NEWSLETTER

Centre for Acoustic Signal Processing Research (CASPR)

January 2022

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

Contents

Department of Electronic Systems
Section on Artificial Intelligence & Sound
Aalborg University

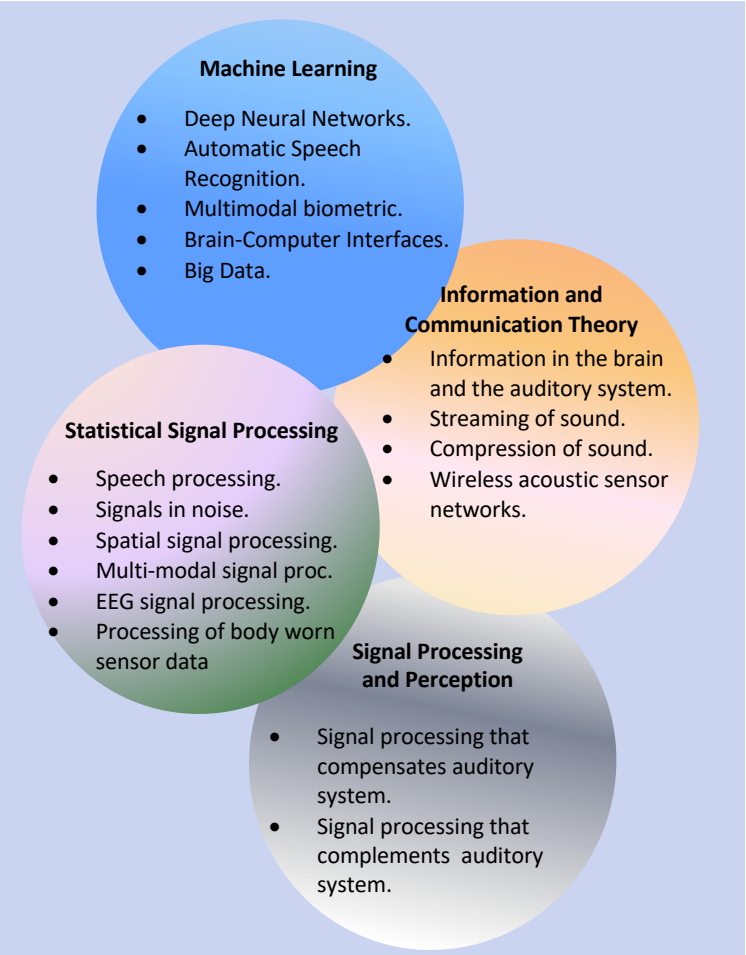
Research in CASPR

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.

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.

The scientific scope of CASPR encompasses

- Signal processing for hearing assistive devices that use multiple modalities such as sound, vision, EEG, and other body signals.
- Advanced signal processing concepts in closer symbiosis with the user in order to e.g., automatically adapt to the user's needs.
- Beyond audibility. Restore audibility, increase intelligibility, decrease listening effort.



Scientific disciplines of CASPR

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:

- Control and optimization, PhD course.
- Machine learning, Master and PhD courses.
- Deep learning, PhD course.
- CASPR Seasonal Schools on Signal Processing for Hearing Assistive Devices.
- Optimization methods, Master course.
- Information theory, Master course.
- Platforms and methods for multi-modal system architectures, Master course.

CASPR is currently involved in 8 student projects:

Project 1
Improved Audio-Visual Speech Inpainting.
Mathematical Engineering, long Master thesis project with Oticon A/S.
Dennis Grøndahl Andersen, Mikkel Fjord Olsen.

Project 2
Real-time Voice Activity Detector based on Machine Learning.
Signal Processing and Acoustics, long Master thesis project with RTX A/S.
Claus Meyer Larsen

Project 3
Separating Mixed Speaker Signals into Individual Audio Tracks.
Signal Processing and Acoustics, 7th semester project with Idun Audio A/S.
Gustav Juul Lind Pedersen, Jacob Alexander Rasmussen, Frederik Sidenius Dam.

Project 4
Zero-delay multiple-description audio coding.
Mathematical Engineering, long thesis project with RTX A/S.
Kristian Søgaard.

Project 5
Eye-gaze Steered Beamforming for Hearing Aids.
Mathematical Engineering, long thesis project with Oticon A/S.
Simone Birk Bols Thomsen.

Project 6
Deep Neural Networks for Audio Coding I.
Mathematical Engineering, 7th semester project.
Magnus Jónhardsson, Sisse Hyldig Pedersen, Frederik Appel Vardinghus-Nielsen, Benjamin Knudsen, Frederik Christensen

Project 7
Deep Neural Networks for Audio Coding II.
Mathematical Engineering, 7th semester project.
Alexander Djupnes Fuglkjær Andreas Kühne Larsen, Mads Arnløv Jørgensen, Magnus Berg Ladefoged, Gustav Wagner Zakarias.

