

# CCRMA Signal Processing Research Overview

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## Outline

- Research Overview
- Current/Recent PhD/EE Students at CCRMA

## For More Details

See the **CCRMA Overview**<sup>1</sup> and/or the website of the individual listed.

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<sup>1</sup><http://ccrma.stanford.edu/CCRMA/Overview/Overview.html>

# Ongoing Research Projects at CCRMA

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- **Sonification Research** (Jonathan Berger)
- **Edison Cylinders** (Jonathan Berger)
- **Internet Music** (Chris Chafe)
- **REALSIMPLE Project** (Julius Smith)  
(Modules for Audio Signal Processing Education)

# Ongoing Software Projects at CCRMA

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- **Planet CCRMA Distribution**  
(Fernando Lopez-Lezcano)
- **Synthesis Tool Kit (STK)**  
(Gary Scavone and Perry Cook)
- **Digital Audio Resampling Home Page**  
(Julius Smith)
- **snd program and sndlib library**  
(Bill Schottstaedt)
- **Common Lisp Music (CLM)**  
(Bill Schottstaedt)
- **Common Music Notation (CMN)**  
(Bill Schottstaedt)
- **Common Music (CM)** (Rick Taube)

CCRMA software distributions are available online at  
<http://ccrma.stanford.edu/software/>

# Related Online Books at CCRMA

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- Physical Audio Signal Processing<sup>2</sup>
- Spectral Audio Signal Processing<sup>3</sup>
- Introduction to Digital Filters<sup>4</sup>
- Mathematics of the Discrete Fourier Transform<sup>5</sup>

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<sup>2</sup><http://ccrma.stanford.edu/~jos/pasp/>

<sup>3</sup><http://ccrma.stanford.edu/~jos/sasp/>

<sup>4</sup><http://ccrma.stanford.edu/~jos/filters/>

<sup>5</sup><http://ccrma.stanford.edu/~jos/mdft/>

# Current Research Projects at CCRMA

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See the CCRMA Overview for a more complete list of current research projects. The items below represent more recent updates of which JOS is aware (due to having been updated by the student in one way or another).

## **Spectral Audio Models and Estimators**

- Signal Restoration (Guillermo Garcia)
- Voice Modeling in the Presence of Noise (Pamornpol Jinachitra)
- Blind Source Separation of Stereo Signals (Aaron Steven Master)
- Audio Visualizations and Image Sonification (Woon Seung Yeo)
- Chord Recognition (Kyogu Lee)
- Audio Saliency Modeling (Min Jong Kim)
- Assisted Listening Technology (Ryan Cassidy)

## Physical Model Design and Calibration

- Allpass Filter Design for Highly Dispersive Systems (Jonathan Abel, JOS)
- Active Feedback Control of Guitar Strings (Ed Berdahl, JOS)
- Virtual Analog (David Yeh, JOS)
- Acoustic Guitar Modeling (Nelson Lee, JOS)

# Current PhD Students at CCRMA

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## Current EE/CS Graduate Students

- **Guillermo Garcia**

CCRMA graduate research commenced 1996-1997

**Research:** *Statistical Signal Processing for Audio Noise Removal*

**URL:** <http://ccrma.stanford.edu/~guille/>

- **Arvinhd Krishnaswamy**

CCRMA graduate research commenced 2000-2001

**Research:** *Musical Signal Modeling and Performance Parameters Extraction for Audio Morphing and Perceptual Signal Separation via Resynthesis*

**URL:** <http://ccrma.stanford.edu/~arvinhd/>

- **Pamornpol (Tak) Jinachitra**

CCRMA graduate research commenced 2002-2003

**Research:** *Joint Estimation of Glottal Source and Vocal Tract for Vocal Synthesis Using Kalman Smoothing and EM Algorithm*

