Ivan Abraham, PhD

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DOCTORAL RESEARCH

On Geometric & Topological Methods for Analysis of Biophysical Timeseries Data

Using reparametrization invariant iterated integrals, my work introduced clustering & cyclic ordering to aperiodic yet repeating multi-dimensional signals. These invariants enabled detection of slow cortical waves propagating in the brain using functional magnetic resonance imaging data. Further, utilizing geometric diffusion processes, my work also showed that synergy detection in human motor control, specifically using electromyography signals, is appropriately interpreted as a nonlinear clustering problem.

WORK EXPERIENCE

AUG 2022 - PRESENT (FT)

Discovery Partners Institute – USA
Postdoctoral Research Associate

Research associate with the Neuroscience Program and with the Hearing Health Institute's science faculty.

MAY 2022 - AUG 2022 (FT)

Program Assistant

Organized & led process of standardization, harmonization & curation of terabytes of multi-site multi-paradigm MRI data. Developed & investigated methods of addressing cross-site, scanner & demographic differences. Created and supervised a 10-week internship program for undergraduates at Hearing Health Institute.

SEP 2015 – MAY 2022 (PT)

University of Illinois – USA
Teaching and Research Associate

Involved in creating analysis techniques for high dimensional biophysical data (fMRI/EMG): • to infer brain dynamics between different brain regions and • to create models of mechanisms that map between EMG data and forces generated by muscle movement. Studied use of classification & ML tools to generate interpretable feature from data. Taught or assisted with delivery of three undergraduate & three graduate level courses.

MAR 2015 – JUL 2015 (FT)

Texas A&M – QATAR
Temporary Research Assistant

Worked on design, fabrication & assembly of gas based super plastic forming machine to shape metal at elevated temperatures. Involved in control design & mechanical assembly of the equipment as well as generation of Project Safety Analysis reports & documentation.

JAN 2015 – MAR 2015 (FT)

Carnegie Mellon – QATAR
Temporary Research Associate

Installed, set-up and commissioned processor simulation package from MIT (Graphite) on network file system based prototype cluster. Tested & benchmarked pilot cluster with four nodes, resulting in creation of commissioning manual for future clusters & identification of bugs. Made recommendations for performance specifications of future cluster nodes.

JUL 2014 – AUG 2014 (FT)

Supreme Committee for Delivery & Legacy – Qatar
Intern

Researched under program consultant (CH2MHILL) to ascertain carbon offset initiatives towards carbon neutral FIFA 2022. Applied GHG accounting protocols & principles to preliminary analysis of suitable offset projects & made recommendations regarding possible industry partnerships.

JUN 2013 – JUL 2013 (FT)

Chiyoda Almana Engineering LLC
Mechanical Intern

Generated pressure vessel simulations in Microstation & PV Elite. Made piping designs & simulations using CEASER II and on Smart Plant Review. Prepared requisitions & datasheets for pressure vessels & turbo machinery.

EDUCATION

2017 – 22 **Doctor of Philosophy**
CUM. CGPA: 3.84
Electrical & Computer Engineerinng
University of Illinois, Urbana-Champaign

2015 – 17 **Master of Science**
CUM. CGPA: 3.91
Mechanical Science & Engineering
University of Illinois, Urbana-Champaign

2010 – 14 **Bachelor of Science**
CUM. CGPA: 3.94
Department of Mechanical Engineering
Texas A & M University, Qatar

AWARDS

2014 **Science Faculty Student of the Year**
Texas A & M University, Qatar

2012 – 14 **Full Academic Scholarship**
Qatar Foundation

2011 – 13 **Dean's Honor Roll**
Texas A & M University, Qatar

COMPUTER SKILLS

BEGINNER	C, C++, Rust
INTERMEDIATE	Mathematica, Julia, Python HTML, LaTeX, Microsoft Windows Computer Hardware & Support
EXPERT	Python, MATLAB

TEACHING

TEACHING ASSISTANT	Control System - Theory & Design Nonlinear Systetms Nonlinear & Adaptive Control Undergraduate Control Systems Intro. to Electornics
INSTRUCTION	Engineering Materials - Laboratory

PATENT

Automated, Objective Method of Assessing Tinnitus Condition
Fatima T. Husain, Yuliy Baryshnikov, Benjamin J. Zimmerman, Ivan T. Abraham.
US Patent No: 10,959,670

PUBLICATIONS

Slow cortical waves via cyclicity analysis
Ivan Abraham, Somayeh Shahsavarani, Benjamin J. Zimmerman, Fatima T. Husain, Yuliy Baryshnikov.
(under review)
doi:https://doi.org/10.1162/netn_a_00053

Dissociating tinnitus patients from healthy controls using resting-state cyclicity analysis and clustering
Benjamin J. Zimmerman, Ivan Abraham, Sara A. Schmidt, Yuliy Baryshnikov, and Fatima T. Husain.
Network Neuroscience. 2019.
doi:https://doi.org/10.1101/2021.05.16.444387

Comparing cyclicity analysis with pre-established functional connectivity methods to identify individuals and subject groups using resting state fMRI
Somayeh Shahsavarani, Ivan T. Abraham, Benjamin Z. Zimmerman, Yuliy M. Baryshnikov, Fatima T. Husain.
Frontiers in Computational Neuroscience. 2020.
doi:https://doi.org/10.3389/fncom.2019.00094

PRESENTATIONS

Cyclicity vs. similarity measures for fMRI resting state time series analysis
Ivan T. Abraham, Somayeh Shahsavarani, Benjamin Zimmerman, Yuliy M. Baryshnikov, Fatim T. Husain
Analytical Computational Models. The 49th Annual Meeting, Society for Neuroscience.
Chicago, Illinois, October 19-23, 2019

Automated identification of tinnitus patients using replicable resting state fMRI data
Fatim T. Husain, Benjamin Zimmerman, Ivan Abraham, Sara Schmidt, Somayeh Shahsavarani, Rafay Khan, Yuliyy Baryshnikov
Sixth Biennial Conference on Resting-State and Brain Connectivity
Montreal, Quebec, Canada, September 26-28, 2018

Classification of tinnitus patients vs. control subjects based on cyclicity analysis
Ivan Abraham, Benjamin Zimmerman, Sara Schmidt, Yuliy Baryshnikov, Fatima T. Husain
Inaugural Workshop on Brain Dynamics and Neurocontrol Engineering
Washington University in St. Louis, MO. June 25-27, 2017