PALLAV RANJAN

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RESEARCH INTERESTS

- Environmental Hydraulics (Coastal processes, Sediment transport, Gas exchange, Coral reefs)
- Ecohydraulics (Flow-vegetation interactions, Nature Based Solutions, Climate resilience)
- Geophysical flows (Turbulent transport and mixing)
- Fluid Structure Interactions
- Application of data driven techniques for geophysical flows

RESEARCH SKILLS

Computational Fluid Dynamics	Nek5000, ADCIRC, PROBE
Experimental Fluid Mechanics	PIV, LIF, ADV, Load Cells
Physical Oceanography	WireWalker profiler, Eddy Covariance, Scientific Diving
Programming Languages	MATLAB, Python, Fortran, R, Mathematica
Software Packages	MIKE FLOOD, HEC-RAS, ArcGIS, QGIS, LaTeX

EDUCATION

University of Illinois at Urbana-Champaign Urbana, IL
Doctor of Philosophy in Civil Engineering Aug 2018-July 2023
Graduate concentration in Computational Science and Engineering *GPA: 3.92/4.0*
Graduate minor in Global Studies
Computational Science and Engineering Fellow 2018-2019
Mavis Future Faculty Fellow 2021-2022
Program: Water Resources Engineering and Sciences

University of Illinois at Urbana-Champaign Urbana, IL
Master of Science in Mechanical Science and Engineering Aug 2018-May 2023
Program: Theoretical and Applied Mechanics (Fluid Mechanics) *GPA: 4.0/4.0*

University of Illinois at Urbana-Champaign Urbana, IL
Master of Science in Civil Engineering Aug 2016- Aug 2018
Ravindra K and Kavita Kinra Fellow 2016-2017 *GPA: 3.93/4.0*
Program: Environmental Hydrology and Hydraulic Engineering

Indian Institute of Technology Roorkee Roorkee, India
Bachelor of Technology May 2011-May 2015
Major: Civil Engineering *GPA: 7.92/10.0*

RESEARCH EXPERIENCE

University of California San Diego October 2023 – present
Oxygen and thermal dynamics on Kaneohe Bay coral reef, Hawaii
Field observation of Macroalgal farm hydrodynamics in Southern California *Postdoctoral research*

- Using field observation of hydrodynamics and transport in Kaneohe Bay to understand the dissolved oxygen dynamics and budget in coral reefs.
- Part of muti-institution (UCSD, Stanford, UCI, UCLA, Ocean Rainforest LLC) collaboration to optimize macroalgae farming in Southern California.
- Involved in planning, preparation, and implementation of field observation campaign.
- Using field observations to reveal the hydrodynamics of a macroalgae (Kelp) farm, aimed at understanding the hydrodynamic conditions for optimal growth of Kelp.

University of Illinois at Urbana-Champaign August 2018 – August 2023
Bridging gaps between numerical and physical modeling of aquatic vegetation: Experimental Bias, Near-bed hydrodynamics, and sediment-induced turbulence modulation *Doctoral Thesis*

- Large Eddy Simulations (LES) and flume experiments to identify the effects of aquatic vegetation on near-bed turbulence statistics in emergent aquatic canopies.
- Correlating canopy geometry and turbulence statistics to develop theoretical predictors for turbulence statistics in aquatic vegetation patches.
- Including effects of density stratification to develop theoretical predictor for suspended sediment concentration profiles.
- Used Particle Image Velocimetry (PIV) and optical dissolved oxygen (DO) measurement techniques to understand the DO dynamics due to wave induced turbulence in vegetated channels.

University of Illinois at Urbana-Champaign July 2021 – December 2021
Identifying turbulence features that alter trap efficiency of upstream-swimming lamprey *Pilot Project*

- Conducted flume experiments at Hammond Bay Biological Station to identify the response of Sea Lamprey (fish) to various kinds of turbulence.
- Found out that Sea Lamprey response in turbulent waters can be explained by a join statistic of turbulence statistics as opposed to a single turbulence statistic.

University of Illinois at Urbana-Champaign June 2019 - present
Modeling wind driven transport of plastic from landfills *Collaborative Research*

- Initiated collaborative research between our research group and researchers in Technical University of Denmark.
- Developed a conceptual framework for transport of macro plastic from landfills by wind. Research highlighted by AGU during 2020 Fall meeting.
- Performed experiments on wind tunnel to evaluate threshold of motion for common plastic objects and validate the conceptual framework.

