

BRETT A. MEYERS

2252 US Highway 52 West,
Apartment H2
West Lafayette, IN 47906
(609) 234-7122 (cell)
brett.albert.meyers@gmail.com

Department of Mechanical Engineering
Vlachos Research Group, Purdue University
585 Purdue Mall
West Lafayette, IN 47906
meyers18@purdue.edu

PERSONAL SUMMARY

A passionate, driven, and capable researcher with over 10 years of industrial and academic research experience. More than a dozen publications, patents, and conference papers, focused on tissue mechanics and hemodynamics of the heart and major vessels. Experienced conference presenter and well-versed in classroom teaching.

RESEARCH INTEREST

Cardiovascular mechanics (hemodynamics, tissue dynamics)
Clinical determinants from medical imaging
Image Correlation Techniques
Particle Image Velocimetry (PIV) Digital Image Correlation (DIC)
Micro-scale flows in medical devices

EDUCATION

PhD **Purdue University** | Mechanical Engineering | *July 2014 – April 2021*
Dissertation: Methods for echocardiographic biomechanical measurements

MSME **Virginia Tech** | Mechanical Engineering | *August 2011 – July 2014*
Thesis: Feasibility of Echo-PIV for evaluation of cardiac LV filling function

BSME **Drexel University** | Mechanical Engineering | *August 2006 – June 2011*
Thesis: Biofactory-on-a-Chip

RESEARCH EXPERIENCE

Purdue University, Vlachos Research Lab, West Lafayette, IN *July 2014 - Present*
Advisor: Pavlos P. Vlachos

My thesis research focused on developing novel methods to measure tissue motion and hemodynamics from non-invasive medical imaging, specifically ultrasound. These new approaches enabled us to acquire measurements from fetal echocardiograms, the most challenging population due to heart size and imaging depths. The methods created include:

- A computational method to reconstruct velocity vector fields from color Doppler imaging
- An improved framework for performing Echocardiogram Particle Image Velocimetry
- New image correlation techniques for measurement of cardiac strain
- Automation of clinical LV function determinants from echocardiograms
- Optimizing a machine learning method to predict patients at risk of heart failure

Additional contributions outside of my thesis research include:

- Creating an automated pupil light reflex measurement application for smartphones
- Employing structure causal modeling to create a new hearth failure scoring algorithm

This work resulted in 5 publications in UMB, RSI, JBM, and Pediatric Research

Virginia Tech, AETHER Lab, Blacksburg, VA
Advisor: Pavlos P. Vlachos

August 2011 – July 2014

My thesis research focused on developing a framework for performing echo-PIV on clinical echocardiograms. This earlier project laid the groundwork for me to improve the approach during my first year as a PhD student.

Additional contributions outside of my thesis research include:

- Improved image processing for an existing algorithm which measures alterations in left heart compliance based on atrio-ventricular valve annulus loading
- Contributed to collection of the Stereo-PIV Vortex Ring Case E for 2014 PIV Challenge

Drexel University, BAST Lab, Philadelphia, PA
Advisor: MinJun Kim

June 2008 – August 2011

My senior thesis research focused on developing a multi-level micro-fluid chip which captures individual cells to study cell taxis

Additional contributions outside of my thesis research include:

- Part of student teams focused on cell swarming and artificial micro-swimmers

TEACHING EXPERIENCE

Purdue University, ME 309 – Fluid Mechanics
Teaching Assistant

August 2014 – May 2016

- Lab proctor, recitation lecturer, exam proctor, and grader. Held office hours for lab, homework, and exam preparation

Virginia Tech, ME 4005 – Junior Lab
Laboratory Teaching Assistant

January – May 2012

- Lab proctor and grader for courses on experiment design and application of measurement systems

Virginia Tech, ME 4006 – Senior Lab
Laboratory Teaching Assistant

August – Dec. 2011

- Lab proctor and grader for courses focused on improving seniors in lab report writing

PROFESSIONAL EXPERIENCE

Johnson & Johnson, Consumer Group, Lititz, PA
Process Engineer

April – Sept. 2010

- Improved packaging process for safety and efficiency on manufacturing operation lines

Agilent Technologies, Wilmington, DE
Research & Design Engineer

Sept. 2008 - March 2009

- Designed prototype assemblies for the new Gas Chromatograph (GC) product line
- Participated in weekly engineering design reviews
- Conducted first-stage prototype GC component performance and life testing

Kensey Nash Corp., Exton, PA
Biomaterials Engineer

Sept. 2007 – March 2008

- Assisted lead engineers with design review and production of surgical implants
- Performed strength, life, and quality test of product line samples

