Digital Signal Processing for Music

Part 1: Organizational

alexander lerch

organizational
links & contact

Georgia Tech | Center for Music Technology College of Design

- **contact info**
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    - email: mailto:alexander.lerch@gatech.edu
    - www: www.audiocontentanalysis.org
    - office: Couch 203
    - office hours: **by appointment**: https://go.oncehub.com/alexanderlerch
  - *teaching assistant*
    - Karn Watcharasupat: kwatchar3@gatech.edu
- **classes**
  - Mon, Wed 3:30–4:45pm in WV175
  - additional *tutorial group*: TBD
- **class resources**
  - *canvas*:
    - syllabus, grades, slides: https://canvas.gatech.edu

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goals & requirements

- **goals**
  1. the ability to comprehend typical **representations of digital systems** such as block diagrams and difference equations,
  2. an understanding of typical **transforms in DSP** such as the Fourier transform or the Z-transform,
  3. an understanding of typical **signal processing approaches** to audio and music signals,
  4. the ability to use this understanding to **design audio processing systems** such as audio effects, and
  5. the 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

date	topics	exercise	assignment	notes
01/09	introduction, signals, periodicity, random processes, pdf, expectation values/moments, correlation	correlation		
01/16	convolution	FIR filter	filter & convolution	
01/23	Fourier series & Fourier transform	DFT	Fourier analysis	MLK Hldy.
01/30	Fourier transform, sampling, quantization, SNR, number formats	quantization		
02/06	oversampling, dither, noise-shaping, nonlinear quant.		dither, ns	
02/13	z-transform, digital audio filters, FIR/IIR, FFT filtering	biquad		midterm I
02/20	sample rate conversion, real-time systems	resampling		
02/27	denoising			
03/06	delay-based FX and reverb	vibrato	mod. fx	guthman?
03/13	dynamics processing	PPM	limiter	midterm II
03/20				spring break
03/27	time-segment processing (OLA)	ola		
04/03	phase-vocoder		phase voc	
04/10	source coding: LPC, ADPCM			

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course materials

- **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% denoising competition**

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to do

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

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