DEEPAK N. SUBRAMANI

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EDUCATION

Massachusetts Institute of Technology, Cambridge, MA

Ph.D. in Mechanical Engineering and Computation Feb. 2018
Thesis: Probabilistic Regional Ocean Predictions: Stochastic Fields and Optimal Path Planning
Major: Computational Science and Engineering
Minors: Stochastic Systems; Ocean Sciences; Technology and Public Policy;
Development in Resource Constrained Economies (set of three courses in each)

M.S. in Computation for Design and Optimization 2014
Thesis: Energy Optimal Path-Planning using Dynamically Orthogonal Level-Set Optimization GPA: 4.8/5

Indian Institute of Technology Madras, Chennai, India

M.Tech and B.Tech in Mechanical Engineering 2012
Masters specialization: Energy Technology GPA: 9.11/10
Minor: Operations Research
Thesis: Profile Match-up Algorithms for Geophysical Retrievals and Their Application for Data Assimilation

EXPERIENCE

Massachusetts Institute of Technology, Cambridge, MA	
Postdoctoral Research Associate Advisor: Prof. Pierre F.J. Lermusiaux	Dec. 2017 – present
• Developed data delivery and visualization software systems for ocean forecasts. • Participated in real-time sea exercises as part of the MSEAS team at MIT. • Further developed a data-driven AI and IoT tool for efficient and sustainable fishing. • Team Lead of iFIN Solutions (http://www.ifin-solutions.com/) that plans to commercialize the above tool in the US, and engage with fishing communities in India. • Further developed and applied for a patent for our PDE-based optimal ship routing system in dynamic and uncertain currents and waves. • In discussions with multiple stakeholders to commercialize the above planning software.	
Graduate Research Assistant Advisor: Prof. Pierre F.J. Lermusiaux	Sept. 2012 – Nov. 2017
Research Goals: To develop and apply fundamental theory and computational systems for providing practical solutions to engineering problems • Optimal path planning in strong, dynamic and uncertain environments ○ Developed governing planning S-PDEs and efficient numerical schemes for energy-, stochastic time-, and risk-optimal path planning of autonomous vehicles.	

○ Completed multiple sea experiments for real-time validation of our path planning system with REMUS 600 AUVs in Buzzard's Bay. • Uncertainty quantification and probabilistic regional ocean predictions ○ Developed theory, schemes and implemented dynamically orthogonal ocean primitive equations for quantifying and predicting uncertainties in regional oceans. ○ First full-fledged ocean modeling system with probabilistic prediction capability fully respecting nonlinear governing equations and non-Gaussian statistics. • The above uncertainty quantification theory and schemes is accurate and computationally faster (3-4 orders of magnitude) compared to earlier approximate methods.	
Indian Institute of Technology Madras, Chennai, India	
Research Assistant Advisor: Prof. C. Balaji	Aug. 2011 – May 2012
• Developed a Bayesian inference algorithm for atmospheric state estimation from remote sensing data (TRMM) and models (weather, radar models). • Implemented an ensemble data assimilation scheme in a mesoscale weather model (WRF).	
University of Toronto, Toronto, Canada	
Summer Research Student Advisor: Prof. Timothy Chan	May 2011 – July 2011
• Contributed to development of an inverse linear programming framework to optimize radiative therapy for prostate cancer treatment.	
GE Global Research, John F. Welch Technology Center, Bangalore, India	
Summer Intern Supervisor: Dr. Manoharan	May 2010 – July 2010
• Recommended cost-effective Non-Destructive Evaluation (NDE) strategies for fault detection in cogeneration power plants.	

AWARDS

Postdoctoral and Graduate Fellowship — 2015 – 2018
MIT-Tata Center

SNAME Graduate Travel Award in Ocean Engineering — Dec. 2017
Department of Mechanical Engineering, MIT, Cambridge, MA

Wunsch Foundation Silent Hoist & Crane Award for Outstanding Research — May 2017
Department of Mechanical Engineering, MIT, Cambridge, MA

First Place in Graduate Science — May 2017
De Florez Design Competition, MIT, Cambridge, MA

Best Demonstration/Prototype Award — Sept. 2016
Mechanical Engineering Research Exhibition 2016, MIT, Cambridge, MA

Esteemed Presenter Award for Best Computational Research — Sept. 2015
Mechanical Engineering Research Exhibition 2015, MIT, Cambridge, MA

Best Poster Award — Mar. 2015
Center for Computational Engineering Symposium, MIT, Cambridge, MA

Runner-up Poster Award DyDESS 2014 Conference, Cambridge, MA	Nov. 2014
Institute Merit Prize (Highest GPA in Energy Technology) Indian Institute of Technology Madras, India	2012
GE Foundation Award GE Foundation Scholar-Leaders Program (Global)	2009-2011
National Talent Search (NTS) Scholar, India	2005