MEDIA MENTIONS

Babies Born with Broken Hearts: A collaboration of medicine and engineering in Indiana explores cardiac flow hydrodynamics in fetal single ventricle hearts (*across several outlets*)

Out of the box: Diagnosing concussions with a smart phone, *The Journal of Purdue Undergraduate Research* (2017)

AWARDS AND HONORS

- MSME, Mechanical Engineering (*with distinction*) Virginia Tech
- BSME, Mechanical Engineer (*Cum Laude*) Drexel University
- Dean's undergraduate honors list Drexel University
- Travel Award, Purdue University \$1000 (*cumulative*)
- Augusta H. Hess Mechanical Engineering Scholarship \$2,000 (*cumulative*)
- A. J. Drexel Merit Scholarship \$16,000 (*cumulative*)
- H & T Kraiker Endowment Scholarship \$24,000 (*cumulative*)
- Pi Tau Sigma Inductee November 2010
- National Society of Collegiate Scholars Inductee September 2009
- National Cooperative Education Honor Society Inductee May 2008
- Drexel ASME Mentorship Chair September 2010 - June 2011

MEMBERSHIPS/AFFILIATIONS

- American Society of Mechanical Engineers Sept. 2007 – Present
- American Physical Society (APS) Nov. 2011 – Present

JOURNAL PUBLICATIONS

Sreyashi Chakraborty, **Brett A. Meyers**, Hiroyuki Iwano, Michael E. Hall, and Pavlos P. Vlachos (2021), "A Wavelet Approach to the Estimation of Left Ventricular Early Filling Wave Propagation Velocity from Color M-Mode Echocardiograms", *Ultrasound in Medicine and Biology*.

Brett A. Meyers, Craig J. Goergen, Patrick Segers, and Pavlos P. Vlachos (2020), "Colour-Doppler echocardiography flow field velocity reconstruction using a streamfunction–vorticity formulation", *Journal of the Royal Society Interface*, 17(173): 20200741.

Collin T. Erickson, **Brett Meyers**, Ling Li, Mary Craft, Vivek Jani, John Bilamptis, Karl Stessy Bisselou Moukagna, David A. Danford, Pavlos Vlachos, and Shelby Kutty (2020), "Progression of left ventricular diastolic function in the neonate and early childhood from transmitral color M-mode filling analysis", *Pediatric Research*, 1-9.

Brindise, Melissa C.*, **Brett Meyers***, and Pavlos P. Vlachos. "Universality of Vortex Ring Decay in the Left Ventricle." *Journal of Biomechanics* (2020): 109695.

Brett Meyers, Craig Goergen, Pavlos Vlachos (2018), "Development and Validation of a Phase-Filtered Moving Ensemble Correlation for Echocardiographic Particle Image Velocimetry", *Ultrasound in medicine & biology*, 44(2), 477-488

Andrea Acuna*, Alycia G. Berman*, Frederick W. Damen*, **Brett A. Meyers***, Amelia R. Adelsprerger, Kelsey C. Bayer, Melissa C. Brindise, Brittany Bungart, Alexander M. Kiel,

Rachel A Morrison, and Joseph C. Muskat (2018), “Computational Fluid Dynamics of Vascular Disease in Animal Models”, *Journal of Biomechanical Engineering*, 140(8), 080801.

Francisco J. Londono-Hoyos, Abigail Swillens, Joris Van Cauwenberghe, **Brett Meyers**, Maheswara Reddy Koppula, Pavlos Vlachos, Julio A. Chirinos, Patrick Segers (2018), “Assessment of Methodologies to Calculate Intraventricular Pressure Differences in Computational Models and Patients”, *Medical & Biological Engineering & Computing*, 56(3), 469-481

Hiroyuki Iwano, Min Pu, Bharathi Upadhyaya, **Brett Meyers**, Pavlos Vlachos, William C. Little (2014), “Delay of left ventricular longitudinal expansion with diastolic dysfunction: impact on load dependence of e' and longitudinal strain rate”. *Physiological reports*, 2(7), e12082

* Indicates shared co-authorship between primary authors

CONFERENCE PROCEEDINGS

Brett Meyers, John Charonko, Min Pu, William C. Little, Pavlos Vlachos, “Robust clinical cardiac Echo Particle Image Velocimetry (EchoPIV)”. *The 10th International Symposium on Particle Image Velocimetry*, July 1-3, 2013, Delft, Netherlands. Delft: n.p., July 1st 2013. TU Delft Library

