



AALBORG UNIVERSITY
DENMARK

NEWSLETTER

Centre for Acoustic Signal Processing Research
(CASPR)

January 2024

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.



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

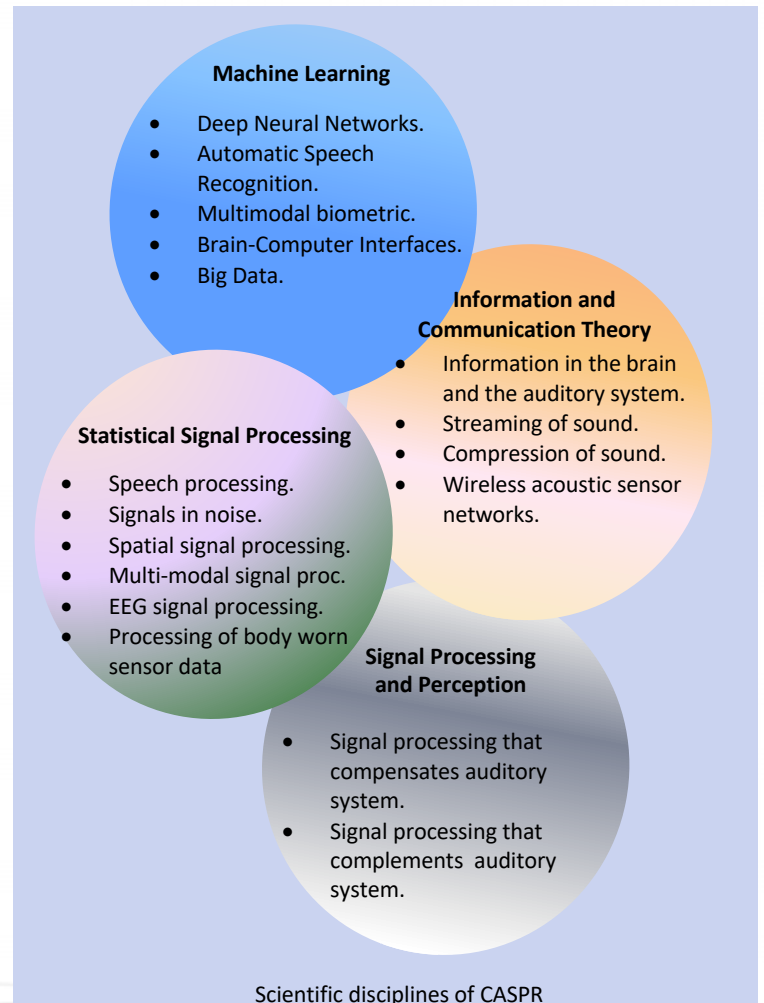
Research in CASPR

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.



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.
- Deep learning, Master and PhD courses.
- Self-Supervised Learning, PhD course.
- CASPR Seasonal Schools on Signal Processing for Hearing Assistive Devices.
- Information theory, Master course.
- Advanced Signal Processing, Master course.

During Autumn 2023, CASPR was involved in the following student projects

- Deep learning based attention decoding for hearing aids.
Mathematical-Engineering 7th semester project with Eriksholm Research Centre, Oticon.
Stine Byrjalsen, Christian Dausel Jensen, Laurits Randers, Julie Timmermann Werge
- Ordinal entropy for classifying brain states
Mathematical-Engineering 7th semester
Mads Lindeborg Larsen, Jakob Olavi Grangaard Olesen, Sif Bjerre Lindby
- Deep-Learning based Real-Time Speech Enhancement on Smartphones.
Computer Engineering: AI, Vision & Sound – 9th semester internship in Oticon.
Shobhit Kotnala.
- Robustifying ASR Systems with Diffusion Models.
Mathematical Engineering, 7th semester project.
Astrid Holm Filtenborg Kitchen, Marie Saugstrup Jensen, Mikkel Sebastian Lundsgaard Brøndt and Nikolai Lund Kühne.
- Robust Keyword Spotting Using Self-Supervised Deep Learning.
Mathematical Engineering, 9th semester project.
Jacob Mørk.
- AI-driven bass enhancement.
Electronic Systems 9th semester internship in B&O.
Tudor-Razvan Tatar.

