



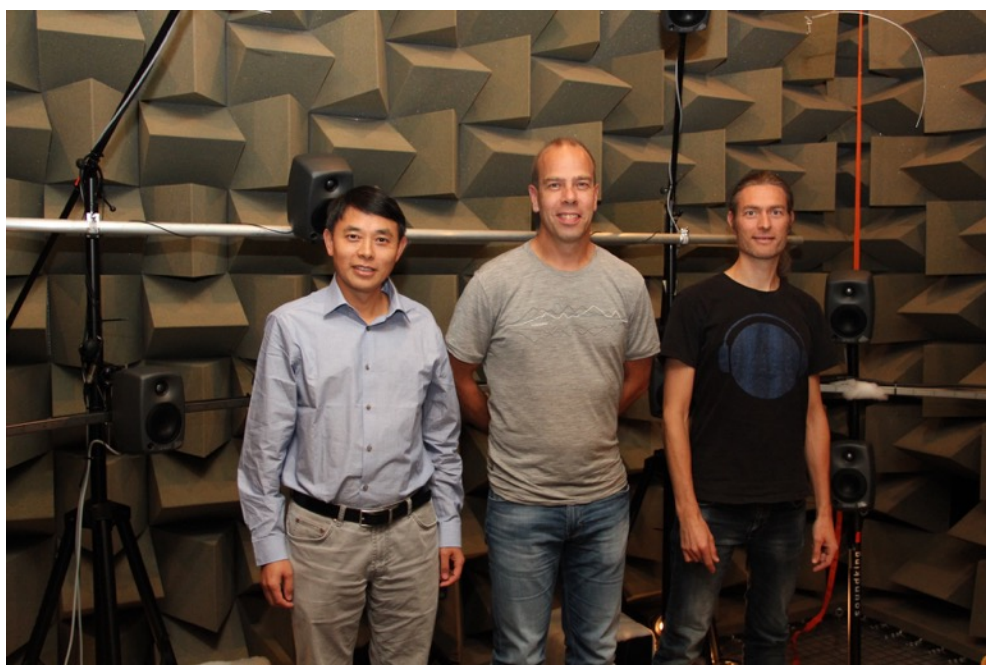
AALBORG UNIVERSITY
DENMARK

NEWSLETTER

Centre for Acoustic Signal Processing Research (CASPR)

June 2017

The Centre for Acoustic Signal Processing Research (CASPR) is a newly founded 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.



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Department of Electronic Systems
Signal and Information Processing Section
Aalborg University

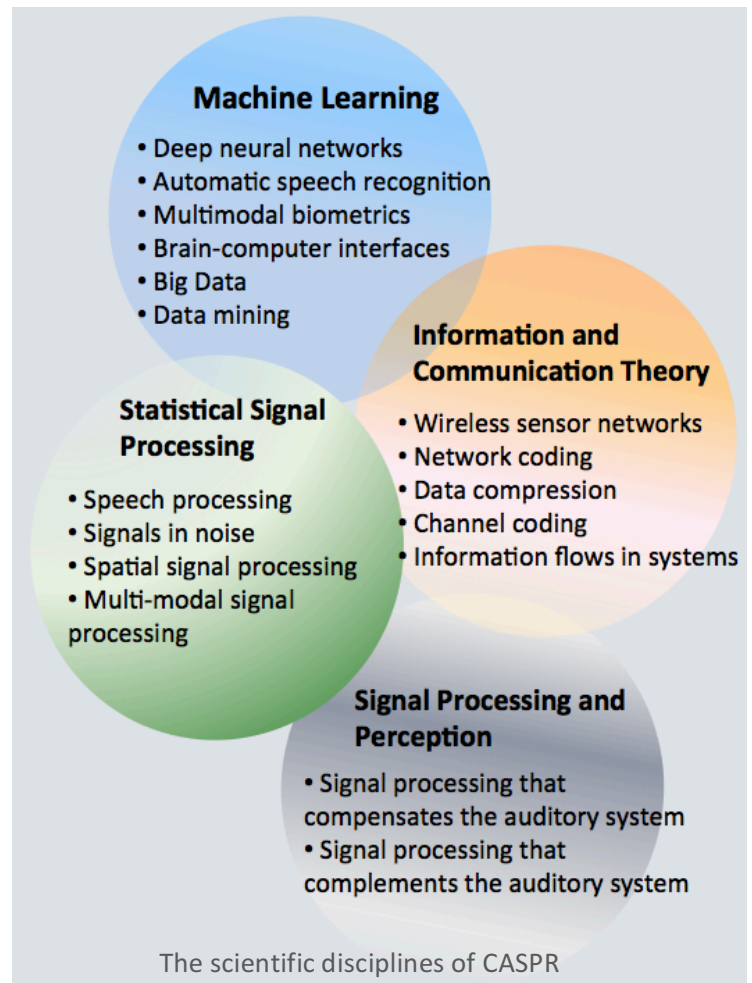
CASPR is conducting research related to advanced statistical signal processing solutions for assistive listening. The research finds direct use in communication devices such as hearing aids, helmets, headphones, cochlear implants, ear monitor, ear pieces, diagnostic equipment, etc. However, the envisioned 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.



