. rapid integer factorization, thereby threatening current cryptosystems, and quicker database searches. Practical difficulties have limited us to seven qubit computers so far, but the possibilities of this emerging technology have led to many centers, learned and popular articles, and even the movie "Timeline". In this workshop, three experts in the theoretical, experimental, and engineering aspects of quantum computation will take us from basics to cutting-edge.

- Go to the talk on Quantum Information, Computation, and Communication[2] (by Prof. Richard Cleve)
- Go to the talk on Prospects for Real Quantum Information Processing Devices in the Laboratory[3] (by Dr. David DiVincenzo)
- Go to the talk on The Future of Quantum Information Processing: How Big, How Fast, How Powerful?[4] (by Prof. Seth Lloyd)

Remark: This workshop was held on February 10, 2005 as part of the Computational Sciences Lecture Series (CSLS)[5] at the University of Wisconsin-Madison.

5.1.2 Quantum Information, Computation, and Communication

By Prof. Richard Cleve[6] (University of Waterloo, Canada)

(Slides are not available) | Video [WMV][7]

ABSTRACT: A quantum computer is an information processing device that harnesses the strange power of quantum mechanics: it can exist in several states simultaneously and its computation paths can interfere with each other. Following a brief introduction to quantum information, the talk will review developments in quantum algorithms and various notions of communication with quantum information.

[1]This content is available online at <http://cnx.org/content/m12738/1.5/>.
[2]http://cnx.org/content/m12738/latest/#cleve_title
[3]http://cnx.org/content/m12738/latest/#divincenzo_title
[4]http://cnx.org/content/m12738/latest/#lloyd_title
[5]http://cnx.rice.edu/content/col10277/latest/
[6]http://www.cs.uwaterloo.ca/research/individual/cleve.shtml
[7]http://cnx.org/content/m12738/latest/mms://real.cae.wisc.edu/ece/CSLS/CSLS-S05_Cleve.wmv

5.1.3 Prospects for Real Quantum Information Processing Devices in the Laboratory

By Dr. David DiVincenzo (IBM Watson Research Center, USA)

Slides of talk [PDF][8] | Video [WMV][9]

ABSTRACT: Some very hard things have to happen in the laboratory to make even rudimentary quantum information processing a reality. I will give a report "from the trenches" to give some idea of how you start from scratch – in a state of the art solid state physics lab – and try to make a working qubit. I will also give a point of view on progress on other fronts where things seem to be going better, in particular in the atomic physics lab.

5.1.4 The Future of Quantum Information Processing: How Big, How Fast, How Powerful?

By Prof. Seth Lloyd[10] (MIT, Cambridge, Massachusetts, USA)

(Slides are not available) | Video [WMV] [11]

ABSTRACT: Existing quantum computers and quantum communication systems operate at the fundamental performance limits posed by the laws of physics. This talk reviews the physical limits to quantum information processing, and explores the future of the field.

[8] http://cnx.org/content/m12738/latest/csls12_divincenzo_slides.pdf
[9] http://cnx.org/content/m12738/latest/mms://real.cae.wisc.edu/ece/CSLS/CSLS-S05_DiVincenzo.wmv
[10] http://www-me.mit.edu/people/personal/slloyd.htm
[11] http://cnx.org/content/m12738/latest/mms://real.cae.wisc.edu/ece/CSLS/CSLS-S05_Lloyd.wmv

Chapter 6

Workshop 5 (April 18, 2005)

6.1 CSLS Workshop on Trends in Wireless Communication[1]

6.1.1 Workshop Overview

According to the International Association for the Wireless Industry CTIA, there were 180 million mobile phone subscribers in the U.S. at the end of 2004. Worldwide, there will soon be 2 billion subscribers. From these figures it is not difficult to see that wireless communication, a technology that is based on the interplay of many sciences, is revolutionizing the way we communicate. In this workshop, three experts in wireless communication will discuss mathematical, technical, algorithmic, and protocol issues that made wireless communication possible and that will enable future wireless systems with more throughput, wider coverage, higher reliability, and new applications.

- Go to the talk on Approximately Universal Codes over Slow Fading Wireless Channels [2] (by Prof. Pramod Viswanath)
- Go to the talk on Quantum Computing and Cellular Phones[3] (by Dr. Rob Calderbank)
- Go to the talk on Proactive Design for Multimedia Communication Systems with Resource and Information Exchanges[4] (by Prof. Mihaela van der Schaar)

Remark: This workshop was held on April 18, 2005 as part of the Computational Sciences Lecture Series (CSLS)[5] at the University of Wisconsin-Madison.

6.1.2 Approximately Universal Codes over Slow Fading Wireless Channels

By Prof. Pramod Viswanath[6] (University of Illinois at Urbana-Champaign, USA)

Slides of talk [PDF][7] | Video [WMV][8]

ABSTRACT: The tradeoff between data rate and reliability of reception is a fundamental issue in theory and practice of communication. In this talk, we try to understand the nature of this tradeoff in a slow fading wireless channel. In particular, we will precisely characterize codes that optimally tradeoff these two quantities for every statistical characterization of the wireless channel. This characterization is then used to

[1]This content is available online at <http://cnx.org/content/m12782/1.5/>.
[2]http://cnx.org/content/m12782/latest/#viswanath_title
[3]http://cnx.org/content/m12782/latest/#calderbank_title
[4]http://cnx.org/content/m12782/latest/#vanderschaar_title
[5]http://cnx.rice.edu/content/col10277/latest/
[6]http://www.ifp.uiuc.edu/~pramodv/
[7]http://cnx.org/content/m12782/latest/csls13_viswanath_slides.pdf
[8]http://mediasite.cae.wisc.edu/MediasiteLive30/LiveViewer/FrontEnd/Front.aspx?cid=1456656a-3e71-44af-9d28-6544bb4fd6a8

construct new coding schemes as well as to show optimality of several schemes proposed in the space-time coding literature.