CASPR Winter School

Signal Processing for Hearing Assistive Devices

We are happy to announce the 2024 CASPR Course on Signal Processing for Hearing Assistive Devices. The course will be in-person (physical face-to-face) and take place at the AAU Campus in Copenhagen, Denmark, during 26/2 – 1/3, 2024.

The three days first will cover teaching, presentations, hands-on practical training, and networking. The last two days encompass “Research talks on emerging technologies” where participation is optional for industry participants. University researchers will give the talks, and you will have the opportunity to network with other participants and experts in sound, signal processing, and machine learning.

	Mon 26/2-24	Tue 27/2-24	Wed 28/2-24	Thu 29/2-24	Fri 1/3-24	
8:30	Registration					
9:00	Welcome and Intro: Hearing Assistive Devices (HADs) Jesper Jensen	Beamforming II Jesper Jensen *	Voice Activity Detection (VAD) Zheng-Hua Tan	EEG and Audio Quality Payam Shahsavari	Self-supervised Learning for speech Holger S. Bovbjerg	■ : Introductory
10:00	Basic: Auditory Perception Steven van de Par	Exercise Beamforming	DNN Single-Microphone Noise Reduction Robert Rehr	Joint Far- and Near-end Speech and Listening Enhancement with Minimum Processing Andreas Fuglsig	Speech enhancement for HADs with a remote mic. Vasudha Sathyapriyan	■ : Fundamental / State-of-the-art
11:00	Basic: Auditory Perception Steven van de Par	Feedback Control Meng Guo	Speech Intelligibility Assessment I Michael Syskind Pedersen	Deep Learning based Hearing Loss Compensation Peter Bysted	Target Identification using Turn-Taking Jesper Jensen	■ : Emerging
11:45	Lunch					■ : Exercise
12:30	Lunch					■ : Hands-on
13:00	Hands-on Experience Aud.Perc Steven van de Par	Feedback Control Meng Guo	Speech Intelligibility Assessment II Michael Syskind Pedersen	Speech Enhancement Using Diffusion-Based Generative Models Philippe Gonzalez	Low-latency speech enhancement and coding Mohammad Bokaei	■ : Other
13:30	Hearing Loss Compensation Jesper Jensen	Hands-on Experience Feedback Meng Guo	Hands-on Experience Speech Intelligibility Michael Syskind Pedersen	Inter- and Intra-trial Deep Learning-Based Auditory Attention Decoding M. Asjid Tanveer	Exercise Beamforming	* : Lectures that support hands-on exercise
14:30	Intro to Exercise Vasudha Sathyapriyan / Jesper Jensen *	Acoustic Transfer Function (DOA) Estimation I Jesper Jensen *	Listening Effort and impact of HAD signal proc. Dorothea Wendt	DNN - EEG and listening effort. Sangeeth G. Jayaprakash	Exercise Beamforming - Last-Minute Questions	Each lecture is 45 min, followed by 15min break
15:30	Beamforming I Jesper Jensen *	Acoustic Transfer Function (DOA) Estimation II Jesper Jensen *	Exercise Beamforming	Exercise Beamforming	Wrap-up	
16:30	Exercise Beamforming (Optional)	Exercise Beamforming (Optional)	Exercise Beamforming (Optional)	Exercise Beamforming (Optional)		
17:30						

For more information and to register for the course, please use the following link: [CASPR 2024 Course](#)
Or contact: Jan Østergaard (jo@es.aau.dk), Jesper Jensen (jje@es.aau.dk)

Dates: 26/2 – 1/3, 2024.

