



AALBORG UNIVERSITY  
DENMARK

# NEWSLETTER

Centre for Acoustic Signal Processing Research  
(CASPR)

July 2018

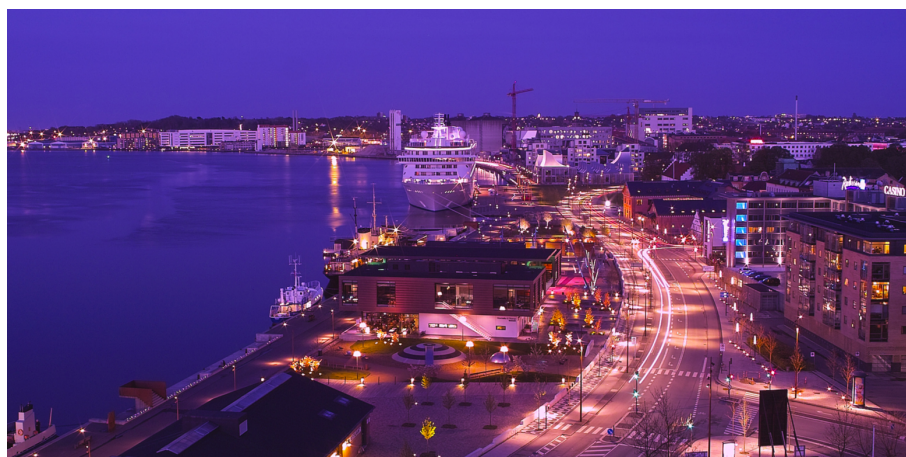
The Centre for Acoustic Signal Processing Research (CASPR) is a research centre at the Section for Signal and Information Processing, Department of Electronic Systems, Aalborg University, Denmark. CASPR is supported by the Oticon Foundation, Oticon A/S, and Aalborg University.

The IEEE 28th International Workshop on Machine Learning for Signal Processing (MLSP2018) will be held in Aalborg, Denmark, September 17-20, 2018, with Zheng-Hua Tan of CASPR as the general chair. This series of workshops is the major event organized annually by the IEEE Signal Processing Society MLSP Technical Committee.

You may take advantage of early registration before July 31, 2018 at: <http://mlsp2018.conwiz.dk>.

## Contents

- 1 CASPR and MLSP
- 2 Research & Teaching
- 4 Research Highlights
- 6 News
- 7 Publications
- 8 PhD Stipends



Department of Electronic Systems  
Signal and Information Processing Section  
Aalborg University

# Research in CASPR

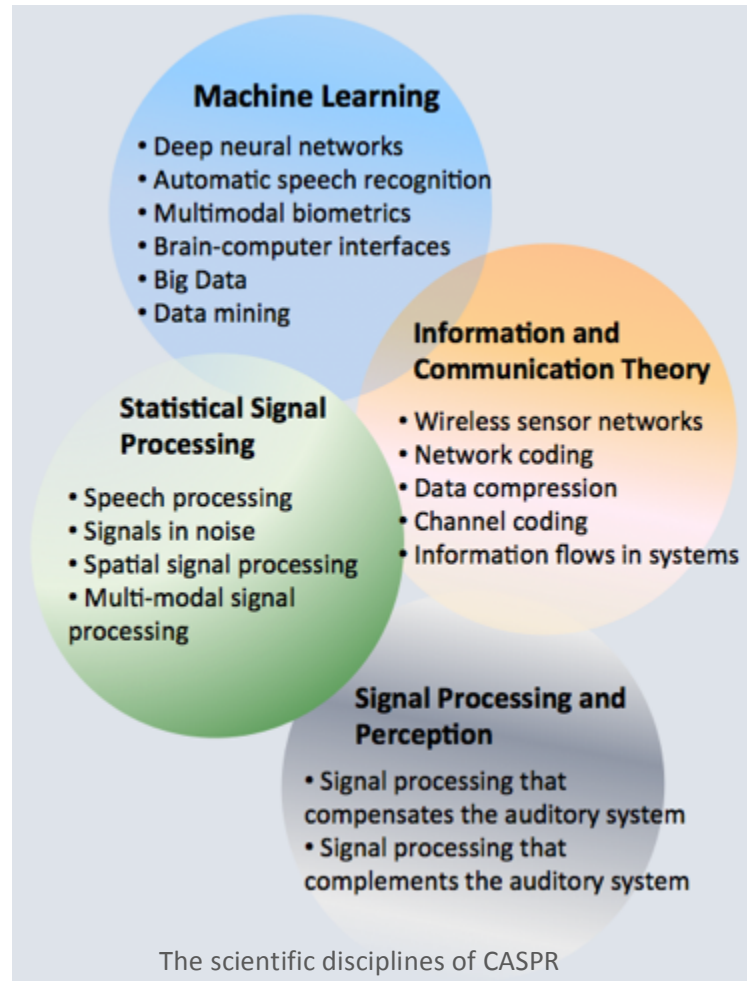
CASPR is conducting research related to advanced statistical signal processing solutions for assistive listening. The research finds direct use in communication devices such as hearing aids, helmets, headphones, cochlear implants, ear monitor, ear pieces, diagnostic equipment, etc. However, the envisioned research also finds use in related areas such as robust speech/speaker recognition, brain computer interfaces, acoustic event detection, etc.