6.1.3 Quantum Computing and Cellular Phones

Prof. Rob Calderbank[9] (Princeton University, USA)

Slides of talk [PDF][10] | Video [WMV][11] | Video [MPEG1][12] | Video [Other MPEG formats][13]

ABSTRACT: Multiple antennas are transforming the rate, reliability and reach of wireless systems. Quantum computers are calling into question the security of cryptosystems where security rests on the presumed intractability of factoring. The speaker, Dr. Robert Calderbank, an AT&T Fellow and co-inventor of space-time codes, will use nineteenth century mathematics to connect these two breakthrough technologies.

6.1.4 Proactive Design for Multimedia Communication Systems with Resource and Information Exchanges

By Prof. Mihaela van der Schaar[14] (University of California at Davis, USA)

Slides of talk [PDF][15] | Video [WMV] [16]

ABSTRACT: Due to their flexible and low cost infrastructure, the Internet and wireless networks are poised to enable a variety of multimedia applications, such as videoconferencing, emergency services, surveillance, telemedicine, remote teaching and training, augmented reality, and distributed gaming. However, these networks provide dynamically varying resources with only limited support for the Quality of Service required by the delay-sensitive, bandwidth-intense and loss-tolerant multimedia applications . This variability of resources does not significantly impact delay-insensitive applications (e.g., file transfers), but has considerable consequences for multimedia applications and often leads to unsatisfactory user experience.

To address these challenges, my research is focused on investigating the theory, algorithm design, implementation, and performance analysis of realistic multimedia systems, in order to gain new insights on what basic principles underlie efficient designs, and use these insights to advance the theory and tool-set for building optimized multimedia compression and transmission algorithms, theories and applications.

In this talk, I will discuss a new proactive algorithm and system design that fundamentally changes the non-collaborative way in which competing wireless stations currently interact, by allowing them to exchange information and resources to improve the performance of multimedia applications.

[9] http://www.ee.princeton.edu/people/Calderbank.php
[10] http://cnx.org/content/m12782/latest/csls14_calderbank_slides.pdf
[11] http://mediasite.cae.wisc.edu/MediasiteLive30/LiveViewer/FrontEnd/Front.aspx?cid=1456656a-3e71-44af-9d28-6544bb4fd6a8
[12] http://www.archive.org/download/QuantumComputingandCellularPhones/csls14_calderbank.mpg
[13] http://www.archive.org/details/QuantumComputingandCellularPhones
[14] http://www.ece.ucdavis.edu/~mihaela/
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[16] http://mediasite.cae.wisc.edu/MediasiteLive30/LiveViewer/FrontEnd/Front.aspx?cid=1456656a-3e71-44af-9d28-6544bb4fd6a8

Index of Keywords and Terms

Keywords are listed by the section with that keyword (page numbers are in parentheses). Keywords do not necessarily appear in the text of the page. They are merely associated with that section. *Ex.* apples, § 1.1 (1) **Terms** are referenced by the page they appear on. *Ex.* apples, 1

C Computational Sciences Lecture Series Workshop, § 6.1(11)
computational vision, § 2.1(3)
CSLS workshop, § 1.1(1)

E eigenvalue, § 4.1(7)

G graphical models, § 3.1(5)

I image analysis, § 2.1(3)

O optimization, § 4.1(7)
overview, § 1.1(1)

Q quantum computation, § 5.1(9)

T Trends, § 6.1(11)

W Wireless Communication, § 6.1(11)

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Module: "CSLS Workshops Overview"
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URL: http://cnx.org/content/m12740/1.6/
Page: 1

Module: "CSLS Workshop on Computational Vision and Image Analysis"
By: Pascal Vontobel
URL: http://cnx.org/content/m12735/1.11/
Pages: 3-4

Module: "CSLS Workshop on Graphical Models"
By: Pascal Vontobel
URL: http://cnx.org/content/m12736/1.4/
Pages: 5-6

Module: "CSLS Workshop on Optimization of Eigenvalues"
By: Pascal Vontobel
URL: http://cnx.org/content/m12737/1.5/
Pages: 7-8

Module: "CSLS Workshop on Quantum Computation"
By: Pascal Vontobel
URL: http://cnx.org/content/m12738/1.5/
Pages: 9-10

Module: "CSLS Workshop on Trends in Wireless Communication"
By: Pascal Vontobel
URL: http://cnx.org/content/m12782/1.5/
Pages: 11-12

Computational Sciences Lecture Series at UW-Madison

The goal of the Computational Sciences Lecture Series (CSLS) is to bring together researchers from mathematics (pure and applied), computer science, physics, and engineering to promote cross-fertilization between these fields and to establish computational science as an active research discipline at UW-Madison. The CSLS will consist of several half-day meetings during each year, each meeting consisting of three lectures by distinguished researchers, grouped around a common theme.