

Dr. Sayantan Bhattacharya

Postdoctoral Research Associate

Department of Mechanical Engineering, Purdue University.

Address: 305 Montefiore Street, Apt 314, Lafayette 47905, IN, USA.

Phone.: (+1) 918-629-2103.

Email: bhattach3@purdue.edu, sayantan.bhattacharya.1310@gmail.com

<https://vlachosresearch.org/pub-author/sayantan-bhattacharya/>



Research interests:

Experimental Fluid Dynamics, Particle Image Velocimetry (PIV), Uncertainty Quantification (UQ), Digital Image and Signal Processing.

Education:

PhD, Mechanical Engineering	Purdue University	3.78/4.0	December, 2019
ME, Mechanical Engineering	Indian Institute of Science	7.40/8.0	July, 2011
BE, Mechanical Engineering	Jadavpur University	8.90/10.0	June, 2009

Academic Achievements and Awards:

- Selected in 2018 MST journal highlights(<https://iopscience.iop.org/journal/0957-0233/page/Highlights-2018>).
- Awarded the 2018 Summer Research Grant for the School of Mechanical Engineering, Purdue University.
- Awarded Estus H. and Vashti L. Magoon Award for Excellence in Teaching for 2018, Purdue University.
- Awarded Ward A. Lambert Graduate Teaching Fellowship for Spring-Fall 2017, Purdue University.
- Achieved first class with distinction in M.E. and was ranked 2nd in a class of 40 students.
- Achieved first class with honors in B.E. and was ranked 4th in a class of 100 students.
- Awarded S. M. Bose Memorial Gold Centered Silver Medal in B.E.
- Achieved all India rank 1 in Graduate Aptitude Test in Engineering (GATE).

Research Experience:

Purdue University, Postdoctoral Research Associate
Vlachos Research Group

January 2020 – current

- Developed a feature based supervised classification using neural networks for subvisible particle detection in therapeutic drugs.
- Developed automatic label classification based on image textural features for subvisible particles using K-means clustering.
- Proposed a Bayesian MAP estimation framework for 3D position reconstruction in volumetric particle image velocimetry (work in progress).

Purdue University, Graduate Research Assistant
Vlachos Research Group

August 2013 – Dec 2019

- Formulated an uncertainty estimation model in particle based volumetric (3D) reconstruction process and subsequent uncertainty quantification in 3D Particle Tracking Velocimetry (PTV) measurement – carried out an experimental validation using time-resolved 3D PTV measurement of pipe flow.
- Proposed the first uncertainty estimation model in stereo-PIV camera calibration process. Determined the contribution of calibration uncertainty, self-calibration uncertainty and 2D correlation uncertainty in the overall 3 component velocity measurement.
- Developed a-posteriori uncertainty quantification framework by directly estimating the PDF of displacement from the cross-correlation plane for a planar PIV analysis.
- Proposed a novel method to perform stereo and tomographic PIV in a full-scale subsonic axial compressor rotor passage.
- Collaborated in building an uncertainty propagation model through a BOS measurement chain to quantify the uncertainty in an instantaneous density measurement.
- Benchmark experiment design of a volumetric steady and pulsatile pipe flow measurement for simultaneous validation of stereo-plenoptic tomo-PIV and traditional tomo-PIV measurement techniques in collaboration with Auburn University.
- Performed stereo-PIV measurement across a radial slice along a rectangular sectioned 90° bend in an APU-style inlet system.
- Investigated laser induced cavitation bubble and air bubble interaction using shadowgraph visualization and simultaneous pressure measurement using hydrophones.

Virginia Tech, Curricular Practical Training
AETHER-Lab

January 2013 – July 2013

- Implemented wavelet-based phase filtering and unwrapping algorithm to estimate PIV displacement from spectral representation of the cross-correlation plane.
- Assessment and troubleshooting of in-vitro pressure measurement in a left-ventricular simulator device to match physiological conditions.

Purdue University, Graduate Research Assistant
Bio-robotics Lab

August 2011 – Dec 2012

- Analyzed Volumetric PIV experimental data using TSI Insight software processing to study the effect of stroke reversal on flapping wings.
- Measured lift and drag force for a mechanical flapper in forward flight condition in a low-speed wind tunnel.

Indian Institute of Science, Master's Thesis Project

August 2009 – May 2011

- Analyzed fluid structure interaction by observing rigid and flexible (PDMS) valve kinematics using particle-based flow visualization and measuring pressure drop for an unsteady flow over a bicuspid valve.