**URL:** <http://www.stanford.edu/~pj97/>

- **Ryan Cassidy**

CCRMA graduate research commenced 2002-2003

**Research:** *Loudness-Based Dynamic Range Compression; Filter Banks*

**URL:** <http://ccrma.stanford.edu/~rjc/>

- **Edgar Berdahl**

CCRMA graduate research commenced 2004-2005

**Research:** *Active control of vibrating strings*

**URL:** <http://ccrma.stanford.edu/~eberdahl/>

- **David Yeh**

CCRMA graduate research commenced 2005-2006

**Research:** *music applications of EE: tube distortion models, pick-up models, amps, distortion circuits*

**URL:** <http://ccrma.stanford.edu/~dtyeh/>

- **Nelson Lee**

CCRMA graduate research commenced 2005-2006

**Research:** *Acoustic Guitar Modeling, REALSIMPLE Project*

**URL:**

<http://www.stanford.edu/~nalee/cv/07-02-16.htm>

**Music (CBMTA) PhD Students at CCRMA**

- **Patty Huang**  
CCRMA graduate research commenced 2000-2001  
**Research:** *Artificial Reverberation; Mesh; Loudness Spectrogram*  
**URL:** <http://ccrma.stanford.edu/~pph/>
- **Kyogu Lee**  
CCRMA graduate research commenced 2002-2003  
**Research:** *Audio Processing Based on Auditory Models*  
**URL:** <http://ccrma.stanford.edu/~kglee/>
- **Woon Seung Yeo**  
CCRMA graduate research commenced 2002-2003  
**Research:** *Image to Sound and Sound to Image Conversions*  
**URL:** <http://ccrma.stanford.edu/~woony/>
- **Hiroko Teresawa**  
CCRMA graduate research commenced 2003-2004  
**Research:** *Timbre Modeling*  
**URL:** <http://ccrma.stanford.edu/~hiroko/>
- **Sook Young Won**  
CCRMA graduate research commenced 2003-2004  
**Research:** *Measurement and Applications of Head Voice*

**URL:** <http://ccrma.stanford.edu/~sywon/>

- **Matt Wright**

CCRMA graduate research commenced 2003-2004

**Research:** *Predicting Subjective Attack Time*

**URL:** <http://ccrma.stanford.edu/~matt/>

- **Gautham Mysore**

CCRMA graduate research commenced 2004-2005

**Research:** *Statistical Signal Processing*

**URL:** <http://ccrma.stanford.edu/~gautham/>

- **Greg Sell**

CCRMA graduate research commenced 2004-2005

**Research:** *still taking courses*

**URL:** <http://ccrma.stanford.edu/~gsell/>

- **Juham Nam**

CCRMA graduate research commenced 2005-2006

**Research:** *still taking courses*

**URL:** <http://ccrma.stanford.edu/~juhan/>

- **Luke Dahl**

CCRMA graduate research commenced 2005-2006

**Research:** *still taking courses*

**URL:** <http://ccrma.stanford.edu/~lukedahl/>

# Career Paths for EEs from CCRMA

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## James A. Moorer

- MIT BS/EE Undergrad
- Stanford PhD/CS: Segmentation and Analysis of Continuous Musical Sound (1975)
- Co-founder, CCRMA
- NSF funded research
- Lucas Arts (ASP, Sound Droid, Edit Droid)
- Sonic Solutions (media mastering workstations)
- Adobe (DVD mastering software)

## F. Richard Moore

- PhD/EE Thesis: *digital synthesizer architecture: "Realtime Interactive Computer Music Synthesis"* (1977)
- Principal research advisor: Jim Angell
- UCSD Music Dept. faculty — CRCA
- Founder, Computer Audio Research Lab (CARL)

- Author of `cmusic` (“acoustic compiler” in C)
- Author of **Elements of Computer Music**, Prentice-Hall, 1990

## Elizabeth Cohen

- MS/EE 1978
- PhD/Acoustics 1980
- Consulting Career in Architectural Acoustics, Audio/Visual System Design, Digital Libraries, and related areas
- Consulting Professorships: Stanford Physics and EE Depts

## Julius Smith

- PhD/EE Thesis: “Techniques for Digital Filter Design and System Identification with Application to the Violin” (1983)
- Committee: Gene Franklin, Martin Morf, Jim Angell
- Systems Control Technology (“post-doc” with Benjamin Friedlander)

- Research Associate at CCRMA (System Development Foundation)
- NeXT (Sound, Music, DSP Group)
- CCRMA Faculty
- <http://ccrma.stanford.edu/~jos/>

### **Jefferey Barish**

- PhD/EE Thesis: *concert hall simulation: "Electronic Simulation of Auditorium Acoustics"* (1984)
- Jim Angell advisee
- Sonic Solutions
- Founder, EuPhonics (Boulder)
- 3Com: Director of Multimedia and Communications

### **Jonathan S. Abel**

- "Localization Using Range Differences" (1989)
- JOS, Widrow advisee
- Systems Control Technology (w. Ben Friedlander)
- Crystal River

- Founder, Kind of Loud Sound (→ Universal Audio, Inc.)
- Music 424 (Digital Audio Effects)