PROFESSIONAL ACTIVITY

- Participant at the *NASA JPL-Caltech Climate Summer School* 2017.
- Received the *Kaufman Teaching Certificate* in June 2015.
- Completed *Tier 1: Conflict Management for Self-Reflection*, Conflict Management@MIT, June 2014.
- Undergraduate Research Opportunities Program Mentor for L. Tsontos (2016) and Q.J. Wei (2015).
- Research mentor for high school students undertaking summer research at MIT (2014-18).
- Referee for The Sea (Monograph), Journal of Computational and Nonlinear Dynamics, Dynamic Data-Driven Environmental System Sciences Conference, IEEE International Conference on Robotics and Automation, International Journal of Thermal Sciences

PUBLICATIONS

Papers in Refereed Journals

1. Subramani, D.N., Q.J. Wei and P.F.J. Lermusiaux (2018). *Stochastic Time Optimal Path Planning in Uncertain, Strong, and Dynamic Flows.* **Computer Methods in Applied Mechanics and Engineering**. 333, pp 218-237. doi: 10.1016/j.cma.2018.01.004
2. Lermusiaux, P.F.J., D.N. Subramani, J. Lin, C.S. Kulkarni, A. Gupta, A. Dutt, T. Lolla, P.J. Haley Jr., W.H. Ali, C. Mirabito, and S. Jana (2017). *A Future for Intelligent Autonomous Ocean Observing Systems***. The Sea Vol. 17: The Science of Ocean Prediction**, Special Issue of J. Marine Res., 75, 765–813.
3. Subramani, D. N., P. J. Haley, Jr., and P. F. J. Lermusiaux (2017). Energy-optimal path planning in the coastal ocean, **Journal of Geophysical Research: Oceans**, 122, 3981–4003, doi:10.1002/ 2016JC012231
4. Sun, W., P. Tsiotras, T. Lolla, D.N. Subramani, and P.F.J. Lermusiaux (2017). *Multiple-Pursuit/One-Evader Pursuit Evasion Game in in Dynamical Flow Fields.* **Journal of Guidance, Control, and Dynamics**. doi: 10.2514/1.G002125.
5. Lermusiaux, P.F.J., P.J. Haley Jr., S. Jana, A. Gupta, C.S. Kulkarni, C. Mirabito, W.H. Ali, D.N. Subramani, A. Dutt, J. Lin, A. Y. Shcherbina, C. M. Lee, A. Gangopadhyay (2017). *Optimal Planning and Sampling Predictions for Autonomous and Lagrangian Platforms and Sensors in the Northern Arabian Sea* **Oceanography** 30(2), 172-185.
6. Subramani, D.N. and P.F.J. Lermusiaux (2016). *Energy Optimal Path Planning by Stochastic Dynamically Orthogonal Level-Set Optimization*. **Ocean Modelling**, 100, pp 57-77.
7. Subramani, D., Chandrasekar, R., Ramanujam, K.S. and C. Balaji (2014). *A new ensemble-based data assimilation algorithm to improve track prediction of tropical cyclones.* **Natural Hazards,** 71, pp 659-682.

8. S. Ramanujam, C. Radhakrishnan, D. Subramani and C. Balaji (2012). *On the Effect of Non-Raining Parameters in Retrieval of Surface Rain Rate Using TRMM PR and TMI Measurements*. **IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing**, 5(3), pp. 735-743.

Under review/in preparation

9. Subramani, D.N. and P.F.J. Lermusiaux (2018). *Risk Optimal Path Planning in Stochastic Dynamic Environments.* CMAME. Sub-Judice.
10. Mannarini, G., D.N. Subramani, P.F.J. Lermusiaux, N. Pinardi (2018). *Graph-Search and Differential Equations for Time-Optimal Vessel Route Planning in Dynamic Ocean Waves*. IEEE Transactions on Intelligent Transportation Systems. Sub-Judice.
11. Subramani, D.N., P.J. Haley and P.F.J. Lermusiaux (2018). *Stochastic Dynamically Orthogonal Primitive Equations: Theory and Applications*. To Be Submitted.

