Eric A. Lehmann

Curriculum Vitæ

Personal Details

Full name	Eric André Lehmann (Ph.D. Eng. ANU, M.Phil. Eng. ANU, Dipl. El.-Ing. ETHZ)
Current position	Research Scientist, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Division of Mathematics, Informatics and Statistics (CMIS)
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Birth year	1976
Citizenship	Swiss, Australian (since March 23, 2009)
Marital status	Married

Higher Education

Postgraduate

2001 – 2004	Doctor of Philosophy in Engineering at the Research School of Information Sciences and Engineering, the Australian National University (ANU), Canberra, Australia *Thesis:* "Particle Filtering Methods for Acoustic Source Localisation and Tracking"
1999 – 2000	Master of Philosophy in Engineering at the Faculty of Engineering and Information Technology, the Australian National University (ANU), Canberra, Australia *Thesis:* "Real-Time Implementation of a Nearfield Broadband Acoustic Beamformer"

Undergraduate

1994 – 1999	Electrical Engineering Diploma ("Dipl. El.-Ing.", Master equivalent) with specialisation in Signal Processing from the Department of Electrical Engineering, Swiss Federal Institute of Technology (ETHZ), Zurich, Switzerland *Examinations:* first and second year examinations ("erstes und zweites Vordiplom"), final diploma examination parts A and B ("Schlussdiplom"): average marks respectively 86.8, 88.8, 86.5 and 88.8% *Diploma thesis:* "Control Algorithms for a Satellite Laser Pointing Mechanism" (industry-based)
1991 – 1994	Lycée cantonal de Porrentruy, Switzerland (university entrance) *Diploma:* scientific Cantonal Maturity Certificate (baccalaureate), obtained with average mark 91%

Scholarship Awards

2001 – 2004	ANU Ph.D. Scholarship, externally funded ANU Tuition Fee Scholarship, externally funded
1999 – 2000	ANU Master Degree Scholarship, externally funded ANU Tuition Fee Scholarship, externally funded

Employment History & Practical Experience

2008 – present *Research Scientist with the Commonwealth Scientific and Industrial Research Organisation (CSIRO)*, within the Division of Mathematics, Informatics and Statistics (CMIS), in Perth, Western Australia. This position currently involves different projects focussing on the application and development of image processing, remote sensing (optical and radar-based) and statistical methods (spatio-temporal data integration) for the assessment, mapping and monitoring of various environmental factors such as forest/vegetation cover and water resources. These projects are carried out in collaboration with various industrial and governmental organisations in Australia and overseas.

2005 – 2008 *Research Fellow with the Western Australian Telecommunications Research Institute (WATRI), Perth*, within the Signal Processing Group. Acted as leader of the *Localisation and Tracking* project (LaMP sub-project), carried out in collaboration with National ICT Australia (NICTA). Research within this project addressed several design issues related to array signal processing, acoustic speaker detection and tracking, distant acquisition and enhancement of speech, voice activity detection, target dynamics modelling, joint audio-video speaker tracking, and real-time implementation of these principles.

2004 *Research Engineer with NICTA, Canberra (3 months).* This work involved the real-time implementation of an algorithm for localising and tracking an acoustic source in reverberant environments, using a scattered array of 16 microphones. This algorithm was based on an enhanced particle filtering method using importance sampling, developed during my previous Ph.D. research. This led to a real-time demonstration system that reliably tracked the location of an acoustic source in a typical office room.

2001 – 2004 *Ph.D. by research at ANU*, under the supervision of Prof. Robert Williamson. The project focused on the study of particle filters (PF) as a new method of dealing with the problem of acoustic source localisation and tracking in reverberant environments, using array signal processing principles. It involved the simulation of several particle filters using recordings of real audio data. An important part of the research was the real-time C/C++ implementation of a PF-based source localisation algorithm on a standard computer running Linux. This research was done partly in collaboration with Dr. Darren Ward from Imperial College, London, UK.

1999 – 2000 *Master Degree by research at ANU*, under the supervision of Prof. Robert Williamson. The project developed a practical nearfield broadband beamformer using an array of acoustic sensors. It involved the design, simulation and practical implementation of various signal processing blocks and control units, under the constraints of a real-time digital realisation. The beamformer was implemented using the SCOPE System from Creamware (PCI card with 15 processors ADSP-2106x) to process the real-time data from a 15 microphone array. This research resulted in a fully integrated development tool for spatial filtering applications.

1998 – 1999 *Industry-based diploma thesis at Oerlikon Contraves (Space Technology), Zurich.* The object of the research was a terminal for short range optical communication developed by the company Oerlikon Contraves AG for the European Space Agency. This device was to be ultimately installed on the satellites of a telecommunication constellation to allow an inter-satellite crosslink using full duplex laser beams. The principal objective of this project was to design several digital control algorithms to steer the laser pointing mechanism, and to assess their respective performance in response to various types of disturbance. The final controller was implemented on a DSP system (ADSP-21020) driving a real model of the terminal.

1998 *Semester project at ETHZ (6 months).* Three different algorithms for voice activity detection were designed and simulated for an implementation on a mobile mail delivery

robot. It involved the extraction of specific features of the human voice buried in noise to render speech/no-speech decisions, which in turn provided some important information for the control of the robot's motion when used in environments shared with humans.

