BRIAN M. WORTHMANN

Brian M. Worthmann
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RESEARCH INTERESTS

Physics-based array signal processing, including underwater acoustics and ground penetrating radar

PROFESSIONAL EXPERIENCE

August 2019 – Present

LAS POSITAS COLLEGE

Position: Adjunct Professor, Physics Department
Supervisor: Eric Harpell, Physics Department, Las Positas College

Sep 2018 – Present

LAWRENCE LIVERMORE NATIONAL LABORATORY

Position: Postdoctoral Research Staff
Supervisor: David H. Chambers, Signal and Image Processing Sciences
Research Description: I am part of the MiRadar team at LLNL, which is developing a ground penetrating radar (GPR) system for buried hazard detection, using a vehicle- and UAS-mounted, multistatic, real-time GPR array system. I assess system performance through detection analytics, quantify hardware performance, and develop physics-based signal processing algorithms for improved surface tracking and volumetric imaging.

EDUCATION

Jun 2013 – Jun 2018

UNIVERSITY OF MICHIGAN

Ph.D. in Applied Physics

Thesis Title: Theory and applications of autoproducts
Thesis Advisor: David R. Dowling, Professor of Mechanical Engineering
Thesis Summary: My thesis research explored the physical and mathematical implications of a physics-based nonlinear array signal processing technique, particularly for acoustic source localization in the shallow ocean despite environmental uncertainty.
GPA: 4.000 / 4.000

Aug 2009 – May 2013

STEVENS INSTITUTE OF TECHNOLOGY

Chemical Engineering, Bachelor of Engineering
Engineering Physics, Bachelor of Science
GPA: 3.969 / 4.000

TEACHING EXPERIENCE

LAS POSITAS COLLEGE

LPC is a public community college in Livermore, CA with 11,000 students. I serve as an adjunct professor in the physics department.

Jan 2020 – May 2020

Physics 2B: Algebra-based introductory electromagnetics, optics, and modern physics
This 4-credit course (3hrs lecture, 3hrs lab per week) has 37 students.

Aug 2019 – Dec 2019

Physics 1A: Calculus-based introductory mechanics
This 5-credit course (4hrs lecture, 3hrs lab per week) had 23 students. I designed this class from scratch, including written homework, customized labs, class included written homework, oral presentations, and . See teaching portfolio for more information.

OSHER LIFELONG LEARNING INSTITUTE AT THE UNIVERSITY OF MICHIGAN

OLLI-UM is an organization dedicated to improving the lives of the 50-and-over community through various community programs, which include not-for-credit courses on various subjects. Each of my courses listed below were created completely from scratch and feature a combination of lectures and demos that non-technically explain some aspect of physics. See olli-umich.org for info.

Sep 2016 – Nov 2016 **Why is the sky blue? … and other awesome questions in physics**
Over eight weeks of two-hour classes, the six participants had the opportunity to learn about the answers to physics questions such as "How do we know the Earth is round?", "How do we know the size of the solar system?", and "Where do the elements come from?".

Jan 2017 – Mar 2017 **Why is the sky blue? … and other awesome questions in physics**
This nine-week course was a revamped version of the first course, which attracted 17 participants.

Sep 2017 – Nov 2017 **Everyday Physics**
This ten-week course featured content such as the physics of medical imaging, radios, and airplanes, and attracted 25 participants.

RELATE: RESEARCHERS EXPANDING LAY AUDIENCE TEACHING AND ENGAGEMENT

Mar 2016 – Dec 2016 **RELATE: Co-Director**
RELATE is a professional organization at the University of Michigan dedicated to science communication training, particularly for graduate students (see learntorelate.org for more info). As co-director, along with three other graduate students, we hosted approximately 20 workshops during my tenure, including our flagship 10-week summer workshop for around twenty graduate students, as well as several one-to-three hour workshops for undergraduates, graduate students, and faculty. Some of my many responsibilities included organizing and teaching the workshops and developing curricula.

