

Research Topic for the ParisTech/CSC PhD Program

***Field:** Information and Communication Sciences and Technologies

Subfield: Human Machine Interface

Title: Use of AI Techniques to Improve Ultrasound Based Silent Speech Interfaces

ParisTech School: ESPCI

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Short description of possible research topics for a PhD: (10-15 lines in English + optional figure) Silent Speech Interfaces, or SSI, that process unvocalized speech in situations where silent communication is required, have been developed in laboratories for several years, yet remain experimental. Recently, significant improvements in SSI performance have been obtained through the application of AI technology to the front-end image processing steps of these systems. The thesis will entail applying the most recent AI techniques, such as Deep Convolutional and Generative Adversarial Networks, to the image processing front-ends of these systems, in order to achieve speech recognition performances allowing SSI to move out of the laboratory and into real world applications. The work will be carried out at the Langevin Institute in Paris, France, using an ultrasound-based SSI acquisition system developed in-house by the pioneering team of Professor B. Denby.

Required background of the student: (Which should be the main field of study of the applicant before applying) The ideal candidate will have top-notch programming skills as well as a willingness to invest him or herself in real-time programming environments involving sensor data. Background in image processing and/or machine learning (AI) techniques will be an advantage.

A list of 5(max.) representative publications of the group: (Related to the research topic)

Bruce Denby, Tanja Schultz, Kiyoshi Honda, Thomas Hueber, J. M. Gilbert, Jonathan S. Brumberg, *Silent Speech Interfaces*, Speech Communication, Volume 52, Issue 4, April 2010, Pages 270-287.

Chengrui Wu, Shicheng Chen, Guorui Sheng, Pierre Roussel, Bruce Denby, *Predicting Tongue Motion in Unlabeled Ultrasound Video Using 3D Convolutional Neural Networks*, ICASSP2018, Calgary, Canada, 15-20 April, 2018.

Shicheng Chen, Yifeng Zheng, Chengrui Wu, Guorui Sheng, Pierre Roussel, Bruce Denby, *Direct, Near Real Time Animation of a 3D Tongue Model Using Non-Invasive Ultrasound Images*, ICASSP2018, Calgary, Canada, 15-20 April, 2018.

Yan Ji, Licheng Liu, Hongcui Wang, Zhilei Liu, Zhibin Niu, Bruce Denby, *Updating the Silent Speech Challenge Benchmark with Deep Learning*, Speech Communication, Volume 98, April 2018, Pages 42-50.