Fachgebiet Audiokommunikation
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Master Thesis

Parametric Statistical Spectral Modeling

Statistical Spectral Modeling [5] offers a method for transferring a sample library of musical instrument sounds into a data set for the use in expressive sound synthesis. Based on sinusoidal modeling [2, 3], the recorded sounds are decomposed into temporal trajectories, describing the tonal and the stochastic part of the signal. Subsequently the temporal axis is eliminated by calculating probability distributions for the obtained trajectories. Frequency domain aspects of the stochastic processes are captured by means of Markov chains. By means of inverse transform sampling [1], these statistical models can be used to generate synthesis parameters for expressive performances in real time.

This thesis will advance the approach towards a fully parametric model of statistical distributions. Instead of training on existing audio data, arbitrary distributions can be designed. The resulting data sets will be described by basic mathematical functions which can be manipulated during synthesis, in order to generate abstract, novel sounds. An existing framework [4], implementing a JACK client, can be used as the basis for the further development. A user experience study will conclude the development, giving insight on the applicability of the system and its parameters.

Requirements

- experience in spectral modeling
- profound knowledge in Python/Matlab and C++

References

[1] Luc Devroye. Sample-based Non-uniform Random Variate Generation. In *Winter Simulation Conference*, pages 260–265, Washington, D.C., USA, 12 1986.

[2] Xavier Serra. *A SYSTEM FOR SOUND ANALYSIS/TRANSFORMATION/SYNTHESIS BASED ON A DETERMINISTIC PLUS STOCHASTIC DECOMPOSITION*. PhD thesis, Stanford University, 1989.

[3] Xavier Serra and Julius Smith. Spectral Modeling Synthesis: A Sound Analysis/Synthesis System Based on a Deterministic Plus Stochastic Decomposition . *Computer Music Journal*, 14(4):12–14, 1990.

[4] Henrik von Coler. A Jack-based Application for Spectro-Spatial Additive Synthesis. In *Proceedings of the 17th Linux Audio Conference (LAC-19)*, Stanford University, USA, 2019.

[5] Henrik von Coler. Statistical Sinusoidal Modeling for Expressive Sound Synthesis. In *Proceedings of the 22nd International Conference on Digital Audio Effects (DAFx)*, Birmingham, UK, 2019.

Supervisors

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