MANUSCRIPTS IN PROGRESS AND PRE-PRINTS

Melissa Brindise, **Brett Meyers**, Shelby Kutty MD, Pavlos Vlachos (2021), “Unsupervised Segmentation of B-Mode Echocardiograms”, *IEEE Transactions in Biomedical Engineering (under review; arXiv preprint arXiv:2010.11816)*

Brett Meyers, Melissa Brindise, Shelby Kutty MD, Pavlos Vlachos (2021), “Methods of Estimating of Left Ventricular Global Longitudinal Strain from Echocardiograms”, *Journal of the American College of Cardiology Cardiovascular Imaging (in preparation; arXiv preprint arXiv:2003.11672)*

Brett Meyers, Melissa Brindise, R. Mark Payne, Pavlos Vlachos (2021), “An Integrated and Automated Tool for Quantification of Biomechanics in Fetal and Neonatal Echocardiography”, *Journal of the American College of Cardiology Cardiovascular Imaging (in preparation; medRxiv)*

Brett Meyers, Paul Griffin, Pavlos Vlachos, Mohammad Adibuzzaman (2021), “Predicting heart failure using a biomarker-labeled XG Boost model with echocardiographic parameters”, *Physiological measurement (in preparation)*

CONFERENCE PRESENTATIONS & POSTERS

Brett Meyers, R. Mark Payne, Pavlos Vlachos, "Tiny hearts in big trouble: cardiac flow hydrodynamics in fetal single ventricle hearts", *American Physical Society, Division of Fluid Dynamics 71st Annual Meeting*, Atlanta, GA, November 2018

Collin Erickson, **Brett Meyers**, Ling Li, Mary Craft, Pavlos Vlachos, David Danford, Shelby Kutty, “Color M-Mode Echocardiography Derived Left Ventricular Diastolic Indices in Infants Strongly Correlate With Left Ventricular Linear Dimensions”, *American Heart Association’s 2018 Scientific Sessions*, November 2018

Collin T. Erickson, Ling Li, **Brett Meyers**, Mary Craft, Andreas Schuster, Pavlos Vlachos, and Shelby Kutty, "Maturation of Early Diastolic Left Ventricular Function is Largely Complete in the First Month of Life: Insights From Semiautomated Analysis of Color M-Mode Echocardiographic Filling Velocities", *American Heart Association's 2017 Scientific Sessions and Resuscitation Science Symposium*, November 2017

Brett Meyers, Craig Goergen, Carlo Scalo, Pavlos Vlachos, "Color Doppler Echocardiogram Velocimetry Flow Reconstruction Using Streamfunction-Vorticity Formulation", *3rd Annual Summer Biomechanics, Bioengineering and Biotransport Conference*, Tucson, AZ, June 2017

Brett Meyers, Pavlos Vlachos, Craig Goergen, Carlo Scalo, "Color Doppler Ultrasound Velocimetry Flow Reconstruction using Vorticity-Streamfunction Formulation", *American Physical Society, Division of Fluid Dynamics 69th Annual Meeting*, Portland, OR, November 2016

Brett Meyers, Pavlos Vlachos, John Charonko, Matthew Giarra, Graig Goergen, "Accuracy and Robustness Improvements of Echocardiographic Particle Image Velocimetry for Routine Clinical Cardiac Evaluation", *American Physical Society, Division of Fluid Dynamics 68th Annual Meeting*, Boston, MA, November 2015

Francisco Londono, **Brett Meyers**, Pavlos Vlachos, Julio Chirinos, Patrick Segers, "Assessment of intraventricular pressure gradients in patients with heart failure with preserved ejection fraction during an acute dose of sublingual Nitro-Glycerine", *13th Belgian National Day on Biomedical Engineering*, Brussels, Belgium, November 2014

Francisco Londono, **Brett Meyers**, Pavlos Vlachos, Patrick Segers, Julio Chirinos, "Effect of organic nitrates on intraventricular pressure gradients in heart failure patients with preserved ejection fraction", *Artery 14*, Maastricht, Netherlands, October 2014

Sayantana Bhattacharya, **Brett Meyers**, Matt Giarra, Roderick LaFoy, Pavlos Vlachos "Uncertainty Estimation for Stereo-Particle Image Velocimetry Measurements", *American Physical Society, Division of Fluid Dynamics 66th Annual Meeting*, Pittsburg, PA, November 2013

Hiroyuki Iwano, Min Pu, Bharathi Upadhyaya, **Brett Meyers**, Pavlos Vlachos, William C. Little "Relation of Early Diastolic Mitral Annular Velocity, Mitral Flow Velocity, and Left Ventricular Strain Rate on Intraventricular Pressure Difference", *American Heart Association 2013 Scientific Sessions and Resuscitation Science Symposium*, Chicago, IL, November 2013 (With Poster)