PEER TUTORING

Aug 2014 – Dec 2015 **University of Michigan Athletic Department: Academic Success Program**
Tutored over 50 different student-athletes in 20 different math, physics and engineering courses through the UM Athletic Department. Approximately 10 hours per week.

May 2010 – Dec 2013 **Stevens Institute of Technology: Peer Tutor**
Tutored over 90 different students in 14 different technical courses, mostly focusing on chemical engineering, physics, and math. Approximately 10 hours per week.

JOURNAL PUBLICATIONS

(7) **B.M. Worthmann** and D.R. Dowling. "*Autoproduct cross-term analysis for improved dynamic range in localization techniques*." (in preparation)

(6) **B.M. Worthmann** and D.R. Dowling. "*Autoproducts in refractive environments with caustics and shadow zones*." (in review, Journal of the Acoustical Society of America)

(5) **B.M. Worthmann** and D.R. Dowling. "*Autoproducts near acoustic shadow zones created by barriers*." (in review, Journal of the Acoustical Society of America)

(4) J.E. Lipa, **B.M. Worthmann**, and D.R. Dowling. (2018). *Journal of the Acoustical Society of America*. "*Measurement of autoproduct fields in a Lloyd's mirror environment*." doi.org/10.1121/1.5032200

(3) **B.M. Worthmann** and D.R. Dowling. (2017). *Journal of the Acoustical Society of America*. "*The frequency-difference and frequency-sum acoustic field autoproducts*." doi.org/10.1121/1.4985440

(2) **B.M. Worthmann**, H.C. Song, and D.R. Dowling. (2017). *Journal of the Acoustical Society of America*. "*Adaptive frequency difference matched field processing for high frequency source localization in a shallow ocean*." doi.org/10.1121/1.4973955

(1) **B.M. Worthmann**, H.C. Song, and D.R. Dowling. (2015). *Journal of the Acoustical Society of America*. "*Localization of a high frequency source in a shallow ocean sound channel using frequency difference matched field processing*." doi.org/10.1121/1.4936856

Conference Proceedings

(3) **B.M. Worthmann**. (2020). *SPIE Defense and Commercial Sensing: Radar Sensor Technology XXIV*. "*Clutter distributions for tomographic image standardization in ground penetrating radar*." (in preparation)

(2) **B.M. Worthmann** and D.R. Dowling. (2016). *Proceedings on the Meetings of Acoustics*. "*Nonlinear signal processing techniques for active sonar localization in the shallow ocean with significant environmental uncertainty and reverberation*." doi.org/10.1121/2.0000309

(1) **B.M. Worthmann**, H.C. Song, and D.R. Dowling. (2015). *12th Western Pacific Acoustics Conference*. "*High Frequency Source Localization in Shallow Ocean Sound Channels Using Frequency Difference Matched Field Processing*." goo.gl/7wXnHr

Research Presentations

Conferences of the International Society for Optical Engineering (SPIE)

Apr 2020 *Anaheim, CA* — **B.M. Worthmann,** "*Clutter distributions for tomographic image standardization in ground penetrating radar*."

Meetings of the Acoustical Society of America (ASA)

May 2019 *Louisville, KY* — **B.M. Worthmann** and D.R Dowling, "*Analytic solution to a waveguide featuring caustics and shadow zones*." doi.org/10.1121/1.5101606

Nov 2018 *Victoria, BC* — **B.M. Worthmann** and D.R Dowling, "*Autoproducts and out-of-band acoustic fields in refracting multipath environments with caustics*." doi.org/10.1121/1.5068125

May 2018 *Minneapolis, MN* — **B.M. Worthmann** and D.R Dowling, "*Cross-term analysis in frequency-difference-based source localization methods*." doi.org/10.1121/1.5036416

Dec 2017 *New Orleans, LA* — **B.M. Worthmann** and D.R. Dowling. "*Autoproducts in refractive waveguides near shadow zones*." doi.org/10.1121/1.5014235

D.R. Dowling, J.E. Lipa, and **B.M. Worthmann**. "*Measurements of the Acoustic-Field Autoproducts*." doi.org/10.1121/1.5014234