Courses related to CASPR

A significant part of CASPR has to do with teaching at B.Sc., M.Sc., PhD., and Postdoc level in disciplines that are relevant to the scientific scope of CASPR:

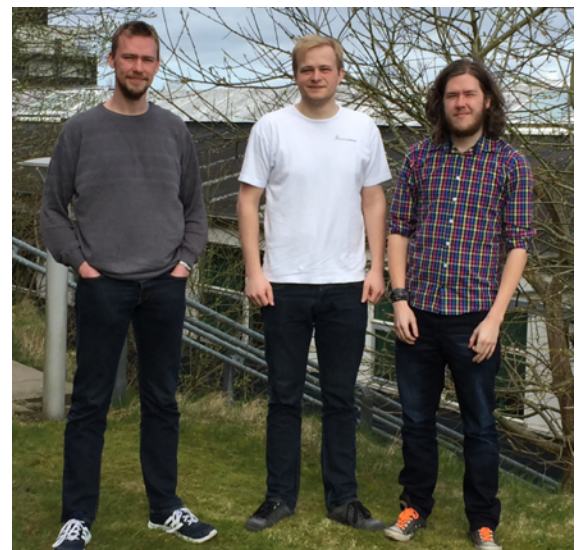
- Machine Learning (Master and PhD courses), Fall+Spring, 2017
- Deep Learning (PhD course), Spring 2017
- Information Theory (Master and PhD courses), Fall 2017
- Array Processing (Master course) Fall 2017
- Optimization (Master and PhD courses), Fall 2017
- Platforms and Methods for Multimodal System Architectures (Master course), Fall 2017.
- Signal Processing for Hearing Assistive Devices (PhD course and Winter School), Fall 2017.

Current Student projects within CASPR

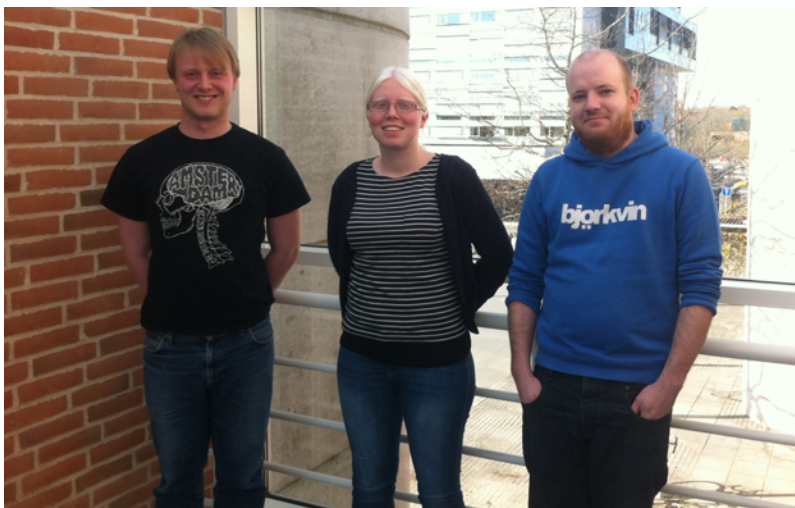
- *"Sound Source Localization for Hearing Aids"*. Mathematical Engineering, 8th Semester. Group G3-111: Emil Skovfoged Gregersen, Martin Mølbach Nissen, Mathias Bach Pedersen, Hoza Benjamin Maniragaba.
- *"Deep denoising autoencoder for speech enhancement"*. Mathematical Engineering, 8th Semester. Group G3-115: Peter Sibbern Frederiksen, Mathias Bülow Kastbjerg, Søren Skov.
- *"Convolutional generative adversarial networks for speech enhancement"*. Mathematical Engineering, 6th Semester. Casper Benjamin Andersen, Barbara Martinovic, Jacob Johansen.
- *"Conditional generative adversarial networks for speech processing"*. Vision, Graphics and Interactive Systems, Master thesis project: Daniel Michelsanti.