Hiroyuki Iwano, Min Pu, Bharathi Upadhyaya, **Brett Meyers**, Pavlos Vlachos, William C. Little, "The Determinants of Early Diastolic Intra Left Ventricular Pressure Difference" *American Heart Association 2013 Scientific Sessions and Resuscitation Science Symposium*, Chicago, IL, November 2013 (With Poster)

Takahiro Ohara, Hiroyuki Iwano, Min Pu, **Brett Meyers**, John Charonko, Pavlos Vlachos, William C. Little, "Left Ventricular Systolic Circumferential Deformation is Associated with Left Ventricular Diastolic Apical Suction", *Japanese Heart Failure 17th Annual Scientific Meeting*, Tokyo, Japan, November 2013

Brett Meyers, John Charonko, Min Pu, William C. Little, Pavlos Vlachos, “Robust clinical cardiac Echo Particle Image Velocimetry (EchoPIV)”, *The 10th International Symposium on Particle Image Velocimetry*, Delft, Netherlands, July 2013

PATENTS, INTELLECTUAL PROPERTY, AND SOFTWARE RELEASED

“Method of processing an image”, provisional patent converted, copyright and utility patent published (62/640,849; 1-6364800131; 16/291,157)

“Video processing methods and software architectures for analyzing transformation in objects” provisional patent converted, utility patent published (62/774,040; 16/697,121)

"System architecture and method of processing image", provisional patent converted, utility patent filed (62/987,978; 17/199,017)

"System architecture and method of processing image", provisional patent converted, utility patent filed (62/987,964; 17/199,006)

A Method for Automatic Echocardiogram Segmentation (IP Disclosure; 2020-VLAC-68780)

A Method for Direct Estimation of Heart Mechanics from Echocardiograms (IP Disclosure; 2020-VLAC-68781)

Method for optical detection of neurological alterations (IP Disclosure; 2019-VLAC-68416)

Method for Reconstructing Two Component Velocity Fields from Ultrasound Color Doppler Scans (IP Disclosure; 2017-SCAL-67985)

EXTERNAL RESEARCH SUPPORT (ACTIVE)

Echocardiography Analysis Tools for Congenital Heart Disease

Co-PI: Pavlos Vlachos, R. Mark Payne MD 04/2018-(04/2022)

Role: Research Assistant, Co-author

Summary: Congenital heart diseases (CHDs) affect 1% of children born in the US annually. Hypoplastic left heart syndrome (HLHS), 2–3% of CHDs, is detectable in utero, and factors can stratify them into high and low risk candidates for surgery. However, these factors are limited and do not account for fetal heart flow and biomechanics. We investigate how diastolic heart flow and mechanical parameters (intraventricular vortex strength, energy loss, intraventricular pressure difference, strain, strain rate) evolve during the development of HLHS and normal hearts, in fetal and pediatric studies. To accomplish this, we first need to develop reliable tools to analyze echocardiograms across echocardiogram studies with varying image quality.

INTERNAL RESEARCH SUPPORT (ACTIVE)

Causally-driven Healthcare Science, Integrative Data Science Initiative, Purdue

Co-PI: Pavlos Vlachos, Mohammad Adibuzzaman, \$265,000, 06/2018-(06/2021)

Role: Research Assistant

Summary: Investigate potential improvements in heart failure diagnose using a novel scoring method derived from structure causal modeling, compared against state-of-the-art algorithms.

EXTERNAL RESEARCH SUPPORT (COMPLETED)

Eli-Lilly-Injectable Biologics

Co-PI: Pavlos Vlachos, 2017-2018 (renewable for 5 years)

Role: Research Assistant

Summary: To investigate the drug delivery and bio-transport in the subcutaneous tissue.

Assessment of Left Ventricle Function Using Color M-Mode Echocardiography

PI: Pavlos Vlachos, 07/2014-06/2016

Role: Research Assistant

Summary: The goal of this project was to overcome limitations in the estimation of left ventricle (LV) propagation velocity (V_p) to delineate the filling mechanics. This knowledge was used to develop a physically consistent, accurate, and robust methodology for quantifying early diastolic filling function. A new parameter, early filling strength (V_s), which combines V_p and the deceleration distance, was developed and shown to better differentiate between normal diastolic filling function and patients with diastolic dysfunction.

Development of new measurement tools for accurate estimation of wall-shear stress in medical devices using Particle Image Velocimetry (PIV) methods

PI: Pavlos Vlachos, 07/2012-06/2014

Role: Research Assistant

Summary: The goal of this work was to develop high accuracy, high resolution measurement datasets on a flow geometry representative of implantable cardiovascular devices.