

Proceedings of the 33rd WIC Symposium on
Information Theory in the Benelux
and
The 2rd Joint WIC/IEEE Symposium on
Information Theory and Signal Processing in the
Benelux

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Proceedings

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Edited by Raymond N.J. Veldhuis, Luuk J. Spreeuwers, Jasper Goseling and Xiaoying Shao, Enschede

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**Signals and Systems Group, Stochastic Operations Research Group
Faculty of Electrical Engineering, Mathematics and Computer Science
University of Twente**

on behalf of the Werkgemeenschap voor Informatie- en Communicatietheorie, the IEEE Benelux Information Theory Chapter and the IEEE Benelux Signal Processing Chapter.

Organizing committee

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Sandra Westhoff

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Preface

The Werkgemeenschap voor Informatie- en Communicatietheorie (WIC) has organized the annual Symposium on Information Theory in the Benelux (SITB) since 1980. This year's symposium, the 33rd in the series, takes place in Boekelo, The Netherlands. For the second time, it is organized jointly with the IEEE Benelux Signal Processing Chapter. The symposium is organized by the Signals and Systems Group and Stochastic Operations Research Group of University of Twente.

These proceedings contain the papers which are presented during the symposium. We are grateful to the authors for submitting their latest results.

This year we are extremely fortunate to have two renowned invited lecturers: Dr. Job Oostveen (TNO, The Netherlands) and Prof. Gernot Kubin (TU Graz, Austria).

We gratefully acknowledge the sponsorship provided by the Gauss Foundation (presenting the Best Student Paper Award) and the IEEE Benelux Chapter on Information Theory. We also express our sincere thanks to Ms. Sandra Westhoff for her assistance in the organization of the symposium.

We hope that this symposium offers a good opportunity to exchange knowledge and improve personal contacts among the participants.

Enschede, The Netherlands, May 2012,
Raymond Veldhuis, Luuk Spreeuwens, Jasper Goseling, Xiaoying Shao (Symposium Organizers)

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Challenges faced by the mobile operators and the resulting evolution of mobile networks

Job Oostveen
TNO, Dept. Network Technologies, The Netherlands

Abstract

For almost 2 decades, the mobile operators have been able to work in a relatively stable environment: Customers were using voice and SMS services while mobile data (UMTS!) was only picking up slowly, and networks were designed to provide these services from a dominantly macro-cellular deployment.

However, since a number of years, the market has become much more dynamic if not explosive: huge uptake of mobile data usage, declining turnover in voice and SMS, increasing pressure on roaming tariffs, etc. As a consequence, operators have to find solutions to a large spectrum of technical and business-economic challenges. In this presentation I will describe a few of the most influential market trends which the operators are facing. Based on this analysis, I will sketch directions which may provide (partial) answers to the challenges, with a focus on the technical evolution of mobile networks.

Biography

Job is a senior scientist and consultant at TNO Information and Communication Technology in the area of mobile and wireless communications.

After obtaining his M.Sc. from University of Twente and his Ph.D. from the University of Groningen, Job worked at Philips Research Laboratories for over 7 years. Initially as a senior researcher in digital signal processing (with focus on digital watermarking and multimedia recognition. Later he became leader of a team working on signal processing for wireless communications. Throughout this period, he has been involved in global standardisation efforts and transfer of technology to product development.

In 2006, Job joined TNO, where he is responsible for research and consultancy in the area of upcoming radio access network technologies (mainly LTE). His activities range from physical layer (MIMO OFDM) and propagation modelling to network quality monitoring and optimisation.

Signals and systems from an information theory point of view

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Graz University of Technology, Austria

Abstract

Signal processing clearly deals with information processing, but many of the concepts used for the description of signals and systems are rooted in energy as conceptual basis for second-order statistics, such as signal energy, power, correlation, power spectral density etc. When looking for concepts like information or entropy in signal processing textbooks, they are hard to be found. We start from the few known exceptions and expand to a more general theory.

First, linear time-invariant systems can be shown to be "information all-passes", i.e., such filtering changes the entropy rate of a signal by an amount that is independent of the signal properties.

Therefore, we are led to consider nonlinear input-output systems which, from the data processing inequality, can best be characterized in terms of their information loss. We define information loss as a quantitative measure and we apply this concept to both static systems and systems with memory, whose inputs are fed with stationary stochastic processes.

We illustrate our results with examples practically relevant in signal processing such as cascades of static nonlinearities, digital filters with finite word lengths, dimensionality reduction, and multi-rate systems.

Finally, we proceed to nonlinear autonomous systems which are capable of generating information and review the notion of chaotic signals.

Biography

Gernot Kubin was born in Vienna, Austria, on June 24, 1960. He received his Dipl.-Ing. (1982) and Dr.techn. (1990, sub auspiciis praesidentis) degrees in Electrical Engineering from TU Vienna. He is Professor of Nonlinear Signal Processing and head of the Signal Processing and Speech Communication Laboratory (SPSC) as well as the Broadband Communications Laboratory at TU Graz/Austria since September 2000 and January 2004, respectively. He acted as Dean of Studies in EE-Audio Engineering 2004-2007 and as Chair of the Senate 2007-2010, and he has coordinated the Doctoral School in Information and Communications Engineering since 2007. Earlier international appointments include: CERN Geneva/CH 1980, TU Vienna 1983-2000, Erwin Schroedinger Fellow at Philips Natuurkundig Laboratorium Eindhoven/NL 1985, AT&T Bell Labs Murray Hill/USA 1992-1993 and 1995, KTH Stockholm/S 1998, and Global IP Sound Sweden&USA 2000-2001 and 2006, UC San Diego & UC Berkeley/USA 2006, and UT Danang, Vietnam 2009. He is active in several national research centres for academia-industry collaboration such as the Vienna Telecommunications Research Centre FTW 1999-now (Key Researcher and Board of Governors), the Christian Doppler Laboratory for Nonlinear Signal Processing 2002-2010 (Founding Director), the Competence Network for Advanced Speech Technologies COAST 2006-now (Scientific Director), the COMET Excellence Project Advanced Audio Processing AAP 2008-now (Key Researcher), and in the National Research Network on Signal and Information Processing in Science and Engineering SISE 2008-now (Principal Investigator) funded by the Austrian Science Fund. Dr. Kubin is a Member of the Board, Austrian Acoustics Association, and of

the Speech and Language Processing Technical Committee of the IEEE. His research interests are in nonlinear signals and systems, digital communications, computational intelligence, and speech communication. He has authored or co-authored over one hundred forty peer-reviewed publications and ten patents.