## **Perry R. Cook**

- “Identification of Control Parameters in an Articulatory Vocal Tract Model, with Applications to the Synthesis of Singing” (1990)
- JOS, Widrow, Boyd advisee
- CCRMA Technical Director
- Princeton Computer Science and Music Departments (Joint Appointment)
- <http://ccrma.stanford.edu/~prc/>

## **More Recent PhD/EEs from CCRMA**

- Avery Wang
  - “Instantaneous and Frequency-Warped Signal Processing Techniques for Auditory Source Separation” (1994)
  - Chromatic Research (Xenon)

- Founder, Hyperactive Audio
- Founder, CTO, Shazam Ltd
- Gary Scavone (MS/EE, PhD/Music: JOS advisor)
  - “An Acoustic Analysis of Single-Reed Woodwind Instruments with an Emphasis on Design and Performance Issues and Digital Waveguide Modeling Techniques” (1997)
  - CCRMA Technical Director
  - Assistant Professor, McGill University
  - <http://ccrma.stanford.edu/~gary/>
- Bill Putnam
  - Research: Convex optimization applied to audio digital filter design
  - Founder, Kind of Loud Sound (→ Universal Audio)
  - Founder, Bitbop
- Scott Levine
  - “Audio Representations for Data Compression and Compressed Domain Processing” (Spring 1999)
  - Liquid Audio, Inc.
  - Verance Inc. (Digital Audio Watermarking)
  - Columbia Business School

- Venture Firm
- Dave Berners
  - “Acoustics and Signal Processing Techniques for Physical Modeling of Brass Instruments” (Spring 1999)
  - Universal Audio, Inc.
  - Music 424 (Digital Audio Effects)
  - <http://ccrma.stanford.edu/~dpberner/>
- Yoon Kim
  - Improved speech recognition front-end based on Bark frequency warping, non-uniform linear prediction, and cepstral smoothing (Spring 2000)
  - Verbaltek (speech recognition)
  - Novauris (speech technology)
  - <http://ccrma.stanford.edu/~yoonie/>
- Hui-Ling Lu
  - “Toward a High-Quality Singing Synthesizer with Vocal Texture Control” (Spring 2002)
  - Misc. Si Valley jobs (signal processing R&D)
  - Optimal Synthesis Inc.
- Stefan Bilbao

- “Wave and Scattering Methods for Numerical Simulation” (Spring 2001)
- Queen’s College, Belfast (Finite Difference Schemes)
- <http://ccrma.stanford.edu/~bilbao/>
- Tim Stilson
  - Research: Variable digital filter structures, root locus algorithms
  - Founder, Staccato Systems
  - Analog Devices, Inc.(Audio DSP Guru)
  - <http://ccrma.stanford.edu/~stilti/>
- Harvey Thornburg
  - “On the Detection and Modeling of Transient Audio Signals with Prior Information”
  - Assistant Professor of Arts, Media and Engineering and Electrical Engineering; Arizona State University; Arts, Media and Engineering Program, Tempe AZ
  - <http://ccrma.stanford.edu/~harv23/>
  - <http://ame.asu.edu/faculty/Thornburg.html>
- Yi-Wen Liu

- “Audio Watermarking through Parametric Signal Representations”
- Research Associate, Boys Town National Research Hospital, Omaha NB
  - Diagnosis of middle-ear conditions via pulse reflectometry
- <http://ccrma.stanford.edu/~jacobliu/>
- Aaron Master
  - Stereo blind source separation
  - Melodis (<http://www.melodis.com/>)
    - Diagnosis of middle-ear conditions via pulse reflectometry
  - <http://ccrma.stanford.edu/~jacobliu/>

# Career Paths for Music PhDs from CCRMA (Incomplete)

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- John Strawn
  - Yamaha Music Technology
  - S Systems
- Xavier Serra
  - Yamaha Music Technology
  - Music Technology Group, Institut Universitari de l'Audiovisual and Department of Technology, Universitat Pompeu Fabra, Barcelona (Catalunya), Spain
- John Gordon
  - Charlie Smith's company
  - Applied Signal Technology: signal processing software, hardware design
- Gary Scavone
  - CCRMA Technical Director
  - Assistant Professor, Music Technology, Schulich School of Music, McGill University

- Tamara Smyth
  - CCRMA Technical Director (for one very productive summer)
  - Assistant Professor, School of Computing Science, Simon Fraser University
- Stefania Serafin
  - Professor of Medialogi, Aalborg University, Copenhagen