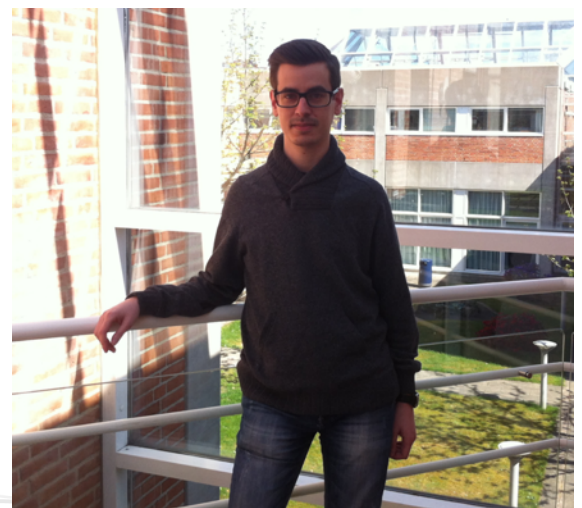
G3-111: (left to right) Martin, Mathias, Emil, Hoza



G3-115: (left to right) Mathias, Peter, Søren

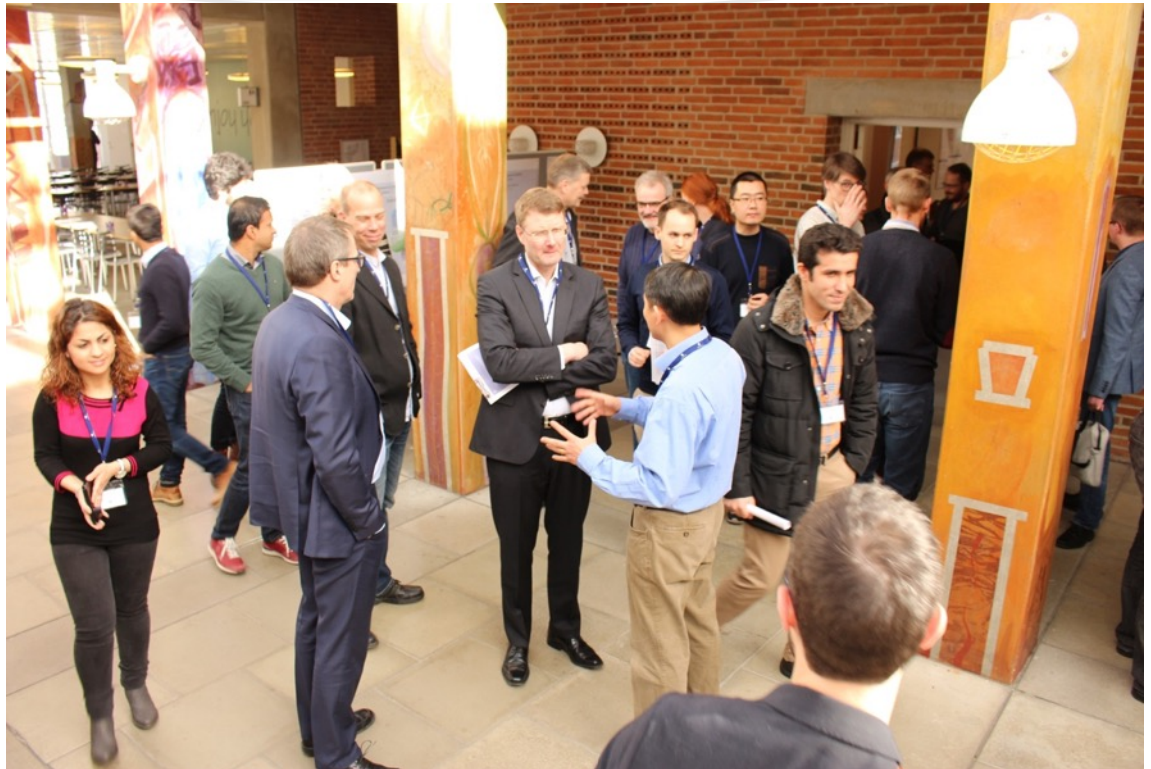


C4-207: (left to right) Casper, Barbara, Jacob



17gr1046: Daniel

On March 2nd, 2017, CASPR was officially opened. The event took place at Aalborg University and included speeches from *Eskild Holm Nielsen*, Dean of the Technical Faculty of ICT and Design, AAU, *Finn Möhring*, Vice President at Oticon A/S, *Børge Lindberg*, Head of Department of Electronic Systems, AAU, and *Claus Nielsen*, Eriksholm, Oticon A/S. The event hosted more than 60 participants including industrial participants, students and researchers.



Børge Lindberg, Head of Department of Electronic Systems, AAU.



Research audiologist from Oticons audiological research center, *Claus Nielsen* places hearing loss and hearing aids in a historical perspective.

A reception was set up in the main hall. At the reception, the PhD students in the Section for Signal and Information Processing (SIP) presented their latest research on posters, and demos and lab tours were given.

The following demos were given at the event:

- Detection of words in noise
- DNN for speech enhancement
- Social Robots (iSocioBot)
- Multi microphone speech enhancement
- Hearing aids hands-on



Poster	Research Topic	Presenter
#1	<i>Detection of Spoken Words in Noise: Comparison of Human Performance to Maximum Likelihood Detection</i>	M. Jahromi
#2	<i>Wireless High-Quality Audio Streaming with Superregular Erasure Correction</i>	J. Hansen
#3	<i>Joint Audio Compression and Enhancement in Networks</i>	A. Zahedi
#4	<i>Deep Neural Networks for Speech Enhancement and Separation</i>	M. Kolbæk
