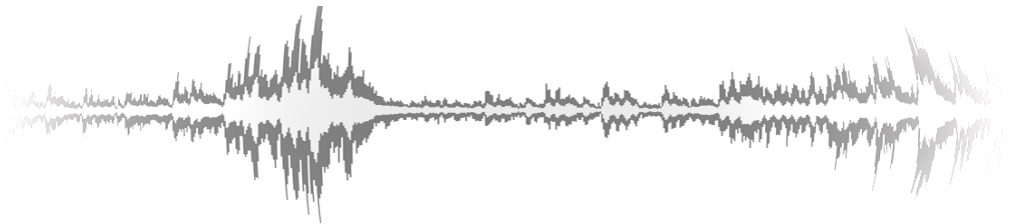
# Digital Signal Processing for Music

## Part 1: Organizational

alexander lerch



Georgia Tech Center for Music Technology
College of Design

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## links & contact

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- **contact info**
  - *alexander lerch*
    - email: mailto:alexander.lerch@gatech.edu
    - www: www.audiocontentanalysis.org
    - office: Couch 205B
    - office hours: **by appointment**: https://www.calendly.com/alexanderlerch
- **classes**
  - Mon, Wed 3:00–4:15pm in WV163
  - additional *tutorial group*: TBD
- **class resources**
  - *canvas*:
    - syllabus, grades, slides: www.canvas.gatech.edu

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## goals & requirements

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- **goals**
  1. ability to comprehend typical representations of digital systems such as block diagrams and difference equations,
  2. understanding of typical transforms in DSP such as the Fourier transform or the Z-transform,
  3. ability to use this understanding to design audio processing systems such as audio effects, and
  4. ability to implement such designs in a programming language such as Matlab.
- **requirements**
  - math
  - rudimentary programming skills, familiarity with Matlab

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## outline

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| date | topics | exercise | assignment | notes |
|---|---|---|---|---|
| 01/07 | introduction, signals, periodicity, random processes, pdf, moments, correlation | correlation | | |
| 01/14 | convolution, power spectral density | FIR filter | filter & convolution | |
| 01/21 | Fourier series & Fourier transform | DFT | Fourier analysis | MLK Hldy. |
| 01/28 | Fourier transform, sampling, quantization, SNR, number formats | quantization | | |
| 02/04 | oversampling, dither, noise-shaping, nonlinear quant. | | dither, ns | |
| 02/11 | z-transform, digital audio filters, FIR/IIR, FFT filtering | biquad | | midterm I |
| 02/18 | sample rate conversion, real-time systems | resampling | | |
| 02/25 | delay-based FX and reverb | vibrato | mod. fx | |
| 03/04 | dynamics processing | PPM | limiter | guthman |
| 03/11 | time-segment processing (OLA) | ola | | midterm II |
| 03/18 | | | | spring break |
| 03/25 | phase-vocoder | | phase voc | |
| 04/01 | source coding: LPC, ADPCM | | | |
| 04/08 | source coding: Huffman, AAC | | | |
| 04/15 | denoising | | | |
| 04/22 | competition results | | | |

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## course materials

Georgia Tech Center for Music Technology College of Design

- **roughly based on**:
  - Zölzer, Udo (2008): *Digital Audio Signal Processing*, Wiley
- **additional reading**:
  - Lyon, Richard (2011): *Understanding Digital Signal Processing*, Prentice Hall
  - Zölzer, Udo (2011): *DAFX: Digital Audio Effects*, Wiley
- **additional additional reading**:
  - Pohlmann, Ken (2000): Principles of Digital Audio, 4th, McGraw-Hill
  - Watkinson, John (2001): The Art of Digital Audio, Focal Press
- **software**:
  - Matlab: www.matlab.gatech.edu
  - github.com etc

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## assessment



- **40%: assignments** (equally weighted): projected deadlines see syllabus
  1. convolution and FIR filters
  2. Fourier analysis
  3. Dither & Noise Shaping
  4. modulated audio effects
  5. compressor & limiter
  6. (phase vocoder)
- **10%: mid-term exam I**
- **10%: mid-term exam II**
- **5%: participation**
- **15%: quizzes**
  - every week?!
- **20% codec competition**

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## to do

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1. **install Matlab** (Octave/Freemat)
2. **brush up** your math and DSP

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