Project 8
Control of sound zones with wireless speakers.
B.Sc. thesis in Electronic and IT.
Klaus Nørholm Frandsen Hammer, Martin Christensen, Niels Christian Paredes Dyrberg.

CASPR Continuation

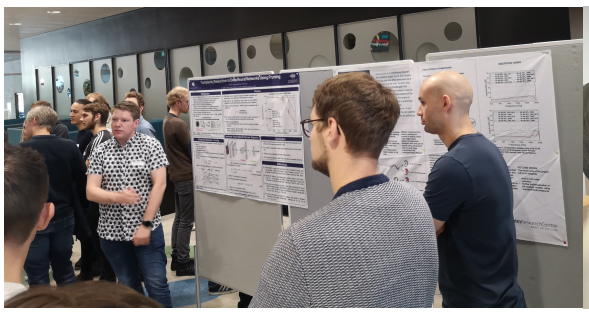
We are happy to announce that the William Demant Foundation, Aalborg University, and Oticon A/S has agreed to financially support a 5-year continuation of CASPR for the period November 1st, 2021 – October 31st, 2026.

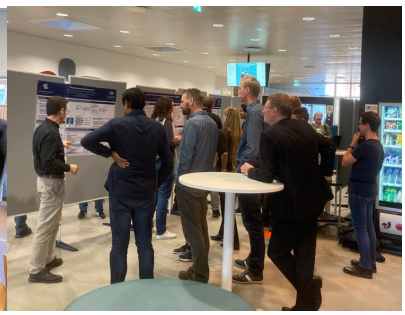
To celebrate the continuation, we organized an open lab event to demonstrate our latest research within AI and sound. The event took place on Monday November 29th, 2021, at Aalborg University, and hosted 60 participants from industry and academia.

Talks were given by Morten Dahlgaard, Deputy Director, AAU Innovation, Aalborg University, Finn Möhring, Senior Vice President R&D, Oticon, and Kim Tilgaard Petersen, Vice President, Audiology & Embedded Systems, Oticon.

Poster presentations:

- User symbiotic hearing aids, Poul Hoang, Oticon
- EEG attention decoding in music, Adele Simon, B&O
- EEG-based perceived SNR of noisy speech, Payam Shahsavari, AAU
- Complexity reduction in deep natural networks, Morten Ø. Nielsen, AAU
- Voice conversion using deep variational autoencoders, Yuying Xie, AAU
- Joint far and near end speech intelligibility enhancement for headsets, Andreas Fuglsig, RTX
- Deep learning for hearing loss compensation, Peter Asbjørn Leer Bysted, Oticon
- DNN based speech enhancement and separation, Zheng-Hua Tan & Jesper Jensen, AAU
- Deep Spoken Keyword Spotting, Ivan Lopez Espejo, AAU





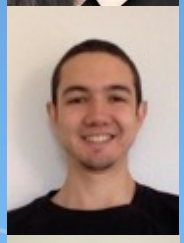
Lab demonstrations:

- Audio-visual lip- reading and speech enhancement – Daniel Michelsanti, Oticon
- Eye-tracking and pupillometry measurements – Aleksandra Kaszowaka, AAU
- Sound zones at hospitals and domestic environments, Lars Bo Larsen, AAU
- Make a room sound like any other room – spatial decomposition methods, Christian S. Pedersen, AAU

News

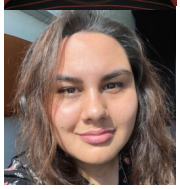
CASPR staff is involved in the following new PhD projects in the context of the Marie Skłodowska-Curie Actions European Training Network (MSCA-ETN) entitled “Service-Oriented Ubiquitous Network-Driven Sound (SOUNDS)” (https://www.sounds-etn.eu/).

Researcher: Vasudha Sathyapryiari
Project: Distributed Sound Source Localization.
With Oticon A/S.



Researcher: Jose Cavadid
Project: Learning and Compressing Acoustic Changes in Networks.
With B&O A/S.

Researcher: Mohammad Bokaei
Project: Real-Time Distributed Speech Compression and Enhancement.
With Oticon A/S.



Researcher: Pia Porysek
Project: Quantification of perceived quality of sound fields with dynamic relations between listener positions and audio objects.
With B&O A/S.

PhD researcher Morten Ø. Nielsen presented his paper entitled “Compression of DNNs Using Magnitude Pruning and Nonlinear Information Bottleneck Training” at IEEE Int. Workshop on Machine Learning for Signal Processing (MLSP), October, 2021.

Prof. Zheng-Hua Tan is appointed to be member of the IEEE Signal Processing Society Conferences Board for the term 2022-2024.