University of Illinois at Urbana-Champaign August 2016 - August 2018
High resolution numerical investigation of hydrodynamics and sediment transport within emergent vegetation canopy *Master's Thesis*

- Characterize Flow-Vegetation-Sediment interactions via High Resolution Large Eddy Simulations (LES) and Direct Numerical Simulations (DNS) using Nek5000, an incompressible 3-D Navier-Stokes solver.
- Development of coupled numerical model for interaction of vegetation with flow and sediment transport, based on a Eulerian framework.
- Validation of model with experimental results from experiments conducted at Ven Te Chow Hydrosystems Laboratory.

Indian Institute of Technology Bombay August 2015 - January 2016
Evaluation and mapping of coastal flooding using Numerical modelling and Geo-Spatial Techniques *Research Project*

- Simulated storm surge in the Bay of Bengal to study its effect on Paradip, a major port of India using Advanced Circulation (ADCIRC) model.
- Validated the numerical model using data of Cyclone Phailin which made a landfall near the port in October 2013.
- Surveyed the coasts of Orissa in India to track nearshore morphological changes, pre and post storms.
- Project was sponsored by Indian Space Research Organization.

Centre for Environmental Sciences and Engineering, IIT Bombay February 2016 - July 2016
Near-Real-Time Urban Flood Forecasting System *Research Project*

- Created an Urban Flood Forecasting Model for the city of Mumbai to issue early flood warnings.
- Used MIKE FLOOD, which is a dynamically coupled 1-D and 2-D model for urban flooding, to generate flood scenario maps for Mumbai.

Indian Institute of Technology Roorkee August 2014 - November 2014
Morphological study of River Ganga *Bachelor's Thesis*

- The plan form morphology for Ganga near Madhubani, India was analyzed using satellite imagery and GIS, for a period of 25 years (1989-2014).
- Temporal changes in sinuosity, erosion and sedimentation of consecutive bends were calculated to establish that the regime is in quasi equilibrium.
- Project further evolved into a larger-scale project for entire Ganga Basin funded by the Ministry of Environment, GOI

Indian Institute of Remote Sensing, Indian Space Research Organization May 2014 - June 2014
GPS Data Processing: Calculation and Time Series analysis of TEC *Internship Project*

- Temporal variation of Total Electron Content (TEC) in ionosphere is an important indicator of tectonic activity.
- Executed the Klobuchar Algorithm on a R based program to calculate the TEC of the ionosphere.
- Used GPS navigation data to solve for variables in the Klobuchar Algorithm.
- Performed time series analysis of the obtained temporal TEC variation.

Transerve Technologies, Goa, India November 2014 - December 2014
Decision Support System for efficient groundwater management *Internship Project*

- Created back-end data for web-based Decision Support System to predict ground water level variations in a municipality.
- Used the extensively collected ground water data and predictive modelling to compute past and future water levels.
- Used open-source Quantum GIS software to perform watershed analysis for the city and create shapefiles for topography, water supply and sanitation infrastructure, water quality and water level contours.

Center for Technological Alternative for Rural Areas, IIT Bombay May 2013 - June 2014
Assessment of reservoirs for drinking water security *Internship Project*

- Calculated the total water budget for Shahpur district in Maharashtra and accessed the impact of changes in the usage of reservoirs to reducing water shortage in the area.
- Extensively collected data for reservoirs from local government bodies and designed a water supply network by interconnecting the reservoirs as an alternative to present system of supplying water by tankers.
- Studied and mapped the existing government water schemes and policies and suggested policy level changes.

TEACHING/MENTORING EXPERIENCE

JTSURF Mentor, Scripps Institution of Oceanography, UCSD May-August 2024

- Mentored an UG student in the JTSURF program to analyze field observations from macroalgal farm in Santa Barbara.
- The student used observations of farm position to develop a framework for predicting current direction and biomass.

Co-Instructor & Teaching Assistant, Department of Civil Engineering, UIUC August-December 2021

CEE 350: Water Resources Engineering

- Taught course module on Open Channel Hydraulics
- Arranged introductory workshops on R and QGIS
- Made it to the prestigious institute wide "list of teachers ranked excellent by their students"

Student Research Mentor, Department of Civil Engineering, UIUC January-August 2021

Research Experience for Undergraduates Mentor

- Mentored an undergraduate student to conduct experiments with flow measurement (ADV & Wave Gauge) and Dissolved Oxygen (DO)
- Research Project: Impact of vegetation on interfacial gas exchange under waves

Undergraduate Summer Research Mentor

- Mentored two undergraduate students to conduct flow measurement using ADV & PIV
- Research Project: Impact of vegetation on interfacial gas exchange under waves

PUBLICATIONS

(1) **Ranjan, P.,** Dobashi, R., Davis, K., Veron, F., Ho, D., Pawlak, G. (2025). Bottom turbulence as driver of oxygen exchange on coral reefs, Journal of Physical Oceanography (Under Preparation)