Place: Aalborg University, Copenhagen Campus. A.C. Meyers Vænge 15, 2450 KBH, Denmark.

Course registration for Industry: [See details here](#).

Course registration for PhD students: [See details here](#).

News

Daniel Michelsanti received the “Best Young Italian Researcher in Denmark” (BIRD) award, in the category of Physical and Engineering Sciences, for his work on audio-visual speech enhancement based on deep learning, conducted at Aalborg University and Oticon. The ceremony was officiated by the Ambassador of Italy to Denmark, Stefania Rosini.



Zheng-Hua Tan, Achintya kr. Sarkar, and Najim Dehak received International Speech Communication Association (ISCA) Best Research Paper Award for their paper “[rVAD](#): An Unsupervised Segment-Based Robust Voice Activity Detection Method,” *Computer Speech & Language*, vol. 59, January 2020. The award ceremony took place at the INTERSPEECH conference in Dublin, Ireland, August 2023.



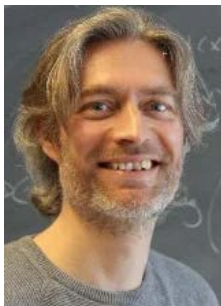
In Oct. 2023, M. Asjid Tanveer started a PhD project entitled “Brain-informed acoustic signal processing for hearing assistive devices.”

Supervisory team: Jan Østergaard, Zheng-Hua Tan, Jesper Jensen.



In Sept. 2023, Filippo Villani started a PhD project entitled “Speaking Style Modifications for Hearing Aid Applications” in collaboration with Prof. Geoffrey Chan, Queen’s University, Ontario, Canada.

Supervisory team: Jesper Jensen, Geoffrey Chan, Zheng-Hua Tan, Jan Østergaard.



As of January 2024, Jan Østergaard has been appointed to serve a 3-year term on the Industrial Researcher Expert Committee of the Innovation Fund Denmark.



In August 2023, Jesper Jensen gave an invited talk at the International Symposium on Auditory and Audiological Research, Nyborg, Denmark, entitled “The minimum overlap-gap algorithm - A microphone-only method for distinguishing a target talker from competing speakers”