Jun 2017 *Boston, MA* — **B.M. Worthmann** and D.R. Dowling. "*The effects of diffraction on the frequency difference and frequency sum autoproducts*." doi.org/10.1121/1.4989039

Dec 2016 *Honolulu, HI* — **B.M. Worthmann** and D.R. Dowling. "*Wave physics of the frequency difference autoproduct: Bilinear time-frequency analysis*." doi.org/10.1121/1.4970216

D.R. Dowling and **B.M. Worthmann**. "*Wave physics of the frequency difference autoproduct: Helmholtz equation analysis*." doi.org/10.1121/1.4970215

May 2016 *Salt Lake City, UT* — **B.M. Worthmann** and D.R. Dowling. "*Target localization in a reverberant shallow ocean waveguide with environmental uncertainty using a nonlinear frequency-difference signal processing*." doi.org/10.1121/1.4950539

D.R. Dowling, S.H. Abadi, and **B.M. Worthmann**. "*Out-of-band beamforming and matched field processing*." Invited paper. doi.org/10.1121/1.4950177

Nov 2015 *Jacksonville, FL* — **B.M. Worthmann**, H.C. Song, and D.R. Dowling. "*Interpretations of the frequency difference autoproduct in multipath environments*." doi.org/10.1121/1.4934069

May 2015 *Pittsburgh, PA* — **B.M. Worthmann** and D.R. Dowling. "*High frequency source localization in a shallow ocean sound channel using frequency-difference matched field processing*." doi.org/10.1121/1.4920175

Oct 2014 *Indianapolis, IN* — **B.M. Worthmann**, H.C. Song, and D.R. Dowling. "*Localization of a high frequency source in a shallow ocean sound channel using frequency-difference MFP*." doi.org/10.1121/1.4899755

May 2014 *Providence, RI* — **B.M. Worthmann** and D.R. Dowling. "*Frequency-difference matched field processing in the presence of random scatterers*." doi.org/10.1121/1.4877923

International Conferences

Sep 2017 — *Skiathos, Greece*
4th Underwater Acoustics Conference and Exhibition (UACE). **B.M. Worthmann** and D.R. Dowling. "*Out-of-band acoustic fields near acoustic shadow zones and caustics*." bit.ly/2uwqE9i

Sep 2016 — *Buenos Aires, Argentina*
22nd International Congress on Acoustics (ICA). **B.M. Worthmann** and D.R. Dowling. "*Nonlinear signal processing techniques for active sonar localization in the shallow ocean with significant environmental uncertainty and reverberation*." doi.org/10.1121/2.0000309

Dec 2015 — *Singapore*
12th Western Pacific Acoustics Conference (WESPAC). **B.M. Worthmann**, H.C. Song, and D.R. Dowling. "*High frequency source localization in shallow ocean sound channels using frequency difference matched field processing*." goo.gl/7wXnHr

Other Research Presentations

Jul 2019 — *Livermore, CA*
Geophysics Seminar: Lawrence Livermore National Lab (LLNL) [Invited by Rob Mellors]
B.M. Worthmann. "*Out-of-band matched field processing for shallow ocean source localization with environmental uncertainty*"

Oct 2018 — *Austin, TX*
Applied Research Lab: University of Texas at Austin (ARL:UT) [Invited by Charlie Loeffler]
B.M. Worthmann. "*Δf-MFP: Trading Spatial Resolution for Environmental Robustness*"

Jul 2018 — *Livermore, CA*
Lawrence Livermore National Lab (LLNL) [Invited by Dave Chambers]
B.M. Worthmann "*Robust Physics-based Underwater Acoustic Source Localization Techniques*"

Jul 2018 — *Los Alamos, NM*
Los Alamos National Lab (LANL) [Invited by Cristian Pantea and Jim TenCate]
B.M. Worthmann. "*Out-of-Band Remote Sensing*"

Jun 2018 — *Washington, DC*
Naval Research Lab (NRL) [Invited by Jeff Rogers]
B.M. Worthmann. "*Overcoming matched field processing's environmental mismatch problem*"

Nov 2015 — *Panama City, FL*
Naval Surface Warfare Center, Panama City Division (NSWC-PCD) [Invited by Joe Lopes]
B.M. Worthmann, H.C. Song, and D.R. Dowling. "*High frequency source localization in shallow ocean sound channels using frequency difference matched field processing*."