(2) **Ranjan, P.**, Fytanidis, D., & Tinoco, R. O. (2025). Near-bed hydrodynamics in aquatic vegetation canopies, Journal of Geophysical Research: Earth Surface (Under Preparation)

(3) **Ranjan, P.**, Fytanidis, D., & Tinoco, R. O. (2025). Reynolds stresses in aquatic vegetation canopies: Quadrant analysis and Eddy Viscosity, Journal of Geophysical Research: Earth Surface (Under Preparation)

(4) **Ranjan, P.**, Yadav, V., Tinoco, R.O. (2025). Mathematical model for wind driven losses of plastics from landfills, Earth Science & Technology Letters (Under preparation)

(5) **Ranjan, P.**, Dennis III, C., Suski, C., Tinoco, R.O. (2024). Sea lamprey display context-dependent attraction to specific types of turbulence within a laboratory flume, *Biological Invasions* (Under review)

(6) **Ranjan, P.**, & Tinoco, R. O. (2023). On suspended sediment induced turbulence modulation in emergent rigid canopies, *Journal of Geophysical Research: Earth Surface*, 129(1), e2023JF007197

(7) **Ranjan, P.**, Mittal, K., Chamorro, L. P., & Tinoco, R. O. (2022). Impact of gaps on the flow statistics in an emergent rigid canopy. *Physics of Fluids*, 34(6), 066601.

(8) Yadav, V., Sherly, M. A., **Ranjan, P.**, Prasad, V., Tinoco, R.O., Laurent, A. (2022). Risk of plastics losses to the environment from landfills, *Resource Conservation and Recycling*

(9) Jin, C., Coco, G., Tinoco, R. O., **Ranjan, P.**, Gong, Z., Dutta, S., ... & Friedrich, H. (2022). High-resolution Large Eddy Simulations of Vortex Dynamics Over Ripple Defects under Oscillatory Flow. *Journal of Geophysical Research: Earth Surface*

(10) Jin, C., Coco, G., Tinoco, R., **Ranjan, P.**, Juan, S. J., Dutta, S., Friedrich, H., Gong, Z., (2021). Large-Eddy Simulation of Three-Dimensional Flow Structures Over Wave-generated Ripples, *Earth Surface Processes and Landform*

(11) Yadav, V., Sherly, M. A., **Ranjan, P.**, Tinoco, R.O., Boldrin, A., Damgaard, A., Laurent, A. (2020). Framework for quantifying environmental losses of plastics from landfills, *Resource Conservation and Recycling*

(12) **Ranjan, P.**, Fischer, P., & Tinoco, R. O. (2020, August). Investigation of hydrodynamics and sediment transport within emergent vegetation canopy. In *10th Conference on Fluvial Hydraulics, River Flow 2020* (pp. 1595-1600). CRC Press/Balkema.

CONFERENCE PROCEEDINGS & PRESENTATIONS

(1) Ranjan, P., Pawlak, G., Davis, K., et al., *Observations of flow around a macro-algal farm.* In AGU Fall Meeting 2024. AGU (Poster)

(2) **Ranjan, P.**, & Tinoco, R. (2023). *A two-layer eddy viscosity model to predict the near-bed hydrodynamic in vegetated flows*. Bulletin of the American Physical Society.

(3) **Ranjan, P.**, Molloy, M., Thompson C., Chen, W., Tseng, CY., & Tinoco. R. O. (2022, November), *Interfacial gas exchange in vegetated channels under free surface waves.* In American Physical Society- Division of Fluid Dynamics annual meeting 2022. (Presentation)

(4) **Ranjan, P.**, & Tinoco. R. O. (2021, October), *Measurements bias within aquatic vegetation canopy: Effect of gap length.* In the 5th International Symposium of Shallow Flows. IAHR (Presentation)

(5) **Ranjan, P.**, & Tinoco, R. O. (2020, December). *Assessment of Experimental Bias on Laboratory Studies of Vegetated Flows.* In AGU Fall Meeting 2020. AGU. (Poster)

(6) **Ranjan, P.**, & Tinoco, R. O. (2020, December). *Initiation of Motion and Form Drag of Plastic Waste in Landfills.* In AGU Fall Meeting 2020. AGU. (e-Lightening session)

(7) **Ranjan, P.**, Fischer, P., & Tinoco, R. O. '*Investigation of hydrodynamics and sediment transport within emergent vegetation canopy*', Uijttewaal, W., Franca, M.J., Valero, D., Chavarrias, V., Ylla Arbós, C., Schielen, R., & Crosato, A. (Eds.). (2020). *River Flow 2020: Proceedings of the 10th Conference on Fluvial Hydraulics (Delft, Netherlands, 7-10 July 2020)* (1st ed.). CRC Press.