1997 *Semester project at ETHZ (6 months)*. The result of the project was the practical realisation of a digital audio effect unit. To this purpose, a custom electronic circuit board based on the ADSP-21061 chip (Analog Devices) was built and several DSP-Assembler routines were developed to perform the desired sound effects. This practical realisation provided an excellent experience of the constraints of real-time and digital audio applications.

1997 *Internship at Philips Semiconductor AG, section Cordless, Zurich (3 months)*. This internship involved the Assembler programming of a DSP chip (Analog Devices ADSP-2185) to test for defects in electronic chips (Philips P87CL884) generating DTMF signals (Dual Tone Multi-Frequency, telephone tones for tone dialling). Several other demonstration circuits and micro-Assembler routines were also developed with the specialised microcontroller chip P87CL884. Important knowledge of electronic circuits, microcontrollers and Assembler programming was gained during this practical training.

Selected Publications

- E. Lehmann, P. Caccetta, Z.-S. Zhou, A. Mitchell, I. Tapley, A. Milne, A. Held, K. Lowell and S. McNeill, "Forest Discrimination Analysis of Combined Landsat and ALOS-PALSAR Data", *International Symposium on Remote Sensing of Environment (ISRSE 2011)*, Sydney, Australia, April 2011
- Anders M. Johansson and Eric A. Lehmann, "Evolutionary Optimization of Dynamics Models in Sequential Monte Carlo Target Tracking", *IEEE Transactions on Evolutionary Computation*, vol. 13, no. 4, pp. 879-894, August 2009
- Eric A. Lehmann and Anders M. Johansson, "Prediction of Energy Decay in Room Impulse Responses Simulated with an Image-Source Model", *Journal of the Acoustical Society of America*, vol. 124, nr. 1, pp. 269–277, July 2008
- Eric A. Lehmann, Anders M. Johansson, and Sven Nordholm, "Modeling of Motion Dynamics and its Influence on the Performance of a Particle Filter for Acoustic Speaker Tracking", *IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA'07)*, pp. 98–101, New Paltz, NY, USA, October 2007
- Eric A. Lehmann and Anders M. Johansson, "Particle Filter with Integrated Voice Activity Detection for Acoustic Source Tracking", *EURASIP Journal on Advances in Signal Processing*, vol. 2007, Article ID 50870, 11 pages, 2007
- Eric A. Lehmann, "Particle Filtering Approach to Adaptive Time-Delay Estimation", *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP'06)*, vol. 4, pp. 1129–1132, Toulouse, France, May 2006
- Eric A. Lehmann and Robert C. Williamson, "Particle Filter Design using Importance Sampling for Acoustic Source Localisation and Tracking in Reverberant Environments", *EURASIP Journal on Applied Signal Processing*, vol. 2006, Article ID 17021, 9 pages, 2006
- Darren B. Ward, Eric A. Lehmann, and Robert C. Williamson, "Particle Filtering Algorithms for Tracking an Acoustic Source in a Reverberant Environment", *IEEE Transactions on Speech and Audio Processing*, vol. 11, nr. 6, pp. 826–836, November 2003

Research Interests

A significant part of my research so far has been in the fields of Bayesian estimation and Sequential Monte Carlo methods, acoustics and acoustic source localisation/tracking, speech processing and enhancement, array signal processing, and real-time digital signal processing.
My research work currently focuses on image processing of remote sensing data (optical, radar, sonar), statistical methods for the integration of spatio-temporal data, and statistical model–data assimilation techniques.
I am also generally interested in applying my knowledge of signal processing and statistical techniques to different fields of scientific research such as telecommunications, video processing, biomedicine, marine science, etc.

General Skills

General Knowledge

University majors	Discrete-time systems and stochastic signals, analog and digital signal processing and filtering, adaptive filters and neural networks, specialised processors for signal processing, communications systems, acoustics
Ph.D. coursework	Overview courses on: machine learning, logic and automated reasoning, computer vision, telecommunications engineering (wireless communication)
Other	Workshops/seminars attended on: intellectual property, commercialisation

Computer Science

Programming	Matlab/Simulink, Maple, [R], C/C++, LaTeX 2_ε, micro-controller Assembler (Philips Semiconductors, Motorola, STMicroelectronics), DSP-Assembler (Texas Instruments, Analog Devices)
Software	ENVI (SARscape), ER Mapper (image processing and analysis); Protel (PCB design); SCOPE and SCOPE DSP Developer Kit (signal processing tool by Creamware); SHARC EZ-Kit (ADSP-2106x development tool); and generic software under Windows and Linux (OpenOffice, Microsoft Office, XEmacs, etc.)

Languages

French	Native language
German	Fluent: studies in German-speaking Switzerland from 1994 until 1999
English	Current first language (fluent)

Personal Interests

Music	Didgeridoo, acoustic and electric guitar
Sport	Swimming, horse riding, abseiling, caving
Precision games	Darts, billiards (French and American)
Electronics	Design and production of custom PCBs, Assembler programming for micro-processor-based electronic circuits, general software and GUI programming
Other	Photography, travelling, Calvin & Hobbes comics