Fellowships and Awards

Sep 2019 — **Outstanding Poster Award** [Computational Engineering Division, LLNL]
A division-level award for the lab-wide LLNL Postdoc Poster Symposium

Aug 2019 — **Global Security 2019 Directorate Gold Award** [Global Security Directorate, LLNL]
A directorate-level award given to the whole MiRadar (ground penetrating radar) team

May 2018 — **First Place for Best Student Paper Award** [Acoustical Society of America]
In the Signal Processing Technical Committee. Presentation entitled: "*Cross-term analysis in frequency-difference-based source localization methods*."

Jun 2017 — **First Place in the Gallery of Acoustics** [Acoustical Society of America]
Presentation entitled: "*Kaleidosone*."

Dec 2015 — **First Place for Best Student Paper Award** [Acoustical Society of America]
In the Underwater Acoustics Technical Committee. Presentation entitled: "*Interpretations of the frequency difference autoproduct in multipath environments*."

Nov 2015 — **First Place and Audience Choice Award in Demo Competition** [Optical Society at UM]
Presentation entitled: "*Seeing Maxwell's Equations*."

Nov 2015 — **Second Place in Engineering Graduate Symposium** [College of Engineering, UM]
In the Fluids, Acoustics, and Thermal Sciences poster session. Presentation entitled: "*Nonlinear Signal Processing Algorithm for Remote Acoustic Source Localization in a Shallow Ocean*."

2015 – 2018 — **NSF Graduate Research Fellowship** [National Science Foundation]

May 2015 **Outstanding Tutor Award** [Academic Success Program, Athletic Department, UM]

Nov 2014 **First Place in Engineering Graduate Symposium** [College of Engineering, UM]
In the Signal and Information Processing poster session. Presentation entitled: "*Localization of a high frequency source in a shallow ocean sound channel using frequency-difference matched field processing*."

LEADERSHIP, MENTORSHIP & SERVICE

Jun 2019 – Aug 2019 **Undergraduate Research Mentor**
Mentored senior undergraduate Computational Engineering student Alex G. in the development of a MATLAB-based algorithm for improved GPS corrections for performance characterization in the MiRadar project. He presented his research findings at the summer intern poster session, and his contributions were adapted into the main codebase for the project.

Jul 2016 – Dec 2017 (President)
Jan 2018 – Aug 2018 (Member) **Applied Physics Student Council: Founder, President, and Member**
I spearheaded the founding of the Applied Physics Student Council, which grew to 20 members, and together, we organized twice-monthly social events and professional development opportunities such as science writing and interviewing, fellowship panels and writing workshops, problem-of-the-month challenges, among many other events.

May 2016 – May 2018 **Acoustical Society of America: Student Council Member**
I was an extremely active member of ASA's Student Council during my two years serving as the Underwater Acoustics representative. I joined the other 13 members of the student council in organizing dozens of student-focused events for the several hundred student members. I also obtained funding for and organized a science communication workshop, revamped the student council website and print media, and created an ultrasound-based scavenger hunt.

Oct 2016 – Dec 2017 (Member)
Jan 2018 – Aug 2018 (Vice President) **Michigan Acoustics: Co-Founder, Vice President and Member**
To foster a greater sense of community among the wide variety of acoustics disciplines researched at the University of Michigan, six graduate students and I founded the Michigan student chapter of the Acoustical Society of America, through which we have organized several seminars, and created acoustics outreach demos for middle school students.

Mar 2016 – Dec 2016 **RELATE: Co-Director, and Workshop Coordinator**
See teaching experience for details.

Jul 2016 – Apr 2017 **English Language Institute: Conversation Circle Leader**
Met with six international students once a week over three semesters as part of UM's English Language Institute to help improve their English skills. In these 'conversation circles', we would play the game 'Cards Against Humanity' and discuss the various pop culture topics that arose.

