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 Engineering and Stochastic Systems
Minors: Data Analytics; Ocean Sciences; Technology and Public Policy;
      Development in Resource Constrained Economies (set of three courses in each)

S.M. 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: 9.1/10
Minor: Operations Research
Thesis: Bayesian Inference for Rainfall Estimation from TRMM/PR Observations

EXPERIENCE

Massachusetts Institute of Technology, Cambridge, MA

Postdoctoral Research Associate   Dec. 2017 –
Advisor: Prof. Pierre F.J. Lermusiaux   present

Graduate Research Assistant   Sept. 2012 –
Advisor: Prof. Pierre F.J. Lermusiaux   Nov. 2017

Research Goals: To develop and apply fundamental theory and computational systems for providing practical solutions to engineering problems

- Optimal path planning in dynamic environments
  - Developed novel optimal planning S-PDEs for energy- and stochastic time-optimal path planning of autonomous vehicles in strong and dynamic environments.
  - Developed software systems for time-optimal ship routing by integrating optimal planning S-PDEs and multi-model ocean wave, current and wind forecasts.
    - Completed multiple sea experiments for real-time validation of our path planning algorithms with REMUS 600 AUVs in Buzzard's Bay and Vineyard Sound Regions.
- 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 technologies are accurate and computationally faster—by 3-4 orders of magnitude—compared to existing approximate methods.
- Developing an advisory service for sustainable fisheries management in India combining coastal in-situ and remote sensing, and probabilistic ocean modeling.
- Tools:
  - Methodology development in scripting environments (MATLAB, R, Python) and production code development in FORTRAN and C++.
  - Hands-on experience with handling atmospheric and oceanic data from multiple sensors and sources.
- Member of a highly collaborative research team: contributed to development and troubleshooting of in-house computer codes for numerical ocean modeling and state of the art data assimilation schemes.

Indian Institute of Technology Madras, Chennai, India

Research Assistant   Aug. 2011 –
Advisor: Prof. C. Balaji   May 2012

- Developed a Bayesian inference algorithm for atmospheric state estimation from remote sensing data (TRMM) and models (WRF, radar models).
- Implemented an ensemble data assimilation scheme in WRF.

University of Toronto, Toronto, Canada

Summer Research Student   May 2011 –
Advisor: Prof. Timothy Chan   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   May 2010 –
Supervisor: Dr. Manoharan   July 2010

- Recommended cost-effective Non-Destructive Evaluation (NDE) strategies for fault detection in cogeneration power plants.

AWARDS

Graduate Fellowship MIT-Tata Center	2015 – 2018
SNAME Graduate Travel Award in Ocean Engineering Department of Mechanical Engineering, MIT, Cambridge, MA	Dec. 2017
Wunsch Foundation Silent Hoist & Crane Award for Outstanding Research Department of Mechanical Engineering, MIT, Cambridge, MA	May 2017
First Place in Graduate Science De Florez Design Competition, MIT, Cambridge, MA	May 2017
Best Demonstration/Prototype Award Mechanical Engineering Research Exhibition 2016, MIT, Cambridge, MA	Sept. 2016
Esteemed Presenter Award for Best Computational Research Mechanical Engineering Research Exhibition 2015, MIT, Cambridge, MA	Sept. 2015

Honorable Mention Award	May 2015
De Florez Design Competition, MIT, Cambridge, MA	
Best Poster Award	Mar. 2015
Center for Computational Engineering Symposium, MIT, Cambridge, MA	
Runner-up Poster Award	Nov. 2014
DyDESS 2014 Conference, Cambridge, MA	
Institute Merit Prize (Highest GPA in Energy Technology)	2012
Indian Institute of Technology Madras, India	
MITACS Globalink Research Award	2011
MITACS Canada	
GE Foundation Award	2009-2011
GE Foundation Scholar-Leaders Program (Global)	
National Talent Search Scholar	2005
Government of India	

PROFESSIONAL ACTIVITY

- Participant at the NASA JPL-Caltech Climate Summer School 2017.
- Received the Kaufman Teaching Certificate in June 2015.
- Undergraduate Research Opportunities Program Mentor for L. Tsontos (2016) and Q.J. Wei (2015).
- Research mentor for high school students undertaking summer research (2014-17).
- 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 (2018). *A Future for Intelligent Autonomous Ocean Observing Systems.* The Sea. Volume 17, The Science of Ocean Prediction, Part 2, Special Issue, J. Marine Res. 75. In Press.

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. doi: 10.1016/j.ocemod.2016.01.006

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: 659. doi:10.1007/s11069-013-0942-1

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. doi: 10.1109/JSTARS.2012.2189557

    Under review/in preparation

9. Subramani, D.N. and P.F.J. Lermusiaux (2018). *Risk Optimal Path Planning under Uncertainty.* CMAME. To Be Submitted.

10. Subramani, D.N., P.J. Haley and P.F.J. Lermusiaux (2018). *Stochastic Dynamically Orthogonal Primitive Equations: Theory and Applications*. To Be Submitted.

11. Mannarini, G., D.N. Subramani, P.F.J. Lermusiaux, N. Pinardi (2018). Validation of VISIR with comparison to differential time-optimal planning. IEEE Journal of Transportation. To Be Submitted.

Proceedings of 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 LNCS. 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

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.

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
9. *Optimal Path Planning and Nonlinear Non-Gaussian Data Assimilation,* Indian Institute of Technology Bhubaneswar, India 10 August 2015

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