The scientific scope of CASPR encompasses

- statistical signal processing.
- machine learning.
- information and communication theory with applications to wireless exchange of information between listening devices and other external devices.
- pattern recognition.
- data mining in body worn sensor data.
- perception-based statistical signal processing.

CASPR will navigate in a rapidly changing technological landscape: we envision a near future, where the technological landscape allows very different, and better, hearing assistive devices than are known today. Specifically, we envision that near-future hearing assistive devices will:

- increase the wireless exchange of information with each other, with other body-worn devices and with devices outside the body.
- make use of additional microphones on or outside the body, and will employ other types of body-worn or outside-the-body sensors.
- work in a much closer symbiosis with the user.



# Teaching in CASPR

## Current courses related to CASPR

CASPR is heavily involved in teaching and education at B.Sc., M.Sc., PhD., and Postdoc level in disciplines that are relevant to the scientific scope of CASPR:

- Machine Learning (Master and PhD courses), Fall+Spring, 2018.
- Deep Learning (PhD course), Spring 2018.
- Information Theory (Master and PhD courses), Fall 2018.
- Optimization (Master course), Fall 2018.

CASPR is currently involved in seven student projects:



Søren Skov. Project on *"Indoor Visual Navigation using Deep Reinforcement Learning"*. Mathematical Engineering, long thesis project.



Poul Hoang. Project on *"A Hybrid Approach for Speech Enhancement with DNN Supported Acoustic Beamforming"*. Signal Processing and Computing, 10th Semester project with Oticon A/S.

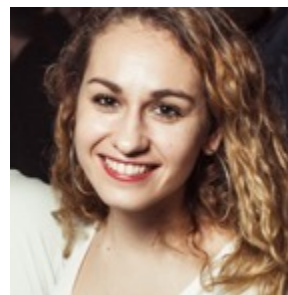
Morten Ø. Nielsen, Sanne D. Nielsen, Julius Garde. Project on *"Acoustic Source Localization in Small Rooms Using Compressive Sensing"*. Mathematical Engineering, 8th Semester project with Bang & Olufsen.



Thomas R. Hansen, Mathias B. Pedersen, Hoza B. Maniragaba. Project on *"Convolution Framelets for High-Quality Multi-Channel Audio Coding"*. Mathematical Engineering, 10th Semester. With Oticon A/S.



Peter S. Frederiksen. Project on *"Single-Channel BLSTM Enhancement for Language Identification"*. Mathematical Engineering, long thesis project.



Andrea L. Coifman, Péter Rohoska. Project on *"Measuring the Attention Level of a User Through Contextual Features in the Home"*. Vision, Graphics and Interactive Systems, long thesis project with Bang & Olufsen.

Mathias Bülow Kastbjerg. Project on *"Speaker De-Identification using a Factorized Hierarchical Variational Autoencoder"*. Mathematical Engineering, 10th Semester project.



