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Chad McKell

ABOUT

Position	Ph.D. Candidate, UC San Diego
Affiliations	Center for Visual Computing, Department of Music
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Research — My research covers mathematical modeling and numerical simulation of acoustic systems. I am especially interested in computational geometric methods for acoustic simulation. Current research topics include mathematical modeling of boundaries in acoustic wave propagation simulations; modeling of complex sound sources for computer animation; and variational methods for simulating fluid-structure interactions in musical instruments and the human cochlea.

EDUCATION

9/19–	**University of California San Diego**, Ph.D. in Computer Music GPA: 4.0. Dissertation: *Computational Geometric Methods for Acoustic Simulation.* Advisors: Albert Chern (CSE) and Miller Puckette (Music).
9/16–10/17	**University of Edinburgh**, M.S. in Acoustics and Music Technology
8/09–12/15	**Wake Forest University**, M.S. in Physics
6/02–8/09	**Brigham Young University**, B.S. in Biophysics

EMPLOYMENT

9/19–	**University of California San Diego**, Teaching Assistant/Researcher (Music)
8/21–3/22	**Meta, Reality Labs Research**, Research Intern/Student Researcher (Acoustics)
7/18–7/19	**Applied Research in Acoustics**, R&D Scientist (Acoustics)
5/18–5/18	**Moog Music**, Freelance Audio Software Developer (Audio DSP)
4/17–9/17	**Lofelt**, Freelance Acoustic Simulation Researcher (Acoustics)
10/14–8/16	**J.P. Morgan/Neovest**, Consulting Software Development Engineer in Test (QA)
8/12–12/12	**University of North Carolina School of the Arts**, Adjunct Instructor (Physics)
9/09–9/11	**Wake Forest University**, Teaching Assistant (Physics)
9/08–6/09	**Brigham Young University**, Tutorial Lab Assistant (Physics)
8/07–3/09	**Brigham Young University**, Research Assistant (Philosophy)

RESEARCH ACTIVITIES

9/19–	**University of California San Diego**, Ph.D. Student/Candidate (Acoustics) La Jolla, California. Research topics: *acoustics, fluid dynamics, hearing science, differential geometry.* Dissertation summary: develop geometric methods for simulating the acoustics of 3D sound fields, musical instruments, and human hearing. Committee members: Albert Chern (co-chair, Computer Science), Miller Puckette (co-chair, Music), Melvin Leok (Mathematics), Shahrokh Yadegari (Music), Stefan Bilbao (Music, University of Edinburgh), and Sebastian Prepeliță (Audio, Reality Labs at Meta).

RESEARCH ACTIVITIES CONT.

8/21–3/22 **Meta, Reality Labs Research**, Research Intern/Student Researcher (Acoustics)
La Jolla, California. Research topics: *binaural audio, numerical simulation, parallel programming, discrete complex analysis.* Research summary: conducted computational acoustics research for virtual and augmented reality devices. Supervisor: Sebastian Prepeliță. Team Lead: Ravish Mehra.

7/18–7/19 **Applied Research in Acoustics**, R&D Scientist (Acoustics)
Culpeper, Virginia. Research topics: *underwater acoustics, matched filtering, sparse estimation, beamforming.* Research summary: developed physics-based signal processing algorithms for naval sonar systems. Team Lead: Jonathan Botts.

1/17–8/17 **University of Edinburgh**, Master's Student (Acoustics)
Edinburgh, Scotland. Research topics: *speech acoustics, elastodynamics, numerical simulation.* Thesis summary: developed physics-based numerical simulations of structural vibrations for haptic feedback devices. My thesis was partially funded by Lofelt, a Berlin-based haptic feedback company acquired by Meta in 2022. Advisor: Stefan Bilbao.

1/10–9/13 **Wake Forest University**, Master's Student (Physics)
Winston-Salem, North Carolina. Research topics: *optical trapping, laser characterization, fluid dynamics.* Thesis summary: implemented transverse nanoparticle tracking in surface-isolated laser traps. Advisor: Keith Bonin.

8/07–8/09 **Brigham Young University**, Undergraduate Student (Biophysics)
Provo, Utah. Research topics: *structural biology, scanning probe microscopy.* Research summary: studied the effect of anesthetics on lipid bilayer structure using atomic force microscopy. Advisor: David Busath.

TEACHING EXPERIENCE

As Instructor

UNCSA

SCI 1100 General Physics. Fall 2012 (1 term).

