EEMT17 Spatial Audio in VR Engineering [5 credits]

Lecturer(s): Assistant Prof. Enda Bates ebates@tcd.ie

Module organisation

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<tr>
<th>Semester</th>
<th>Start Week</th>
<th>End Week</th>
<th>Associated Practical Hours</th>
<th>Lectures</th>
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Total Contact Hours: 33

Module description, aims and contribution to programme
Spatial Audio is intended for those interested in using spatial audio techniques in a variety of different contexts, including but not limited to; 360 video and Virtual/Augmented Reality, cinema surround sound, audio production and recording, surround sound for gaming and mobile devices, multimedia performance and interactive installations, spatial music composition, sonification, auditory interfaces, and psychoacoustics. This course is intended to enable future audio engineers, composers, researchers and sound-designers to clearly determine the optimal spatialization schemes and techniques for a given application and environment, as well as motivating further innovation and artistic creativity in the field. Students are presented with a wide variety of spatial audio content, both in class and also in additional listening sessions/concerts of contemporary and historical works of spatial electroacoustic music. The history of spatial audio is discussed, in terms of mainstream cinema and film, popular music releases on DVD, and a wide variety of contemporary/ electroacoustic music and composers. Students are encouraged to critically assess the strengths and weaknesses of different techniques to enable their effective and creative use of spatial audio, in different contexts.

The aim of this course is to give the student a complete understanding of all relevant aspects of current spatial audio technology. It addresses the psychoacoustic principles underlying different techniques, as well as practical production techniques for 5.1 surround sound using the DAW Reaper, Ambisonics, Binaural processing, and a variety spatial microphone techniques. By the end of the course, the student will have a deep understanding of the issues and creative possibilities of spatial audio and a thorough knowledge of all relevant spatial audio systems and topics. This knowledge will enable students to effectively use spatial audio in their subsequent artistic work, and/or facilitate further technical research in this area.

Learning outcomes
On successful completion of this module, students will be able to:
1. Compose, produce and design original spatial content for fixed media, live performance and interactive installations.
2. produce and engineer spatial recordings using binaural and surround microphone techniques
3. characterise the strengths and weaknesses of different spatialization methods
4. understand the psychoacoustical principles underlying different approaches to spatial audio
5. select an appropriate and effective spatial audio technique for a particular application
6. analyse, describe and identify techniques and methods used by spatial music composers and sound designers
7. setup and configure spatial audio software and hardware

Module content
History of spatial audio
Spatial hearing and psychoacoustics.
Stereophony: theory, implementation and limitations
5.1 Production in Reaper
Bass Management
Ambisonics & HOA
Surround Sound recording techniques
Spatial Music Composition
Array Calibration
Spatial Audio for 360 Video and VR
Binaural recording and processing
Spatial Impulse Response Rendering

Teaching strategies
The teaching strategy is a combination of lectures, software and hardware tutorials, dedicated listening sessions, and critique classes on assignment work. Tutorials in Reaper and spatial audio plugins are held in the first half of the semester, while practical demonstrations of recording techniques, microphone configurations and array calibration are presented later in the semester. Dedicated listening sessions/concerts of classic and contemporary works of spatial music are presented throughout the module. In addition, conventional lecture presentations include many demonstrations of other material, in particular surround sound for film and popular music releases on DVD.

Assessment
Assessment for EEMT17 is entirely based on practical assignment work consisting of two projects worth 30% and 70% of the final mark respectively. The assignments are based on course lectures and reading material and consist of practical audio recording and production work, and accompanying written report.
Recommended Text(s)
Jens Blauert: *Spatial Hearing: The Psychophysics of Human Sound Localization*;
Francis Rumsey: *Spatial Audio*
Denis Smalley: *Spectromorphology: explaining sound-shapes* - *(Organised Sound / Volume 2 / Issue 02 / August 1997, pp 107-126)*;
Enda Bates: *The Composition and Performance of Spatial Music*

Further information
School of Engineering weblink.