

# EE Department Seminars

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Yorgo I Stefanopulos Meeting Lounge (KB 217)

## Advances on Bootstrap Methods for Signal Processing

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The use of more accurate models in signal processing applications such as communications, radar, sonar, biomedical engineering, speech and image processing and machine learning has become a fundamental requirement. With an improved accuracy the models have become more complex and inferential statistical signal processing required in parameter estimation and signal detection and classification, for example, has become intractable. The signal processing practitioner requires a simple but accurate method for assessing errors of estimates and answering inferential questions. Asymptotic approximations are useful only when enough data is available, which is not always possible due to time constraints, the nature of the signal or the measurement setting. In place of the formulae and tables of parametric and non-parametric procedures based on complicated mathematics and asymptotic approximations, tools such as the Bootstrap have revolutionized statistics in the last decade and have become powerful for solving complex engineering problems. It is the method of an engineer's choice for solving inferential signal processing problems, such as signal detection, confidence limits estimation and model selection, to mention a few. First, a brief history of the bootstrap methodology is given. We then discuss the basic principle underlying the bootstrap method for identically and independently distributed data and give several practical examples of its use. A comprehensive overview of the bootstrap for dependent data is also given with emphasis on spectral analysis. Examples with real-life measurements are given throughout the talk.

**Abdelhak M ZOUBIR** is a Fellow of the IEEE and IEEE Distinguished Lecturer (2010-2011). He received his Dr.-Ing. from Ruhr-Universität Bochum, Germany in 1992. He was with Queensland University of Technology, Australia from 1992-1998 where he was Associate Professor. In 1999, he joined Curtin University of Technology, Australia as a Professor of Telecommunications and was Interim Head of the School of Electrical & Computer Engineering from 2001 until 2003. In 2003, he moved to Technische Universität Darmstadt, Germany as Professor and Head of the Signal Processing Group. His research interest lies in statistical methods for signal processing with emphasis on bootstrap techniques, robust detection and estimation and array processing applied to telecommunications, radar, sonar, car engine monitoring and biomedicine. He published over 300 journal and conference papers on these areas. Dr Zoubir has co-authored the book titled *Bootstrap Techniques for Signal Processing* published by Cambridge University Press in 2004 and he Guest Co-Edited a Special Issue on the Bootstrap and Its Applications in the *IEEE Signal Processing Magazine* in 2007. Dr Zoubir co-authored the paper *Detection of Sources Using Bootstrap Techniques* that received the 2003 IEEE SPS Young Author Best Paper Award.

Professor Zoubir was Technical Chair of the 11th IEEE Workshop on Statistical Signal Processing (SSP 2001) held in Singapore in 2001, General Co-Chair of the 3rd IEEE International Symposium on Signal Processing & Information Technology (ISSPIT 2003) held in Darmstadt, Germany in 2003 and General Co-Chair of the 5<sup>th</sup> IEEE Workshop on Sensor Array and Multi-channel Signal Processing (SAM 2008), which was held in Darmstadt, Germany in 2008. Dr Zoubir was an Associate Editor of the *IEEE Transactions on Signal Processing* from 1999-2005 and he currently serves on the Editorial Boards of the EURASIP journals *Signal Processing* and the *Journal on Advances in Signal Processing (JASP)*. Since 2009 he has been a Member of the Senior Editorial Board of the *IEEE Journal on Selected Topics in Signal Processing*. He has been a member of the IEEE SPS Technical Committee *Signal Processing Theory and Methods (SPTM)* since 2002, its Vice-Chair from 2008-2009 and its Chair from 2010-2011. He is a Member of the IEEE SPS Technical Committee *Sensor Array and Multichannel Signal Processing (SAM)* (since 2007) and was a Member of the IEEE SPS Technical Committee on *Signal Processing Education (SpEd)* from 2006-2008. He is an elected member of AdCom for the European Association for Signal and Image Processing (EURASIP).