# CASPR Research Project in Focus

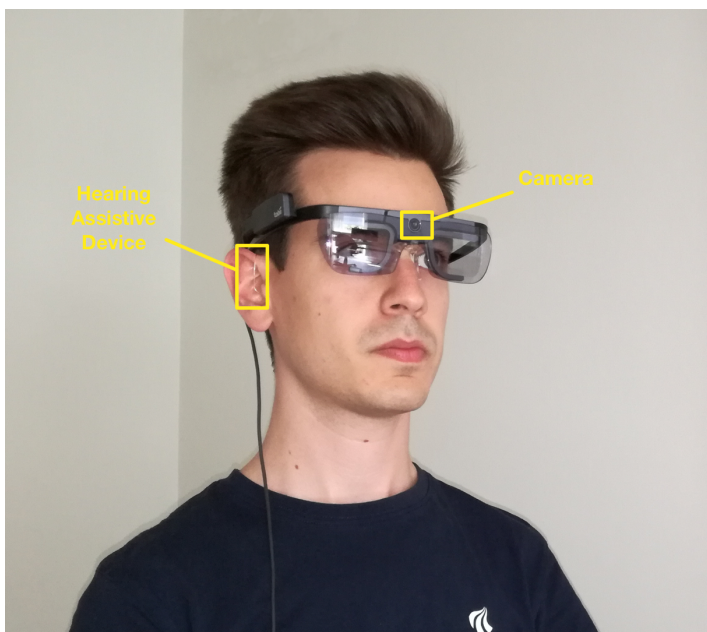
## PhD Project: Audio-Visual Speech Enhancement for Hearing Assistive Devices by Daniel Michelsanti

In many situations human-human communication can be problematic due to background noise. Especially for hearing impaired people, the presence of a background noise can be very disturbing, which may limit communication quality, and even influence their social life. The task of reducing this noise by improving the quality and the intelligibility of the target speech is known as speech enhancement. Most speech enhancement systems try to estimate the clean speech by processing only the audio signal. However, speech is not a unimodal process since its production is based on the movements of the articulatory organs that are visible to the listener, as well as general facial expressions of the target speaker. Hence, better speech enhancement systems may be devised by integrating visual cues, e.g. facial expression of the target speaker, in the enhancement process. Nowadays, this integration is possible thanks to technological advances that have allowed to considerably reduce the size of cameras, and have increased the available computational power, which may be embedded in wearable devices.



PhD student Daniel Michelsanti

With this project we aim at studying audio-visual speech enhancement for hearing assistive devices. We will focus our investigation on audio-visual systems that are able to work in real-world conditions, where no prior knowledge is available regarding the talkers and the environment. This may make it possible to develop better algorithms for hearing aid systems and improve the life quality of many people with a hearing loss.



# News - MLSP 2018

The IEEE 28th International Workshop on Machine Learning for Signal Processing (MLSP2018), will be held in Aalborg, Denmark, September 17-20, 2018, with Zheng-Hua Tan of CASPR as the general chair.

Machine learning, as the driving force of the AI wave, provides powerful solutions to many real-world technical and scientific challenges. The 28th MLSP workshop, an annual event organized by the IEEE Signal Processing Society MLSP Technical Committee, will present the most recent and exciting advances in machine learning for signal processing through keynote talks, tutorials, as well as special and regular single-track oral and poster sessions. MLSP2018 further features data competition, best student paper award, and a networking event.

## **Highlight topics:**

- Neural networks and deep learning
- Speech and audio processing applications
- Image and video processing applications
- Bayesian Learning and modeling
- Source separation and independent component analysis
- Signal detection, pattern recognition and classification
- Semi-supervised and unsupervised learning
- Learning from multimodal data
- Biomedical applications and neural engineering
- Learning theory and modeling

## **Invited talks:**

- The Bayesian Bonus: Benefits of Being Bayesian in the Deep Learning Era. Prof. Max Welling, Professor at the University of Amsterdam, the Netherlands and VP Technologies at Qualcomm, USA
- End to End Speech Recognition Systems Explored. Distinguished Scientist and Vice General Manager, Dong Yu, Tencent AI Lab, Seattle, USA
- Temporal Models with Low-rank Spectrogram. Senior Researcher Cédric Févotte, CNRS, Toulouse, France
- A Reality Check on Data Driven Business – What are the Real Life Potential and Barriers? Data Science Evangelist Kaare Brandt Petersen, Implement Consulting Group, Copenhagen, Denmark
- Opening the Black Box – How to Interpret Machine Learning Functions and Their Decisions. Prof. Lars Kai Hansen and Laura Rieger, Technical University of Denmark, Denmark
- Bayesian Filtering and Smoothing Methods for Machine Learning. Prof. Simo Särkkä, Aalto University, Helsinki, Finland

