ENS Research Internship Topic

Towards a Wave Field Synthesis Library for the Faust Programming Language

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Technical Information

- Location: Citi Lab (INSA Lyon), 6 avenue des arts, 69100 Villeurbanne (France)
- Dates: June 19th July 28th, 2023 (6 weeks)
- Advisors: Romain Michon (Inria) and Tanguy Risset (INSA Lyon)

Internship Topic

In the era of augmented and virtual reality, spatial audio plays a central role. While there exists different techniques for creating artificial sound fields in 2D or 3D such as Ambisonics [1], VBAP [2], etc., Wave Field Synthesis (WFS) [3, 4, 5] is one of the few that doesn't feature a "sweet spot." This means that the sound field is created everywhere in the space and not just in one small location, which of course is much better.

The INSA Lyon/Inria Emeraude team¹ has been working during the past few years on various kinds of WFS systems based either on Field Programmable Gate Arrays (FPGAs) or networks of distributed microcontrollers.² They can all be programmed with the Faust programming language³ [6] which is also developed within the team. While some primitive WFS algorithms have already been implemented in Faust and used for prototyping [7], it is our aim to develop a more advanced and comprehensive WFS library in Faust. This will be the main goal of this short 6 weeks internship.

After familiarizing with the math behind WFS and the Faust programming language, the successful candidate will hence sketch the basis of a WFS library in Faust. Full access will be given to the intern to one of our prototype WFS system for prototyping and testing. This work will potentially be integrated to the main Faust distribution.

References

- Michael A Gerzon. Ambisonics in multichannel broadcasting and video. Journal of the Audio Engineering Society, 33(11):859–871, 1985.
- [2] Ville Pulkki. Virtual sound source positioning using vector base amplitude panning. Journal of the audio engineering society, 45(6):456–466, 1997.

¹https://team.inria.fr/emeraude/

²https://team.inria.fr/emeraude/plasma

 $^{^{3}}$ https://faust.grame.fr

- [3] Jens Ahrens. Analytic methods of sound field synthesis. Springer Science & Business Media, 2012.
- [4] Augustinus J Berkhout, Diemer de Vries, and Peter Vogel. Acoustic control by wave field synthesis. *The Journal of the Acoustical Society of America*, 93(5):2764–2778, 1993.
- [5] Tim Ziemer. Wave Field Synthesis, pages 329–347. Springer Berlin Heidelberg, Berlin, Heidelberg, 2018.
- [6] Yann Orlarey, Stéphane Letz, and Dominique Fober. New Computational Paradigms for Computer Music, chapter Faust: an Efficient Functional Approach to DSP Programming. Delatour, Paris, France, 2009.
- [7] Julius O. Smith. A spatial sampling approach to wave field synthesis: PBAP and huygens arrays. CoRR, abs/1911.07575, 2019.