updated: 6/23

Curriculum Vitae: Chad McKell

ABOUT

Position	Ph.D. Candidate, UC San Diego
Affiliations	Center for Visual Computing, Department of Music
Address	9500 Gilman Dr MC 0099, La Jolla, CA 92093
Phone	+1 661 289 4215
Email	cmckell@ucsd.edu
Website	chadmckell.com

Research — My research covers mathematical modeling and numerical simulation of acoustic systems. Current projects include geometric boundary modeling for acoustic wave simulation; non-spherical harmonics for acoustic simulation, capture, and rendering; and physical simulation of cochlear fluid dynamics. I am especially interested in applications of acoustic simulation in audio technology and hearing science.

EDUCATION

9/19–	**University of California San Diego**, Ph.D. in Music (Computational Acoustics) Dissertation: *Acoustic Wave Simulation using The Minkowski-Kelvin Transform* Advisors: Albert Chern and Miller Puckette.
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 in Music
6/23–	**Meta, Reality Labs Research**, Research Scientist Intern in Acoustics
8/21–3/22	**Meta, Reality Labs Research**, Research Intern/Student Researcher in Acoustics
7/18–7/19	**Applied Research in Acoustics**, R&D Scientist in Acoustics
5/18–5/18	**Moog Music**, Freelance Audio Software Developer
4/17–9/17	**Lofelt (acquired by Meta in 2022)**, Freelance Acoustics Researcher
10/14–8/16	**J.P. Morgan/Neovest**, Consulting Software Development Engineer in Test
8/12–12/12	**University of North Carolina School of the Arts**, Adjunct Instructor of Physics
9/09–9/11	**Wake Forest University**, Teaching Assistant in Physics
9/08–6/09	**Brigham Young University**, Tutorial Lab Assistant in Physics
8/07–3/09	**Brigham Young University**, Research Assistant in Philosophy

RESEARCH ACTIVITIES

9/19–	**University of California San Diego**, Ph.D. Student (Acoustics) La Jolla, California. Research topics: *computational acoustics, differential geometry.* Dissertation summary: develop geometric boundary models for acoustic wave simulation. Committee members: Albert Chern (co-chair), Miller Puckette (co-chair), Melvin Leok, Shahrokh Yadegari, Stefan Bilbao (Univ. of Edinburgh), and Sebastian Prepeliță (Meta).

RESEARCH ACTIVITIES CONT.

6/23–	**Meta, Reality Labs Research**, Research Scientist Intern (Acoustics) Redmond, Washington. Research topics: *binaural audio, numerical simulation, parallel programming.* Research summary: Conduct computational acoustics research for virtual and augmented reality devices. Build custom numerical simulation tools using finite-difference methods in C++/CUDA. Supervisor: Sebastian Prepeliță. Team Lead: Ravish Mehra.
8/21–3/22	**Meta, Reality Labs Research**, Research Intern/Researcher (Acoustics) La Jolla, California. Research description: see above.
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 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 (Optics) 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: investigated the effect of anesthetics on lipid bilayer structures 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". Under review.

> *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 the fact that wave propagation on an infinite Minkowski spacetime is equivalent to wave propagation on a bounded Minkowski spacetime under a Kelvin-like transformation, we simulate wave propagation on the entire infinite domain using a finite discretization of the bounded domain with no additional loss of accuracy from the transformation.*

(2) **C. McKell**, *Acoustic Wave Simulation using The Minkowski-Kelvin Transform*, Ph.D. Dissertation, University of California San Diego, Department of Music. Defense planned for Spring 2024. Advisors: Albert Chern and Miller Puckette.

> *In this work, I demonstrate that the conformal invariance of the wave equation under a Kelvin transform in Minkowski spacetime allows for the efficiently handling of infinite domains and curved obstacle boundaries in acoustic wave simulations. In particular, I use the transform to convert infinite domains into bounded domains and curved boundaries into flat boundaries. I then solve the transformed wave problems using standard numerical methods with no additional loss of accuracy introduced by the transform.*

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*, Master's Thesis, University of Edinburgh, Acoustics and Audio Group, 2017. Advisor: Stefan Bilbao.

(6) **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

(7) **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.