(8) Tinoco, R. O., **Ranjan, P.**, & Prada Sepulveda, A. F. (2019, December). *Particle Capture by Aquatic Vegetation Patches: Application to Eggs and Larvae Traveling in Streams.* In AGU Fall Meeting Abstracts (Vol. 2019, pp. EP41C-2343). (Poster)

(9) **Ranjan, P.**, Dutta, S., Fischer, P. & Tinoco, R. (2018, December). *Effect of emergent vegetation on suspended sediment transport.* In AGU Fall Meeting 2018, AGU. (Poster)

(10) **Ranjan, P.**, Dutta, S., Fischer, P. & Tinoco, R. (2019, April). *Stratification Effects in a Sediment-Laden Vegetated Open Channel Flow.* In Finite Elements in Fluid Conference 2019, Chicago, USA. (Presentation)

(11) **Ranjan, P.**, Dutta, S., Mittal, K., Fischer, P. & Tinoco, R. (2018, June). *Investigation of Oscillatory Flow through Emergent Aquatic Vegetation Patches using High-Resolution Numerical Simulations*, In the 8th International Symposium on Environmental Hydraulics (Presentation)

(12) Mohanty, M. P., Gusain, A., **Ranjan, P.**, Karmakar, S., Ghosh, S., (2016). *A Comparative Flood Hazard Assessment with Climate Projections for India,* 3rd International Conference on Regional Climate, ICRC-CORDEX, Stockholm, Sweden (Poster)

(13) Beniwal, D., **Ranjan, P.**, Desai, R., Sohoni, M. (2014). *Drinking water security in rural Maharashtra.* 14th Delhi Sustainable Development Summit, New Delhi, India (Poster)

LEADERSHIP AND ACTIVITIES

Organizer for AGU Fall Meeting session December 2024

- Convenor and Chair for the session – "Biophysical and Physical Processes in Coastal Environments: Linking Nearshore to Onshore Processes Through Hydrodynamics, Sedimentary Processes, and Morphodynamics"

Graduate Students Advisory Committee, CEE May 2021– May 2022

- Representing graduate students in Water Resources Engineering Program

International Association for Hydro-Environment Engineering and Research May 2019– May 2020

- Treasurer and Engineering Open House in charge

Engineering Open House, University of Illinois at Urbana-Champaign March 2017– Aug 2023

- Lead exhibitor of "Effectiveness of Masks in reducing droplet spread from coughing" at EOH 2021.
- Awarded the first place in "Most Engaging Exhibit" category
- Co-Exhibitor of "Wind Tunnel Schlieren Imaging" at EOH 2018
- Secured 3rd position under "Encore Technical" category

Vedanta Study Circle, University of Illinois at Urbana-Champaign August 2016 – May 2018

- Held the position of Treasurer
- Lead weekly discussions on the philosophy of "Vedanta" and critically analyze its contemporary relevance

Special Interest Group for Civil Engineers, IIT Roorkee August 2014 – May 2015

- Initiated group discussion on latest trends to promote Civil Engineering research, as the Founding President of the group.
- Feasibility study of the River Interlinking project in India.

SOPAN, IIT Roorkee Chapter August 2011 – May 2015

- Taught middle school kids of *Bhangeri* village on every weekend
- Conducted annual talent search examinations in local schools

Student Affairs Council, IIT Roorkee August 2014 – May 2015

- Council member of "Ravindra Bhawan" Hostel dining mess

Formula SAE, IIT Roorkee Chapter August 2012 – May 2013

- Designed the fuel intake control a hybrid powertrain race car as part of the Society of Automotive Engineers

HONORS AND ACHIEVEMENTS

Mavis Future Faculty Fellowship August 2021 – July 2022

- Prestigious fellowship for senior PhD students interested in pursuing academic career

Computational Science and Engineering Fellowship August 2018 – July 2019

- One of the five recipients of the institute wide fellowship

Ravindra K and Kavita Kinra Fellowship August 2016 – July 2017

- Fellow in the Department of Civil and Environmental Engineering

Merit-cum-Means Scholarship August 2011– May 2015

- Prestigious scholarship by the Indian Ministry of Human Resource Development
- Four times recipient of the scholarship for excellent academic performance during Undergraduate Studies at IIT Roorkee

National Cadet Corps (NCC), IIT Roorkee August 2011 – July 2012

- Received the NCC 'B' certificate for military training
- Secured first position in annual shooting competition