

Audio Synthesis with Neural Regularisation Networks

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Project description:

Synthesising sounds plays an important role in the creation of digital music. It describes the process of generating artificial sound samples that sound as if they were generated from real or artificial instruments, or even voices, such that the process allows the control of intrinsic parameters like pitch, volume, or timbre. In recent years, focus on research in digital music has shifted from model-based synthesisers to deep neural network-based synthesisers.

In this context, generative modelling techniques like Normalising Flows, Variational Autoencoders or Cycle-Consistent Adversarial Networks have proven to be powerful tools for generating synthesised sounds. These generative modelling techniques, however, require neural networks that are either continuously invertible or that have stable approximate inverses.

To achieve this requirement, we will explore a new class of neural networks that are based on Regularisation operators. Regularisations are families of continuous operators that approximate the unstable inverse of a forward model in a way that is stable with respect to measurement errors. The goal of this PhD project is to model and mathematically analyse these regularisation-based networks, and to apply them to 1) produce dubbed voices in movies that maintain core characteristics of the original voice and 2) maintain data privacy by creating digital vocal avatars that conceal an individual's voice.

Research in generative modelling for audio synthesis is very timely, with many recent publications exploring different methodologies. Most of these publications struggle with the stable (approximate) inversion of the generators, which renders the proposed research timely and novel. The project impact goes beyond re-voicing in the film industry or the creation of tools for data privacy but extends to all applications in digital music that require audio synthesis (e.g., music production) and also music psychology. It aligns with the data-centric engineering theme by encompassing research in digital twinning, multimedia and digital media.

Further information:

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