Recent CASPR Related Research

Conference Papers

1. Self-Supervised Pre-Training for Robust Personalized Voice Activity Detection in Adverse Conditions. H. S. Bovbjerg, J. Jensen, J. Østergaard, Z.-H. Tan. Proc. ICASSP 2024. Accepted.
2. Diffusion-Based Speech Enhancement in Matched and Mismatched Conditions Using a Heun-Based Sampler. P. Gonzalez, Z.-H. Tan, J. Østergaard, J. Jensen, T. S. Alstrøm, T. May. Proc. ICASSP 2024. Accepted.
3. Speaker Adaptation for Enhancement of Bone-Conducted Speech. A. Edraki, W.-Y. Chan, J. Jensen, D. Fogerty. Proc. ICASSP 2024. Accepted.
4. Speech enhancement in hearing aids using target speech presence estimation based on a delayed remote microphone signal. V. Sathyapriyan, M. S. Pedersen, M. Brookes, J. Østergaard, P. A. Naylor, J. Jensen, Proc. ICASSP 2024. Accepted.
5. Binaural Speech Enhancement using Deep Complex Convolutional Transformer Networks. V. Tokala, E. Grinstein, M. Brookes, S. Doclo, J. Jensen, P. A. Naylor. Proc. ICASSP 2024. Accepted.
6. Speech enhancement using binary estimator selection applied to hearing aids with a remote microphone. V. Sathyapriyan, M. S. Pedersen, J. Østergaard, M. Brookes, P. A. Naylor, and J. Jensen. Proc. 2023 IEEE Int. Conf. Frontiers of Signal Processing (ICFSP).
7. Correlation based glimpse proportion index. A. Alghamdi, L. Moen, W.-Y. Chan, D. Fogerty, and J. Jensen. Proc. IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (WASPAA) 2023.
8. Binaural Speech Enhancement using Complex Convolutional Recurrent Networks. V. Tokala, E. Grinstein, M. Brookes, S. Doclo, J. Jensen, P. A. Naylor. Proc. 57th Asilomar Conference on Signals, Systems, and Computers, 2023.
9. Deep Joint Source-Channel Analog Coding for Low-Latency Speech Transmission over Gaussian Channels. M. Bokaei, J. Jensen, S. Doclo, J. Østergaard. Proc. European Signal Processing Conference (EUSIPCO), 2023.
10. Speech Inpainting: Context-Based Speech Synthesis Guided by Video. J.F. Montesinos, D. Michelsanti, G. Haro, Z.-H. Tan, and J. Jensen. Proc. Interspeech, 2023.
11. Robust Sound Zone Filters for Synchronization Errors. M. Zhou, M. B. Møller, C. S. Pedersen, N. E. M. de Koeijer and J. Østergaard. 10th Convention of the European Acoustic Association, Forum Acusticum, Turin, Italy, 2023.
12. Sound quality evaluation of packet loss concealment for wireless low-frequency sound zones. C. S. Pedersen, M. Zhou, M. B. Møller, N. E. M. de Koeijer and J. Østergaard. 10th Convention of the European Acoustic Association, Forum Acusticum, Turin, Italy, 2023.
13. Head Orientation Estimation with Distributed Microphones using Speech Radiation Patterns. K. Müller, B. Çakmak, P. Didier, S. Doclo, J. Østergaard, T. Wolff. Asilomar Conference, 2023.
14. Adaptive Coding in Wireless Acoustic Sensor Networks for Distributed Blind System Identification. M- Blochberger, J. Østergaard, R. Ali, M- Moonen, F. Elvander, J. Jensen, T. van Waterschoot. Asilomar Conference, 2023.
15. PAC-Bayes Generalisation Bounds for Dynamical Systems Including Stable RNNs. D. Eringis, J. Leth, Z.-H. Tan, R. Wisniewski, and M. Petreczky. The 38th Annual AAAI Conference on Artificial Intelligence, 2024.

Journal Papers

1. Masked spectrogram prediction for unsupervised domain adaptation in speech enhancement. K. Žmolíková, M. S. Pedersen, J. Jensen. IEEE Open Journal of Signal Processing, 2023. Accepted.
2. Validity and reliability of self-reported and neural measures of listening effort. Y. Mohammadi, J. Østergaard, C. Graversen, O.K. Andersen & J. Biurrun Manresa. European Journal of Neuroscience. 58(11), pp. 4357-4370. Dec. 2023.
3. Data-Driven Non-Intrusive Speech Intelligibility Prediction using Speech Presence Probability. M. B. Pedersen, Z.-H. Tan, S. H. Jensen, and J. Jensen. IEEE Trans. Audio, Speech, Language Process., Vol. 32, pp. 55-67, Oct. 2023.
4. Phase-locking of neural activity to the envelope of speech in the delta frequency band reflects differences between word lists and sentences. Y. Mohammadi, C. Graversen, J. Østergaard, O. K. Andersen and T. Reichenbach. Journal of Cognitive Neuroscience, vol. 35(8):1301-1311, August 2023.

Contact CASPR

If you are interested in learning more about the research and teaching taking place in CASPR:

Check our webpage at: <http://caspr.es.aau.dk>

Reach out to:

Professor Jan Østergaard (jo@es.aau.dk)

Professor Zheng-Hua Tan (zt@es.aau.dk)

Professor Jesper Jensen (jje@es.aau.dk).

In 2024 CASPR will have one or more fully financed 3-years PhD stipends available within the topics of acoustic signal processing for hearing assistive devices.

If you are interested feel free to frequently check our website or reach out to us.

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.