- Developed a CFD code for flow past a cylinder using fully staggered grid in polar coordinates using projection method as a part of the CFD course project.
- Analyzed and modified of finite element codes for 2D analysis of different loading problems using various 2D elements (CST element, 8 node and 9 node elements) as a part of Finite Element Analysis course.

Jadavpur University, Undergraduate Research Project

May 2007 – May 2009

- Design, fabrication and operation of non-IBR, semi-automatic, tabletop boiler.

Teaching and Mentoring Experience:

Purdue University, Postdoctoral Research Associate

January 2020 – current

- Mentoring 3 Ph.D. students on their projects in PIV 3D uncertainty and multiphase flow experiments.

Purdue University, Teaching Assistant

August 2016 – Dec 2018

- Instructor for undergraduate fluid mechanics lab (ME309) in Fall 2016 and Fall 2018.
- Lecturer for undergraduate fluid mechanics course (ME309) in Fall 2017, for a class of 72 students.
- Substituted course instructor in graduate level experimental fluid dynamics course for lectures on stereo-PIV and PIV uncertainty.

Teaching evaluation for coursework by students in Fall2017 is 4.0/5.0 for class motivation, teaching preparedness and encouraging interaction.
Overall, TA evaluation for Spring2018 is 4.5/5.0.

Skills:

- Experimental: Non-invasive optical techniques (Laser/ LED based) for flow velocity measurement using multi-camera setup (e.g., planar, stereo and volumetric PIV/PTV)
- Software: MATLAB, Python, Fortran, C++, Solid works, LabVIEW.

Publications:

Journal-

Total number of journal articles: 8; Citations: 163; h-index: 6; i10-index: 3; (source: [Google Scholar](#))

- **Bhattacharya, S.**, Berdanier, R. A., Vlachos, P. P., & Key, N. L. (2016). A New Particle Image Velocimetry Technique for Turbomachinery Applications. *Journal of Turbomachinery*, 138(12), 124501.
- Boomsma, A.*, **Bhattacharya, S.***, Troolin, D., Pothos, S., & Vlachos, P. (2016). A comparative experimental evaluation of uncertainty estimation methods for two-component

PIV. *Measurement Science and Technology*, 27(9), 094006. (* both authors contributed equally)

- **Bhattacharya, S.**, Charonko, J. J., & Vlachos, P. P. (2016). Stereo-particle image velocimetry uncertainty quantification. *Measurement Science and Technology*, 28(1), 015301.
- **Bhattacharya, S.**, Charonko, J. J., & Vlachos, P. P. (2018). Particle image velocimetry (PIV) uncertainty quantification using moment of correlation (MC) plane. *Measurement Science and Technology*, 29(11), 115301.
- **Bhattacharya, S.**, & Vlachos, P. P. (2020). Volumetric particle tracking velocimetry (PTV) uncertainty quantification. *Experiments in Fluids*, 61(9), 1-18.
- Zhang, J., **Bhattacharya, S.**, & Vlachos, P. P. (2020). Using uncertainty to improve pressure field reconstruction from PIV/PTV flow measurements. *Experiments in Fluids*, 61, 1-20.
- Rajendran, L. K., Zhang, J., **Bhattacharya, S.**, Bane, S. P., & Vlachos, P. P. (2020). Uncertainty quantification in density estimation from background-oriented Schlieren measurements. *Measurement Science and Technology*, 31(5), 054002.
- Rajendran, L. K., **Bhattacharya, S.**, Bane, S., & Vlachos, P. (2021). Meta-Uncertainty for Particle Image Velocimetry. *Measurement Science and Technology*.

Conference-

- Rajendran, L. K., Bhattacharya, S., Zhang, J., Bane, S. P., & Vlachos, P. P. (2019). Assessment of Uncertainty Quantification methods for density estimation from Background Oriented Schlieren (BOS) measurements. In *13th International Symposium on Particle Image Velocimetry* (pp. 377-395).
- Bhattacharya, S., & Vlachos, P. P. (2019). Uncertainty quantification in volumetric PTV. In *Proc. 13th Int. Symp. on Particle Image Velocimetry*.
- Pothos, S., Boomsma, A., Troolin, D., Bhattacharya, S., & Vlachos, P. (2016, July). PIV Uncertainty: Computational and Experimental Evaluation of the Peak Ratio Method. In *Fluids Engineering Division Summer Meeting* (Vol. 50312, p. V002T10A005). American Society of Mechanical Engineers.
- Boomsma, A., Bhattacharya, S., Troolin, D., Vlachos, P., & Pothos, S. (2015, September). PIV Uncertainty: Computational & Experimental Evaluation of Uncertainty Methods. In *11th International Symposium on Particle Image Velocimetry*. Santa Barbara, California.
- Charonko, J. J., Bhattacharya, S., Xue, Z., Vlachos, P. P. (2014). Direct Estimation of PIV Uncertainty from Correlation Plane Analysis. *17th International Symposium on Applications of Laser Techniques to Fluid Mechanics, Lisbon*.