Jan 2017 – May 2017 **Undergraduate Research Mentor**
Mentored and researched with a senior undergraduate Mechanical Engineering student Jessica L. to experimentally measure acoustic field quantities which validated the theory developed in my thesis research. These results were published in *JASA*, with the student as first-author.

SCIENCE COMMUNICATION EXPERIENCE

SATURDAY MORNING PHYSICS

The University of Michigan's Physics Dept. hosts a weekly seminar series about physics accessible to a general audience, with around 300 people from the Ann Arbor community typically in attendance. These presentations are also recorded and broadcast on local TV channels.

Mar 2018 "*The Sound Heard 'Round the World*"
In this talk, I discussed the distances over which sound can travel in air and in the ocean, and how refraction in the deep ocean leads to sound propagation over tens of thousands of kilometers.

NERD NITE ANN ARBOR

Nerd Nite is a monthly event held in hundreds of cities around the world in casual locations. At Nerd Nite Ann Arbor, each event consists of three speakers giving approximately 20 minute presentations on whatever topics interest them, such as science, culture, history, and art. Audiences are usually around 120 young- and middle-aged adults from the Ann Arbor area. See annarbor.nerdnite.com for more info.

Feb 2017 "*Pink is Bullshit*"
This talk was about color perception, and why pink is not in the rainbow, and included discussions of wavelengths of light, cone cells, CIE chromaticity diagrams, and emission spectra from various light bulbs.

Mar 2016 "*Journey to the Center of the Earth*"
This talk was about the historical use of earthquakes and seismometers to determine the structure of the Earth's interior – particularly the discovery of the Earth's core via P- and S-wave shadow zones.

Sep 2015 "*The Sound Heard 'Round the World*"
This talk was about acoustic propagation over long distances, including atmospheric waveguiding effects and the underwater SOFAR channel, and focused on the Battle of Gettysburg, and the Heard Island Feasibility Test.

PHYSICS GRADUATE STUDENT SYMPOSIUM

The University of Michigan's Physics Graduate Council hosts an hour-long presentation by a graduate student speaker once a week during the summer for an audience of approximately 50 physics graduate students. For more info, see logan.physics.lsa.umich.edu/gss/

Jun 2016 "*Acoustic Source Localization*."
This talk was about using sound to determine a direction or location of sound, and included discussions of spectrograms, head-related transfer functions, beamforming, and matched field processing.

Jun 2015 "*Ocean Acoustics and the SOFAR Channel*."
This talk was about ocean acoustics, particularly the physics and oceanography relating to the creation of the deep ocean sound speed profile, and ray-based modeling techniques for acoustic refraction in the deep ocean.

PROFESSIONAL SOCIETIES

Sept 2013 – Dec 2018 Student Member
Jan 2019 – Present Associate Member

Acoustical Society of America

- Attended all twice-yearly ASA meetings since Dec 2013
- Served as a peer reviewer for the journals: *JASA* and *JASA Express Letters*
- Served for two years on ASA Student Council (see leadership experience)
- Co-founded the Michigan Student Chapter of the ASA
- Member of Task Force 3: Dissemination of Information and Knowledge
- Member of the Education Committee

PROFESSIONAL DEVELOPMENT

May 2017 **Preparing Future Faculty Workshop**
Participated in this month-long 35-hour workshop hosted by the University of Michigan's Center for Research on Learning and Teaching which was aimed at helping senior graduate students prepare for a faculty career, through discussions on teaching and learning scholarship, inclusive teaching strategies, and innovative curriculum design.

Fall 2015 **RELATE Workshop**
Participated in this semester-long workshop, hosted by RELATE at the University of Michigan, which sought to improve participants' science communication skills through interactive sessions focusing on a variety of presentation aspects including audiences, goals, and narrative structure, and culminated in the production of a 20-min oral presentation. Shortly after this workshop, I was invited to join RELATE's leadership team (see Teaching Experience).

CV last updated: 1/8/2020