Papers in Refereed Conferences

1. Subramani, D.N., T. Lolla, P.J. Haley and P.F.J Lermusiaux (2015). *A stochastic optimization method for energy-based path planning*. In: Ravela, S., Sandu, A. (Eds.), Vol. 8964 Lecture Notes in Computer Science, Springer, pp. 347-358.
2. Subramani, D. N., P. F. J. Lermusiaux, P.J. Haley, Jr., C. Mirabito, S. Jana, C. S. Kulkarni, A. Girard, D. Wickman, J. Edwards, J. Smith (2017). *Time-Optimal Path Planning: Real-Time Sea Exercises*. In: Oceans '17 MTS/IEEE Aberdeen, 19-22 June 2017, DOI: 10.1109/OCEANSE.2017.8084776.
3. Mirabito, C., D.N. Subramani, T. Lolla, P.J. Haley, Jr., A. Jain, P.F.J. Lermusiaux, C. Li, D.K.P. Yue, Y. Liu, F.S. Hover, N. Pulsone, J. Edwards, K.E. Railey, and G. Shaw, (2017). *Autonomy for Surface Ship Interception*. In: Oceans '17 MTS/IEEE Aberdeen, 19-22 June 2017, DOI: 10.1109/OCEANSE.2017.8084817.
4. Sun, W., P. Tsiotras, T. Lolla, D. N. Subramani, and P. F. J. Lermusiaux, (2017). *Pursuit-Evasion Games in Dynamic Flow Fields via Reachability Set Analysis.* 2017 American Control Conference. Seattle, WA, 2017, pp. 4595-4600. doi: 10.23919/ACC.2017.7963664
5. Edwards, J., J. Smith, A. Girard, D. Wickman, P.F.J. Lermusiaux, D.N. Subramani, P.J. Haley, Jr., C. Mirabito, C.S. Kulkarni, and, S. Jana, (2017). *Data-driven Learning and Modeling of AUV Operational Characteristics for Optimal Path Planning*. In: Oceans '17 MTS/IEEE Aberdeen, 19-22 June 2017, DOI: 10.1109/OCEANSE.2017.8084779
6. Ferris, D.L., D.N. Subramani, C.S. Kulkarni, P.F.J. Lermusiaux (2018). *Time-Optimal Multi-Waypoint Mission Planning in Dynamic Environments*. In: MTS/IEEE Oceans '18 Charleston, Accepted.
7. Dutt, A., D.N. Subramani, C.S. Kulkarni, P.F.J. Lermusiaux (2018). *Clustering of Massive Ensemble of Vehicle Trajectories in Strong, Dynamic and Uncertain Ocean Flows*. In: MTS/IEEE Oceans '18 Charleston, Accepted.
8. Kulkarni, C.S., P.J. Haley, Jr., P. F. J. Lermusiaux, A. Dutta, A. Gupta, C. Mirabito, D.N. Subramani, S. Jana, W.H. Ali, T. Peacock, C.M. Royo, A. Rzeznik, R. Supekar (2018). *Real-Time Sediment Plume Modeling in the Southern California Bight*. In: MTS/IEEE Oceans '18 Charleston, Accepted.

Provisional Patent Applications

1. Lermusiaux P.F.J, D.N. Subramani, C.S. Kulkarni, P.J. Haley Jr. (2018). Optimal Ship Routing in Strong, Dynamic, and Uncertain Ocean Currents and Waves. US Provisional Application No.: 62/689,011. Filing Date: June 22, 2018.

2. Subramani, D.N, A. Gangopadhyay, M. Fernandez (2018). Systems and Methods for Generating Real-Time Fishing Zones and Efficient Routing. US Provisional Application No: 62/762,675. Filing Date: May 14, 2018.

PRESENTATIONS

Professional Conferences Without Proceedings

1. *Probabilistic Risk-Optimal Path Planning and Sampling in Uncertain Environments*, AGU Ocean Sciences Meeting 2018, Portland, OR, Feb '18 [Presented by Chinmay Kulkarni].
2. *Stochastic Ocean Predictions with Dynamically-Orthogonal Primitive Equations*, AGU Fall Meeting 2017, New Orleans, LA, Dec '17.
3. *Probabilistic Predictions of Regional Ocean Dynamics,* AGU Fall Meeting 2016, San Francisco, CA, Dec '16
4. *Probabilistic Regional Ocean Prediction,* SIAM Conference on Uncertainty Quantification, Lausanne, Switzerland, 02 April 2016 [Presented by Prof. Pierre Lermusiaux].
5. *Energy-Optimal Path Planning: Integrating Coastal Ocean Modelling with Optimal Control,* AGU Ocean Sciences Meeting, New Orleans, LA 15 February 2016

Selected Talks

6. *Coastal Sensing and Modeling to aid Sustainable Fisheries Managements in India*, Tata Trusts-Sustainable Fisheries Group Meeting, UCSB, Santa Barbara, CA 20-21 July 2017.
7. *Probabilistic Ocean Prediction and Energy-Optimal Path Planning,* IEEE - OES India Chapter and Ocean Society of India Lecture Series, National Institute of Ocean Technology, Chennai, India, 03 January 2016.
8. *Coastal Forecasting for a Sustainable Fisheries Management System in India,* The First Annual Tata Fellows Poster Session, Cambridge, MA, 31 March 2016.

PROFESSIONAL REFERENCES

1. Prof. Pierre F.J. Lermusiaux, Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, pierrel@mit.edu
2. Prof. Avijit Gangopadhyay, Professor, School of Marine Science and Technology, University of Massachusetts, Dartmouth, MA avijit.gangopadhyay@umassd.edu
3. Dr. Glen Gawarkiewicz, Senior Scientist, Woods Hole Oceanographic Institution (WHOI), Woods Hole, MA ggawarkiewicz@whoi.edu