Visiting PhD researcher to CASPR, Juan M. Martín-Doñas, has received the 2021 best journal paper award of the Spanish Network of Speech Technologies for the paper “Online Multichannel Speech Enhancement Based on Recursive EM and DNN-Based Speech Presence Estimation”, J. M. Martín-Doñas, J. Jensen, Z.-H. Tan, A. Gomez and A. Peinado, IEEE/ACM Transactions on Audio, Speech, and Language Processing, Vol. 28, pp. 3080-3094, Dec. 2020. The paper was a result of a collaboration initiated with Juan M. Martín-Doñas’ research stay at CASPR in 2020.

Recent CASPR Related Research

Journal papers

1. The Minimum Overlap-Gap Algorithm for Speech Enhancement. P. Hoang, Z.-H. Tan, J. Haan, J. Jensen. Accepted by IEEE Access.

2. Deep Spoken Keyword Spotting: An Overview. I. López-Espejo, Z.-H. Tan, J. Hansen, and J. Jensen. IEEE Access, 2022. Accepted.

3. Multichannel Speech Enhancement with Own Voice-Based Interfering Speech Suppression for Hearing Assistive Devices. P. Hoang, J. M. de Haan, Z.-H. Tan, and J. Jensen. IEEE Trans. Audio, Speech, Language Process., 2022. Accepted.

4. A Family of Split Kernel Adaptive Filtering Algorithms for Nonlinear Stereophonic Acoustic Echo Cancellation. S. Burra, S. Sankar, A. Kar, J. Østergaard. Journal of Ambient Intelligence and Humanized Computing, 2022. Accepted.

5. Performance of Low Complexity Fully Connected Neural Networks for Monoaural Speech Enhancement. H. Reddy, A. Kar, J. Østergaard. Applied Acoustics, 2022. Accepted.

6. Creating Clarity in Noisy Environments by Using Deep Learning in Hearing Aids. A. H. Andersen, S. Santurette, M. S. Pedersen, E. Alickovic, L. Fiedler, J. Jensen and T. Behrens. Seminars in Hearings, No.3, Vol. 42, Aug. 2021.

7. A Family of Adaptive Volterra Filters Based on Maximum Correntropy Criterion for Improved Active Control of Impulsive Noise. G. Gowthan, S. Burra, A. Kar, J. Østergaard, P. Sooraksa, V. Mladenovic, D.B. Haddad. Springer Circuits, Systems, and Signal Processing. August 2021.

Conference Papers

1. Joint Far- and Near-End Speech Intelligibility Enhancement based on the Approximated Speech Intelligibility Index. A.J. Fuglsig, J. Østergaard, J. Jensen, L.S. Bertelsen, P. Mariager, Z.-H. Tan. Accepted for presentation at IEEE International Conference on Acoustics, Speech, & Signal Processing (ICASSP), 2022.

2. A Stimuli-Relevant Directed Dependency Index for Time Series. P.S. Baboukani, S. Theodoridis, J. Østergaard. Accepted for presentation at IEEE International Conference on Acoustics, Speech, & Signal Processing (ICASSP), 2022.

3. EEG Phase Synchrony Reflects SNR Levels During Continuous Speech-in-Noise Tasks. P. S. Baboukani, C. Graversen, E. Alickovic, J. Østergaard, Proceedings of the 43rd Annual International Conference of the IEEE Eng. In Medicine & Biology Society (EMBC), 2021.

4. Improved intelligibility prediction in the modulation domain. Alghamdi, W.-Y. Chan, D. Fogerty and J. Jensen. Proc. IEEE WASPAA. 2021.

5. Compression of DNNs Using Magnitude Pruning and Nonlinear Information Bottleneck Training. M. Ø. Nielsen, J. Østergaard, J. Jensen, Z.-H. Tan. Proc. IEEE Int. Workshop on Machine Learning for Signal Processing (MLSP), 2021.

6. A Spectro-Temporal Glimpsing Index (STGI) for Speech Intelligibility Prediction. A. Edraki, W.-Y. Chan, J. Jensen, and D. Fogherty, Proc. Interspeech, 2021.

7. Disentangled Speech Representation Learning Based on Factorized Hierarchical Variational Autoencoder with Self-Supervised Objective. Y. Xie, T. Arildsen, Z.-H. Tan, Proc. of IEEE 31st International Workshop on Machine Learning for Signal Processing (MLSP), 2021.

PhD Stipends Available in CASPR

CASPR will have one or more fully funded PhD stipends available in 2022. 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 perception, machine learning, 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 Jan Østergaard (jo@es.aau.dk), Professor Zheng-Hua Tan (zt@es.aau.dk), or Professor Jesper Jensen (jje@es.aau.dk), CASPR, Aalborg University, concerning the scientific aspects of the stipends.

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 20.000 regular (both undergraduate and postgraduate) students and 900 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 U.S. News & World Report, Aalborg University is the best Engineering University in Europe and the fourth best worldwide.