For details, please refer to <http://mlsp2018.conwiz.dk>

# NEWS



Poul Hoang will start as an Industrial PhD in CASPR on August 15, 2018. The title of the PhD project is "User-Symbiotic Speech Enhancement for Hearing Aid Systems" and is in collaboration with Oticon A/S.

Prof. Zheng-Hua Tan had a research stay at Computer Science and Artificial Intelligence Laboratory (CSAIL), MIT, Cambridge, USA, to collaborate on deep learning for speech processing. He gave a talk at MIT on the same topic as well.

Prof. Zheng-Hua Tan has become an elected Member of the IEEE Signal Processing Society Machine Learning for Signal Processing Technical Committee (MLSP TC).

Prof. Jesper Jensen gave a keynote lecture at Imperial College London on June 27, 2018, to mark the retirement of Prof. Mike Brookes. The title of the talk was "Signal Processing for Hearing Aid Systems – A Historical Tour".



Prof. Mike Brookes, Imperial College London.

Graduate students supervised by CASPR staff successfully defended their Master theses in June 2018:

- Thomas R. Hansen
- Hoza B. Maniragaba
- Mathias B. Pedersen
- Søren Skov
- Peter S. Frederiksen
- Andrea L. Coifman
- Peter Rohoska
- Poul Hoang

Please visit the CASPR website  
<http://caspr.es.aau.dk> for more news.

# Recent CASPR Related Research Publications

## Journal Papers

1. Zero-Delay Rate Distortion via Filtering for Vector-Valued Gaussian Sources. P.A. Stavrou, J. Østergaard, and C. Charalambous. Accepted by IEEE Journal on Selected Topics in Signal Processing.
2. Refinement and Validation of the Binaural Short Time Objective Intelligibility Measure for Spatially Diverse Conditions. A.H. Andersen, J.M. de Haan, Z.-H. Tan and J. Jensen, accepted by Speech Communication.
3. Non-Intrusive Speech Intelligibility Prediction using Convolutional Neural Networks. A.H. Andersen, J.M. de Haan, Z.-H. Tan and J. Jensen, accepted by IEEE/ACM Transactions on Audio, Speech and Language Processing.
4. A Spatial Self-Similarity Based Feature Learning Method for Face Recognition under Varying Poses. X. Duan and Z.-H. Tan, accepted by Pattern Recognition Letters, 2018.
5. Bias-compensated Informed Sound Source Localization Using Relative Transfer Functions. M. Farmani, M. S. Pedersen, Z.-H. Tan, and J. Jensen, IEEE/ACM Transactions on Audio, Speech and Language Processing, Vol.27, No.7, pp.1271-1285, 2018.
6. Using Closed-set Speaker Identification Score Confidence to Enhance Audio-based Collaborative Filtering for Multiple Users. S.E. Shepstone, Z.-H. Tan and M.S. Kristoffersen, accepted by IEEE Transactions on Consumer Electronics, 2018.
7. Evaluation and Comparison of Late Reverberation Power Spectral Density Estimators. S. Braun, A. Kuklasinski, O. Schwartz, O. Thiergart, E.A.P. Habets, S. Gannot, S. Doclo, and J. Jensen, IEEE/ACM Transactions on Audio, Speech and Language Processing, Vol.26, No.6, pp.1052-1067, 2018.
8. A Perceptually Motivated LP Residual Estimator in Noisy and Reverberant Environments. R. Peng, Z.-H. Tan, X. Li, and C. Zheng, accepted by Speech Communication, 2017.

