STREAMING FREQUENCY-DOMAIN DAFX IN CSOUND 5
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This work discusses the implementation of frequency domain digital audio effects using the Csound 5 music programming language, with its streaming frequency-domain signal (fsig) framework. It introduces the framework and its related unit generators. It describes in detail the different types of spectral DAFx made possible by these new opcodes.

The FSG Framework
- Streaming frequency-domain signals are defined by the Csound fsg type.
- Such signals are processed at the rate of generation of new spectral frames.
- Fsms currently support two types of data format: (1) Amplitude and Frequency (or phase) bin data, and (2) Partial Track data.
- Fsms are self-describing, containing information about DFT length, hopsize, window size, window type and data format.

Spectral Processing
- Amplitude Transformations
  - Filtering
  - Noise Reduction/“Stencilling”

Frequency Transformations
- Frequency Scaling
- Frequency Shifting

Spectral Analysis
- Phase Vocoder:
- Instantaneous Frequency Distribution:
- Partial Track Analysis:

Cross-synthesis and Other Transformations
- Morphing by interpolation of bin frames
- Channel vocoder-like amplitude substitution (pvs voc)
- Partial track cross-synthesis (pvcross)
- Reverse Panning (pvsademix), loosely based on the ADRess algorithm
- Spectral Blurring and other smoothing effects
- Several other partial track effects

Resynthesis
- Overlap add inverse Phase Vocoder
- Bin frame Additive Synthesis
- Partial track Additive Synthesis
  - Linear
  - Cubic Phase

Conclusion
- The fsg framework in Csound5 and its spectral opcodes provide a comprehensive, flexible and intuitive way to build frequency-domain effects computer instruments.
- New opcodes will be continuously added to the existing set.
- Work on the sliding DFT analysis/resynthesis method by fitch and Dobson will eventually be incorporated into the system.

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