Presentations Only-

- Bhattacharya, S., Bilionis, I., & Vlachos, P. (2021). Approximate Bayesian framework for 3D reconstruction in a volumetric PIV/PTV measurement. In *14th International Symposium on Particle Image Velocimetry. (ISPIV 2021 Chicago)*
- Bhattacharya, S., Vlachos, P., & Bilionis, I. (2021). Learning How to Solve the 3D Reconstruction Problem Volumetric Particle Image Velocimetry. SIAM Conference on Computational Science and Engineering.
- Bhattacharya, S., Bilionis, I., & Vlachos, P. (2020). Approximate Bayesian approach for volumetric reconstruction in a 3D PIV measurement. *Bulletin of the American Physical Society*, 65.

- Sapkota, B., Bhattacharya, S., Puayen Tan, Z., Kelly, D., Eshraghi, J., Vlachos, P., & Thurow, B. (2020). Performance of kHz-rate plenoptic-PIV versus tomo-PIV on a 10mm-scale pipe flow. *Bulletin of the American Physical Society*, 65.
- Rajendran, L., Bhattacharya, S., Bane, S., & Vlachos, P. (2018). Effect of density gradients on the Cramer-Rao lower bound for volumetric PIV/PTV measurements. *Bulletin of the American Physical Society*, 63.
- Bhattacharya, S., & Vlachos, P. (2018). Uncertainty Quantification in Volumetric Particle Tracking Velocimetry (PTV). *Bulletin of the American Physical Society*, 63.
- Bhattacharya, S., Charonko, J., & Vlachos, P. (2016). Uncertainty quantification in volumetric Particle Image Velocimetry. *Bulletin of the American Physical Society*, 61.
- Pothos, S., Bhattacharya, S., Vlachos, P., Troolin, D., & Lai, W. (2014). Benchmark measurements for evaluation of PIV uncertainty method. *Bulletin of the American Physical Society*, 59.
- Bhattacharya, S., & Vlachos, P. (2014). Uncertainty Estimation in Stereoscopic Particle Image Velocimetry. *Bulletin of the American Physical Society*, 59.
- Xue, Z., Bhattacharya, S., Charonko, J., & Vlachos, P. (2014). Direct Estimation of Particle Image Velocimetry Measurement Uncertainty from Cross-Correlation Plane Moments. *Bulletin of the American Physical Society*, 59.
- Bhattacharya, S., & Vlachos, P. (2014). Quantification of uncertainty in a stereoscopic particle image velocimetry measurement. In A. Bajaj, P. Zavattieri, M. Koslowski, & T. Siegmund (Eds.). *Proceedings of the Society of Engineering Science 51st Annual Technical Meeting, October 1-3, 2014*, West Lafayette: Purdue University Libraries Scholarly Publishing Services, 2014. <https://docs.lib.purdue.edu/ses2014/mfts/qunfv/5>
- Bhattacharya, S., & Vlachos, P. (2014). Uncertainty Quantification in Stereoscopic PIV. Symposium on Uncertainty Quantification in Flow measurements and Simulation-ASME FEDSM.
- Bhattacharya, S., Meyers, B., Giarra, M., La Foy, R., & Vlachos, P. (2013). Uncertainty estimation for Stereo-Particle Image Velocimetry measurements. *Bulletin of the American Physical Society*, 58.

Thesis-

- Bhattacharya, S. (2019). *Uncertainty Quantification in Particle Image Velocimetry* (Doctoral dissertation, Purdue University Graduate School).

Intellectual Property Disclosures:

Uncertainty Quantification in Volumetric Particle Tracking Velocimetry (PTV), 2019-VLAC-68470
 Stereo-Particle Image Velocimetry Uncertainty Quantification, 2017-VLAC-67630