## Conference Papers

1. Effectiveness of Single-Channel BLSTM Enhancement for Language Identification. P.S. Frederiksen, J. Villalba, S. Watanabe, Z.-H. Tan and N. Dehak, accepted by Interspeech 2018, Hyderabad, India, September 2-6, 2018.
2. M. Farmani, M. S. Pedersen, and J. Jensen, Sound Source Localization for Hearing Aid Applications using Wireless Microphones, accepted for IEEE Sensor Array and Multichannel Signal Processing Workshop, 2018.
3. J. Amini, R. C. Hendriks, R. Heusdens, M. Guo and J. Jensen, Operational Rate-Constrained Noise Reduction for Generalized Binaural Hearing Aid Setups, 2018 Symposium on Information Theory and Signal Processing in the Benelux.
4. A. Koutrouvelis, R.C. Hendriks, R. Heusdens, S. van de Par, J. Jensen, and M. Guo, Evaluation of Binaural Noise Reduction Methods in Terms of Intelligibility and Perceived Localization, Accepted for European Signal Processing Conference, 2018.
5. J. Amini, R. C. Hendriks, R. Heusdens, M. Guo, and J. Jensen, Operational Rate-Constrained Beamforming in Binaural Hearing Aids, Accepted for European Signal Processing Conference, 2018.
6. On Zero-Delay Source Coding of LTI Gauss-Markov Systems with Covariance Matrix Distortion Constraints. P. Stavrou, J. Østergaard, M. Skoglund, The European Control Conference (ECC), June 2018.
7. Monaural Speech Enhancement Using Deep Neural Networks by Maximizing a Short-Time Objective Intelligibility Measure. M. Kolbæk, Z.-H. Tan and J. Jensen, The 43th IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2018), 15-20 April 2018, Calgary, Alberta, Canada.
8. Fixed-Rate Zero-Delay Source Coding for Stationary Vector-Valued Gauss-Markov Sources. P.A. Stavrou and J. Østergaard, IEEE Data Compression Conference (DCC), March 2018.

# PhD Stipends available in CASPR

CASPR has a fully funded PhD stipend available:

## **PHD STIPEND IN SIGNAL QUALITY ESTIMATION FOR SPEECH ENHANCEMENT USING MINIATURE EEG DEVICES**

The main objective of this PhD project is to estimate the perceived speech or sound quality from EEG signals recorded by in-ear and around the ear EEG devices. Such compact EEG devices may be integrated into various hearing assistive devices (HADs), for example to help guide the signal processing in the HADs. In this PhD project, a signal processing and information theoretic approach will be pursued, which involves the use of recent results on information losses in the human auditory system, fundamental information flows in the EEG signals, and variants of transfer entropy.

We are looking for highly motivated, independent, and outstanding students that desire to do a successful 3-year PhD programme at Aalborg University. The ideal candidates must have strong expertise in one or more of the following disciplines: statistical signal processing, auditory processing, information theory, or estimation theory. Good English verbal and written skills are a must. Excellent undergraduate and master degree grades are desired. PhD positions in Denmark are fully funded, i.e. no tuition fees, and come with a salary. The salary is subject to a pay grade system based on prior working experience since completing your undergraduate degree. The yearly gross salary is in the range 41.500 – 50.100 Euros.

You may obtain further information about the PhD stipends from Professor (MSO) Jan Østergaard (jo@es.aau.dk), CASPR, Aalborg University, concerning the scientific aspects of the stipends.

To apply for the position, please check the AAU job portal at:  
<https://www.vacancies.aau.dk/show-vacancy/?vacancy=982588>

**Aalborg University** (<http://www.en.aau.dk>) is one of the leading Danish universities with campuses in Aalborg, Esbjerg and Copenhagen. The student population of AAU comprises of around 21.000 regular (both undergraduate and postgraduate) students and 947 PhD students. AAU is famous for its innovative problem and project based learning approach (PBL) where students work on team-based projects solving 'real-life' problems in collaboration with organisations or companies. Aalborg University is acknowledged for collaboration with industry and according to Shanghai/ARWU World Rank, Aalborg University is no.7 in the world within the research field of Electronic and Electrical Engineering. Aalborg University is ranked the best university in Europa and the eighth best university worldwide for engineering according to the Best Global Universities list published by U.S. News and World Report, 2017.