#5	<i>Deep Neural Networks for Spoofing Detection</i>	H. Yu
#6	<i>Robust Audio-Based Direction-of-Attention and Navigation on Social Robots</i>	N.B. Thomsen
#7	<i>Metric Learning for Face Recognition</i>	X. Duan
#8	<i>Incorporating Pass-Phrase Dependent Background Models for Text Dependent Speaker Verification</i>	A.K. Sarkar
#9	<i>Personalising Content Selection Using Vision-Based User Identification in a Contextual Ontological Framework</i>	M.S. Kristoffersen
#10	<i>Intelligibility Prediction for Hearing Assistive Devices</i>	A.H. Andersen
#11	<i>Multi-Microphone Speech Enhancement and Dereverberation</i>	J. Jensen
#12	<i>Informed Sound Source Localization for Hearing Assistive Devices</i>	M. Farmani
#13	<i>The effect of transmission delay on rate and performance in closed-loop networked systems</i>	M. Barforooshan
#14	<i>Hearing aid hands-on</i>	C. Nielsen
#15	<i>CASPR: Vision, Mission, and Scientific Scope</i>	J. Østergaard, Z.-H. Tan, J. Jensen

List of posters presented at the inauguration of CASPR.

NEWS

On February 2nd, 2017, Professor Patrick Naylor from Imperial College London, visited our group and gave a presentation entitled "Measurement and Exploitation of Reverberation in Speech signals".



CASPR is pleased to announce an upcoming Winter School on Signal Processing for Hearing Assistive Devices, to be held at Aalborg University, Denmark on Nov.6 – 10, 2017. The winter school targets researchers and engineers in the sound processing field. Lectures are given by international experts, which cover areas such as basic auditory perception, beamforming, noise reduction, dereverberation, feedback cancellation, hearing loss compensation, cochlear implants, screening of hearing in newborns, and emerging technologies. More information to follow.

