2019 YCCSA SUMMER SCHOLARSHIP PROJECT SUBMISSION

This form is for prospective project supervisors to submit their projects to be included in the YCCSA Summer Scholarships Programme for 2019.

It is the purpose of the YCCSA Summer School that any projects submitted are novel and interdisciplinary in nature.

Date	10/12/2018
Supervisors' Names and Departments / Affiliation and Contact Email	Dr Helena Daffern, Department of Electronics (helena.daffern@york.ac.uk) Dr Gavin Kearney, Department of Electronics (gavin.kearney@york.ac.uk) Dr Jez Wells, Department of Music (jez.wells@york.ac.uk) Dr Amelia Gully, Department of Language and Linguistic Science (amelia.gully@york.ac.uk)
Project Title	*Dynamic Spectral modelling of Human Voice Directivity for Forensic Speech Science and Virtual and Augmented Reality*
Project Description	Within virtual reality environments, sound sources are usually modelled with a very simple radiation pattern that assumes that the source radiates equally well in all directions. However, the reality is that sound source directivity is extremely complex, is frequency dependent and has strong spatial properties. This is particularly true of the human voice and there is an increasing demand within the VR/AR industry to create more plausible and realistic source directivity patterns for use with next generation cinematic, gaming, social media, e-learning and tele-visual services amongst many other applications. Until now, models for the directivity of the human voice have considered average measurements of frequency dependent source directivity. Recordings are made at multiple spatial positions around the subject and a frequency dependent directivity pattern is derived based on a temporal average of the recording. However, this model assumes that the voice never changes in pitch, duration or intensity. This project looks to work toward a more dynamic model of source directivity that adapts to the source input. The result will be a complex system that delivers realistic representation of the voice when propagating into a virtual acoustic environment. The human voice presents a particularly complex problem for spatial audio as every voice is unique and even a repeated utterance by the same person will differ depending on the situation (in terms of both the physical environment and social factors such as emotional/psychological state). In forensic speech science, experts must make judgements about the identity of a speaker based on analysis of audio alone; usually only a single recording made under less than ideal conditions. Understanding how the spectral content of the voice changes with situation, including direction, would allow more robust interpretation of materials in real criminal cases. We seek to engage two YCCSA project students who will work with the supervisors to develop a protocol for the measurement, analysis and synthesis of voice directivity. The tasks undertaken by each student for the 9 week duration are:

	Student 1: - Undertake pilot measurements in the anechoic chamber in collaboration with student 2 to gather some baseline voice data to work with. - Create a protocol for a more sophisticated dataset of recordings in an anechoic chamber for full spectral, temporal and spatial directivity modelling. These recordings will be taken in a spherical grid around the subject. Recent voice research has established Voice Range Profiling techniques which will be used to capture a full representation of person's voice (including different volumes, vowels and pitches). - Analyse the recordings in terms of their directional response patterns and organise the data for directivity synthesis modelling. ***Student 2:*** - Undertake pilot measurements in the anechoic chamber in collaboration with student 1 to gather some baseline voice data to work with. - Develop dynamic directivity models using the measurements undertaken by student 1. - Generate high-accuracy sinusoidal/modal models and investigate how differences in raw model data can be mapped to directivity data. - Compare directivity data quality with work undertaken by Student 1. - Synthesize examples of interpolated data (i.e. combined data from two measurements) and compare with actual measurements (i.e. data collected from spatial position between the two interpolated points).
Required Skills	This project would be suitable for students from an acoustics (audio engineering) background; ability to learn new hardware / software quickly is essential. Basic skills in audio signal processing; experience of audio recording; experience of digital audio workstations; experience using MATLAB.
Supervision and Collaboration Arrangements	All four supervisors will be connected to the individual student's work which will be fully integrated into the whole project. Fortnightly project meetings will take place with the whole team (students and supervisors). Initially there will be more meetings together as the project is reliant on building a protocol that addresses the central question of the project. Student 1: 1st Supervisor: H. Daffern, 2nd Supervisor, G. Kearney 3rd Supervisor, A. Gully Student 2: 1st Supervisor, J. Wells, 2nd Supervisor, G. Kearney
Project Dates	*The summer school runs for 9 weeks, starting on Monday, 08 July 2019 and finishing on Friday, 06 September 2019.*
Other Information	*Anything that doesn't easily fit above.*
References	Kearney, GC, Daffern, H, Thresh, L, Omodudu, H, Armstrong, C & Brereton, JS 2016, 'Design of an Interactive Virtual Reality System for Ensemble Singing'. in Proceedings of the Interactive Audio Systems Symposium. Interactive Audio Systems Symposium, York, United Kingdom, 23 September.

When complete, please email the form to sarah.christmas@york.ac.uk