Special Session Proposal for IEEE SSP 2014

Title:
Advances in Robust Statistical Signal Processing

Motivation:
Many areas of engineering today show that the distribution of the measurements is far from Gaussian as it contains outliers, which cause the distribution to be heavy tailed. Impulsive (heavy tailed) noise can cause optimal signal processing techniques, especially the ones derived using the nominal Gaussian probability model, to be biased or to even break down. The occurrence of impulsive noise has been reported, for example, in outdoor mobile communication channels, due to switching transients in power lines or automobile ignition, in radar and sonar systems as a result of natural or man-made electromagnetic and acoustic interference. In geolocation position estimation and tracking, nonline-of-sight (NLOS) signal propagation, caused by obstacles such as buildings or trees, results in outliers in the measurements, to which conventional position estimation methods are very sensitive. Today’s biomedical applications include monitoring patients with portable recording devices that are equipped with a transmitter in order to communicate health related information and to trigger alarms in case of life threatening situations. However, these devices suffer severely from patient motion-induced artifacts.

Description of the Session and Relevance for SSP 2014:
Robust systems are becoming more important than ever before. With the increase of complexity of engineering system design and the lack of predictability of natural as well as man-made interference, it is timely to devote a special session on advances in robust statistical methods. These methods allow to analyse and reduce the impact on statistical methods caused by a discrepancy between the modeling assumptions and reality.

In this special session, we focus on advances in robust statistical processing. Much progress has been recently made, e.g., in the areas of

- robustness for multichannel estimation and detection problems
- robust methods for complex valued data, as frequently encountered in array processing, radar, and wireless applications
- robustness for dependent data
- signal processing with non-Gaussian noise models
- robust time-frequency analysis
- robust bootstrap methods
- compressive signal reconstruction using robust estimators
- robust adaptive systems and signal processing

The shared objectives of all these robust methods are, e.g., supressing the effects of outliers while maintaining near-optimality at the nominal model. This will provide a common framework of discussion. At the same time, the specific set of advanced applications will provide new perspectives and engage the ensemble of speakers in a cross-disciplinary discussion. Showing the performance gain when using sophisticated robust methods will emphasize their practical importance and usefulness, not only from a theoretical viewpoint, but from a practical engineering perspective. In this way, the session contributes not only to scholarship for experts in the field, but also provides a comparative discussion of practical aspects of the very recent developments to nonspecialists. This will further develop the field and allow for new highly reliable methods for real-life data, even if the assumptions are only approximately valid.
List of Expected Papers with Preliminary Titles:

1. H. Vincent Poor & Visa Koivunen: “Robust inference for high-dimensional data”.
2. Yuan Chen, Hing Cheung So & Ercan E. Kuruoglu: “Estimation under additive mixture of Cauchy and Gaussian noise by Monte Carlo”.
3. Michael Muma: “Robust model selection for ARMA models based on the bounded influence propagation $\tau$-estimator”.
4. Stefan Vlaski & Abdelhak M. Zoubir: “Robust bootstrap confidence region estimation for geolocation in harsh LOS/NLOS environments”.
5. F. Pascal and Y. Chitour: “Generalized shrinkage covariance matrix estimation for STAP detection”.
6. To be defined.

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Biography of Presenters:

Abdelhak M. Zoubir received his Dr.-Ing. degree from Ruhr-Universität Bochum, Germany. He was with Queensland University of Technology, Australia, from 1992 to 1998. He then joined Curtin University of Technology, Australia, as a professor of telecommunications and was interim head of the School of Electrical and Computer Engineering from 2001 to 2003. Since 2003, he has been a professor of signal processing at Technische Universität Darmstadt, Germany. He is an IEEE Distinguished Lecturer (Class 2010-2011), past chair of the Signal Processing Theory and Methods Technical Committee of the IEEE Signal Processing Society, and he is the editor-in-chief of the IEEE Signal Processing Magazine. His research interest lies in statistical methods for signal processing, applied to telecommunications, radar, sonar, car engine monitoring, and biomedicine. He has published over 300 journal and conference papers in these areas. He is a Fellow of the IEEE.

Michael Muma received the Dipl.-Ing. degree in electrical engineering and information technology from Technische Universität Darmstadt, Darmstadt, Germany. He completed his diploma thesis with the Contact Lens and Visual Optics Laboratory, School of Optometry, Brisbane, Australia on the role of cardiopulmonary signals in the dynamics of the eye’s wavefront aberrations. Currently, he is working toward the Ph.D. degree in the Signal Processing Group, Institute of Telecommunications, Technische Universität Darmstadt, Germany. His defense is scheduled for 30 January 2014. His research is on robust statistics for signal processing with an emphasis on correlated data and model selection. Since 2011, he is IEEE SPS Signal Processing Theory and Methods Student Subcommittee Chair.