

Exponent®
Engineering & Scientific Consulting

Chris Ruhl, Ph.D.

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Professional Profile

Dr. Ruhl focuses on engineering challenges in the fields of fluid mechanics, thermodynamics, and heat transfer. Across these disciplines, Dr. Ruhl applies his skills in experimental design, instrumentation and data acquisition, and statistical analysis to provide evidence-based solutions to scientific problems. He has extensive background in the field of turbulence and its impact on marine renewable energy systems. His experimental portfolio includes thermal/fluid analysis on steam power generation, gas turbine engine performance, heat exchanger characterization, wind/water tunnel measurements, and internal combustion engine performance.

Prior to joining Exponent, Dr. Ruhl earned his Ph.D. in Mechanical Engineering from Lehigh University. His dissertation work focused on the turbulent flow characterization of high-energy tidal estuaries and the recreation of said turbulence in a laboratory water tunnel. He used various instrumentation techniques including acoustic Doppler velocimetry and hot-wire anemometry to measure flow tailored by a custom-designed active grid turbulence generator in a water tunnel facility. Dr. Ruhl previously held fellowship positions with private companies and national laboratories where he was tasked with analyzing large marine flow datasets collected from tidal energy site measurement campaigns. He used computational tools to filter and process the data to properly characterize the turbulent flow at each site. Through this work, he gained extensive experience with marine renewable energy technologies.

During his graduate studies, Dr. Ruhl also served as an Adjunct Professor in the Mechanical Engineering Department at Lafayette College. He taught a senior-level capstone course on thermal/fluid systems. The course heavily focused on experimental design and analysis and technical presentation skills. Applicable experiments included the investigation of the thermodynamic/fluid principles behind a gas turbine jet engine, a refrigeration system, a heat exchanger setup, a steam-powered turbine, an internal combustion engine, and bluff bodies placed in a wind tunnel.

As an undergraduate researcher, Dr. Ruhl was part of a research group tasked with building a custom-designed 3-D metal printer powered by a MIG welder. The team successfully constructed numerous iterations of the wire and arc additive manufacturing device. Ultimately, the device was used to print deposited layers of stainless steel to investigate the thermal and structural properties of the printed metal.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Lehigh University, 2023

M.Eng., Technical Entrepreneurship, Lehigh University, 2017

B.S., Mechanical Engineering, Lehigh University, 2016

NSF National I-Corps Program Graduate, 2023

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Office of Energy Efficiency and Renewable Energy's Water Power Technology Office Marine and Hydrokinetic Student Research Program Fellowship, Sandia National Laboratories, 2022-2023

Rossin Dean's Doctoral Fellowship, Lehigh University, 2019

Academic Appointments

Adjunct Professor, Mechanical Engineering, Lafayette College, 2023

Prior Experience

Adjunct Professor – Mechanical Engineering, Lafayette College, 2023

Mechanical Engineer, U.S. Army CCDC C5ISR Center, 2019

Insights Analyst, SportsRecruits, 2017-2019

Professional Affiliations

American Society of Mechanical Engineers (ASME) (Member)

American Physical Society (APS) (Member)

Publications

Judge, A., Ruhl, M., Ruhl, C. "Mechatronics and Dynamic System Design, 3rd Edition." Lulu Press Inc. 2019.

Haden, CV., Zeng, GS., Carter, FM., Ruhl, C., Krick, BA., Harlow, DG. "Wire and Arc Additive Manufactured Steel: Tensile and Wear Properties." Additive Manufacturing. Vol. 16. 2017.

Presentations

Ruhl, C., Hanzla, M., Banerjee, A. "A framework to create a laboratory twin from in situ tidal energy site measurements." UMERC Conference, 2023, Durham, NH.

Ruhl, C., Banerjee, A. "The shape of turbulence generated at highly energetic tidal sites." APS – Division of Fluid Dynamics, 2022, Indianapolis, IN.

Ruhl, C., Banerjee, A. "Parametric study of an active grid turbulence generator to reproduce real-world tidal flow conditions." IMECE Conference, 2022, Columbus, OH.

Ruhl, C., Neary, V.S., Banerjee, A. "The influence of a slack current threshold on tidal energy resource characterization." UMERC+METS Conference, 2022, Portland, OR.

Ruhl, C., Banerjee, A. "Towards twinning tidal energy sites in a laboratory water tunnel." UMERC+METS Conference, 2022, Portland, OR.

Ruhl, C., Banerjee, A. "Analyzing and benchmarking an active grid turbulence generator in a laboratory water tunnel." APS – Division of Fluid Dynamics, 2021, Virtual.

Ruhl, C., Banerjee, A., Chamorro, L., Neary, V. "A survey of turbulence characteristics at six tidal energy sites." APS – Division of Fluid Dynamics, 2021, Virtual.

Hanzla, M., Ruhl, C., Banerjee, A. "Modeling an active grid generated turbulence decay using a coupled

transient RANS model with a stochastic turbulence simulator." APS – Division of Fluid Dynamics, 2021, Virtual.

Ruhl, C., Banerjee, A., Chamorro, L., Neary, V. "Comparison of turbulent inflow statistics at six tidal energy sites." AGU Fall Meeting, 2021, Virtual.

Ruhl, C., Vinod, A., Banerjee, A. "Characterization of tunable active grid generated turbulence in a water tunnel facility." APS – Division of Fluid Dynamics, 2020, Virtual.

Ruhl, C., Vinod, A., Colby, J., Banerjee, A. "On the effectiveness of pylon fairing profiles in minimizing inflow disturbance for a downstream tidal turbine rotor." AGU Fall Meeting, 2020. Virtual.

Peer Reviews

Renewable Energy