AI-Assisted FM Synthesis

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***Abstract*— Frequency Modulation (FM) synthesis is a well-known technique that is used to create interesting timbres at a low computational cost. Recent FM commercial products have seen a resurgence, due to FM's great timbral possibilities, but they still rely on dated and complex sound design paradigms. Scaling up the architecture to improve it seems to be unfeasible due to the increase in complexity it would entail. On the other end of the spectrum, Deep Neural Networks (DNNs), widely employed as classifiers, have been recently used on different generative schemes to classify or to produce musical instrument samples. Moreover, recent works exploit their descriptive power in order to directly control oscillators and filters.**

In our project, we aim to develop a DNN that can describe natural-sounding spectra in terms of the parameters of an FM synthesizer. Obtaining such a decomposition can pave the way to develop novel gestural control strategies or even musical instrument transformations.

***Index Terms*—** Sound matching, FM synthesis, Deep Neural Networks, Instrument Augmentation

I. PROJECT DESCRIPTION

Frequency Modulation (FM) synthesis, firstly presented by John Chowning [1], is an economical mean of generating complex time-varying spectra, by routing simple parametrized signal generators, called *operators*, under different modulator-carrier composition schemes called *algorithms*. Popular throughout the 1980s and '90s, the method fell out of use due to the lack of fine control over the sound and it's sometimes undesirable sonic characteristics [2]. To cope with this, several tools and modifications have been proposed, such as strategies to improve the FM spectra [3] [4], models for gestural control mapping [5] [6], and sound matching techniques [7, 8, 9].

FM has lately regained a fair quote of attention in the music community, with new synthesizers and emulators being released, to name a few: Korg OpSix, Yamaha DX Reface, Elektron Digitone, Korg Volca FM and Dexed. However, their architecture and sound design approach remained similar to that of the Yamaha DX7, a classic six operators architecture from 1983.

Pairing a Deep Neural Network with a synthesizer to describe sounds in terms of its parameters provides a framework for creative control strategies. First, it allows a sound designer to approximate a target sound, being able to continue the workflow with manual fine-tuning if desired [10]. Another interesting possibility is the distillation of mapped meta-controls [11] that can manipulate multiple parameters at the same time in a sonically meaningful way [9]. Finally, we believe that a real-time implementation of such a solution could become an interesting tool for instrument retargeting or intelligent augmentation strategies.

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II. REFERENCES

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