1T3: Audio Signal Processing for Music Applications: Course Outline

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1. Introduction

- Introduction to Audio Signal Processing
- Course outline
- Basic mathematics

2. Discrete Fourier transform

- DFT equation
- Complex exponentials
- Scalar product in the DFT
- DFT of complex sinusoids
- DFT of real sinusoids
- Inverse-DFT

3. Fourier transform properties

- Linearity, shift, symmetry, convolution
- Energy conservation and decibels
- Phase unwrapping, zero padding
- Fast Fourier Transform (FFT)
- FFT and zero-phase windowing
- Analysis/synthesis

4. Short-time Fourier transform

- STFT equation
- Analysis window
- FFT size and Hop size
- Time-frequency compromise
- Inverse STFT

5. Sinusoidal model

- Sinusoidal model equation
- Sinewaves in a spectrum
- Sinewaves as spectral peaks
- Time-varying sinewaves in spectrogram
- Sinusoidal synthesis

6. Harmonic model

- Harmonic model equation
- Sinusoids-partials-harmonics
- Monophonic/polyphonic signals
- Harmonic detection

- Fundamental frequency detection

7. Sinusoidal plus residual modeling

- Stochastic model
- Stochastic approximation of sounds
- Sinusoidal/harmonic plus residual model
- Residual subtraction
- Sinusoidal/harmonic plus stochastic model
- Stochastic model of residual

8. Sound transformations

- Short-time Fourier transform
  - Filtering; morphing
- Sinusoidal model
  - Time and frequency scaling
- Harmonic plus residual model
  - Pitch transposition
- Harmonic plus stochastic model
  - Time stretching; morphing

9. Sound/music description

- Spectral-based audio features
- Description of sound/music events and collections

10. Concluding topics

- Review of class
- Beyond audio signal processing for music applications

References and credits

- Slides released using the CC Attribution-Noncommercial-Share Alike license and available from https://github.com/MTG/sms-tools

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