A paper co-authored by J. Jensen of CASPR received an IEEE Signal Processing Society Best Paper Award. [An Algorithm for Intelligibility Prediction of Time-Frequency Weighted Noisy Speech](#), C. H. Taal, R. C. Hendriks, R. Heusdens and J. Jensen, *Transactions on Audio, Speech, and Language Processing*, Volume 19, No. 7, September 2011.

For this award, papers in a 5 year window spanning from 2011 - 2016 are considered. The award honors the author(s) of a paper of exceptional merit dealing with a subject related to the Society's technical scope, and appearing in one of the Society's solely owned transactions or the Journal of Selected Topics in Signal Processing, irrespective of the author's age.



Best paper award ceremony at the ICASSP conference in New Orleans, USA, March 2017. From left: Dr. C. H. Taal (Quby Labs, Amsterdam), Assistant Prof. R. C. Hendriks (Delft University of Tech.), R. K. Ward (President IEEE Signal Proc. Society), Assoc. Prof. R. Heusdens (Delft University of Tech.), Prof. J. Jensen (Aalborg University).

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

Recent CASPR Related Research Publications

Journal Papers

1. DNN Filter Bank Cepstral Coefficients for Spoofing Detection. H. Yu, Z.-H. Tan, Y. Zhang, Z. Ma, and J. Guo, *IEEE Access*, vol. 5, pp. 4779-4787, 2017.
2. Informed Sound Source Localization Using Relative Transfer Functions for Hearing Aid Applications. M. Farmani, M. S. Pedersen, Z.-H. Tan and J. Jensen, *IEEE Trans. Audio, Speech, Language Process.*, vol. 25, no. 3, pp. 611–623, 2017.
3. Decorrelation of Neutral Vector Variables: Theory and Applications. Z. Ma, J.-H. Xue, A. Leijon, Z.-H. Tan, Z. Yang, and J. Guo, *IEEE Transactions on Neural Networks and Learning Systems*, to appear, 2017.
4. Audio-based Granularity-adapted Emotion Classification. S.W. Shepstone, Z.-H. Tan, and S.H. Jensen, *IEEE Transactions on Affective Computing*, to appear, 2017.
5. Text-Independent Speaker Identification Using the Histogram Transform Model. Z. Ma, H. Yu, Z.-H. Tan, and J. Guo, *IEEE Access*, vol. 4, pp. 9733-9739, 2016.
6. Multi-channel Wiener filters in binaural and bilateral hearing aids – speech intelligibility improvement and robustness to DoA errors. A. Kuklasinski and J. Jensen, *Journal of the Audio Engineering Society*, vol. 25, no. 1/2, pp. 8–16, 2017.
7. Relaxed Binaural LCMV Beamforming. A. I. Koutrouvelis, R. C. Hendriks, R. Heusdens and J. Jensen, *IEEE Trans. Audio, Speech, Language Process.*, Vol. 25, No. 1, pp. 133 – 148, 2017.
8. Speech Intelligibility Potential of General and Specialized Deep Neural Network Based Speech Enhancement Systems. M. Kolbæk, Z.-H. Tan and J. Jensen, *IEEE Trans. Audio, Speech, Language Process.*, Vol. 25, No. 1, pp. 149 – 163, 2017.
9. Source Coding in Networks with Covariance Distortion Constraints. A. Zahedi, J. Østergaard, S.H. Jensen, P. Naylor, and S. Bech, *IEEE Transactions on Signal Processing*, Vol. 64, Issue 22, pp. 5943 – 5958, November 2016.
10. An Algorithm for Predicting the Intelligibility of Speech Masked by Modulated Noise Maskers. J. Jensen and C. H. Taal, *IEEE Trans. Audio, Speech, Language Process.*, Vol. 24, No. 11, pp. 2009 – 2022, 2016.
11. Predicting the Intelligibility of Noisy and Nonlinearly Processed Binaural Speech. A. H. Andersen, Z.-H. Tan, J. M. de Haan, and J. Jensen, *IEEE Trans. Audio, Speech, Language Process.*, Vol. 24, No. 11, pp. 1908 – 1920, 2016.