As TA

UCSD

MUS 5 Sound in Time. Spring 2020 (1 term).
MUS 6 Electronic Music. Fall 2020 (1 term).
MUS 15 Popular Music: David Bowie. Winter 2021 (1 term).
MUS 15 Popular Music: Video Game Music. Winter 2020 (1 term).
MUS 171 Computer Music I. Winter 2022 (1 term).
MUS 172 Computer Music II. 2021–2022 (2 terms).

WFU

PHY 113 General Physics I (Mechanics). 2009–2011 (4 terms).
PHY 114 General Physics II (E&M). Fall 2010 (1 term).

TEACHING EXPERIENCE CONT.

As Tutor

BYU

PHSCS 105	General Physics 1 (Mechanics). 2008–2009 (2 terms).
PHSCS 106	General Physics 2 (E&M). Winter 2009 (1 term).
PHSCS 121	Principles of Physics 1 (Mechanics). 2008–2009 (2 terms).
PHSCS 123	Principles of Physics 2 (Waves/Thermo). W/Sp 2009 (2 terms).
PHSCS 220	Principles of Physics 3 (E&M). W/Sp 2009 (2 terms)

PH.D. COURSEWORK

CSE 167	Computer Graphics I (Jürgen Schulze)
CSE 169	Computer Animation—*audit* (Steve Rotenberg)
CSE 274	Discrete Differential Geometry (Albert Chern)
CSE 291	Physical Simulation—*audit* (Chern/Rotenberg)
CSE 299	Differential Geometry Research (Albert Chern)
MUS 206	Spatialization (Shahrokh Yadegari)
MUS 206	Deep Learning for Music Generation (Shlomo Dubnov)
MUS 206	Computational Acoustic Modeling (Tamara Smyth)
MUS 270A	Digital Audio Processing (Tamara Smyth)
MUS 270B	Analysis of Musical Sound (Miller Puckette)
MUS 270C	Compositional Algorithms (Miller Puckette)
MUS 270D	Advanced Projects in Computer Music (Puckette/Smyth)
MUS 298	Virtual Acoustics Research (Puckette/Smyth/Dubnov)
MUS 298	Differential Geometry Research (Miller Puckette)

PUBLICATIONS

Manuscripts in Progress

(1) **C. McKell**, M. Nabizadeh, S. Wang, and A. Chern, "Wave simulations in infinite spacetime". Submission planned for May 2023.

Description: Simulating wave propagation on an infinite domain has been a long-standing computational challenge. Conventional approaches to this problem only produce wave simulations on a small subset of the infinite domain. Using a novel geometric equation solver, we simulate wave propagation on the entire infinite domain using only finite computational resources.

(2) **C. McKell** et al. A parallel-computed absorbing boundary layer treatment for head-related transfer function simulations. Submission planned for Fall 2023.

Description: Computational simulations of head-related transfer functions are useful for generating personalized binaural audio filters at scale. In this paper, we present a novel parallel-computed absorbing boundary layer treatment for HRTF simulations. An analysis of its accuracy compared to conventional boundary treatments is included.

PUBLICATIONS CONT.

Journal Articles

(3) **C. McKell** and K. Bonin, "Optical corral using a standing-wave Bessel beam," *Journal of the Optical Society of America B*, Vol. 35, No. 8, 1910–1920, 2018.

Conference Proceedings

(4) **C. McKell**, "Sonification of optically-ordered Brownian motion," In Proceedings of the International Computer Music Conference (ICMC), Utrecht, Netherlands, September 2016.

Master's Theses

(5) **C. McKell**, *Real-time physical modeling for haptic feedback rendering*, Final Project Dissertation, University of Edinburgh, Acoustics and Audio Group, 2017. (Advisor: Stefan Bilbao).

(6) **C. McKell**, *Finite-difference simulations of speech with wall vibration losses*, Special Project Dissertation, University of Edinburgh, Acoustics and Audio Group, 2017. (Advisor: Stefan Bilbao).

(7) **C. McKell**, *Confinement and tracking of Brownian particles in a Bessel beam standing wave*, Master's Thesis, Wake Forest University, Department of Physics, 2015. (Advisor: Keith Bonin).

Technical Reports

(8) **C. McKell**, H. Conley, and D. Busath, "AFM study of structural changes in supported planar DPPC bilayers containing general anesthetic isoflurane," Brigham Young University, Paper 827, 2010.