Conference Papers

1. Humans do not maximize the probability of correct decision when recognizing DANTALE words in noise. M. Z. Jahromi, J. Østergaard, and J. Jensen, *Proc. Interspeech 2017*.
2. On the use of Band Importance Weighting in the Short-Time Objective Intelligibility Measure. A.H. Andersen, J.M. de Haan, Z.-H. Tan and J. Jensen, *Proc. Interspeech 2017*.
3. Adversarial Network Bottleneck Features for Noise Robust Speaker Verification. H. Yu, Z.-H. Tan, Z. Ma and J. Guo, *Proc. Interspeech 2017*.
4. Conditional Generative Adversarial Networks for Speech Enhancement and Noise-Robust Speaker Verification. D. Michelsanti and Z.-H. Tan, *Proc. Interspeech 2017*.
5. Improving Speaker Verification Performance in Presence of Spoofing Attacks Using Out-of-Domain Spoofed Data. A. Sarkar, Md Sahidullah, Z.-H. Tan and T. Kinnunen, *Proc. Interspeech 2017*.
6. Permutation Invariant Training of Deep Models for Speaker-Independent Multi-Talker Speech Separation. D. Yu, M. Kolbæk, Z.-H. Tan, J. Jensen, *Proc. International Conf. Audio, Speech, Signal Proc. (ICASSP)*, March 2017.
7. A Non-Intrusive Short-Time Objective Intelligibility Measure. A. H. Andersen, J. M. de Haan, Z.-H. Tan, and J. Jensen, *Proc. International Conf. Audio, Speech, Signal Proc. (ICASSP)*, March 2017.
8. RedDots Replayed: A New Replay Spoofing Attack Corpus for Text-dependent Speaker Verification Research. T. Kinnunen, M. Sahidullah, M. Falcone, L. Costantini, R. Hautamaki, D. Thomsen, A. Sarkar, Z.-H. Tan, H. Delgado, M. Todisco, N. Evans, V. Hautamaki, and K.A. Lee, *Proc. International Conf. Audio, Speech, Signal Proc. (ICASSP)*, March 2017.
9. An Asymmetric Difference Multiple Description Gaussian Noise Channel. J. Østergaard, Y. Kochman, and R. Zamir, *IEEE Data Processing Conference*, April, 2017.
10. TDOA-based Self-Calibration of Dual-Microphone Arrays. M. Farmani, R. Heusdens, M. S. Pedersen, Z.-H. Tan and J. Jensen, *Proc. 19th International Conference on Information Fusion (FUSION)*, 2016.
11. Speech Enhancement Using Long Short-Term Memory Based Recurrent Neural Networks for Noise Robust Speaker Verification. M. Kolbæk, Z.-H. Tan, and J. Jensen, *Proc. IEEE Spoken Language Technology Workshop*, 2016.
12. Further Optimisations of Constant Q Cepstral Processing for Integrated Utterance and Text-dependent Speaker Verification. H. Delgado, M. Todisco, M. Sahidullah, A. Sarkar, N. Evans, T. Kinnunen, and Z.-H. Tan, *Proc. IEEE Spoken Language Technology Workshop*, 2016.
13. Two Asymmetric Descriptions from Many Symmetric Descriptions. A. Mashiach, Y. Kochman, J. Østergaard, and R. Zamir, *International Conference on the Science of Electrical Engineering (ICSEE)*, 2016.
14. Detection of Spoken Words in Noise: Comparison of Human Performance to Maximum Likelihood Detection. M. Z. Jahromi, J. Østergaard, and J. Jensen, *Proc. IEEE Global Conference on Signal and Information Processing (GlobalSIP)*, 2016.

CASPR will have a number of fully funded PhD stipends available in 2017. 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 (MSO) Jan Østergaard (jo@es.aau.dk), Associate 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 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. According to Times Higher Education, Aalborg University is no. 201-250 in the overall world university ranking, and no. 31 in the Top 100 of universities established within the past 50 years.