

# Yogesh A. Girdhar

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## 1 Research Interests

Autonomous exploration, marine robotics, adaptive sampling, computer vision, machine learning, semantic perception, Bayesian nonparametrics, surprise detection, data summarization.

## 2 Professional Preparation

- Rensselaer Polytechnic Institute, Troy, NY  
Computer Science, BS (Summa Cum Laude), 2002.
- Rensselaer Polytechnic Institute, Troy, NY  
Computer Science, MS, 2005.
- McGill University, Montreal, Canada  
Computer Science, PhD, 2014.
- Woods Hole Oceanographic Institution, Woods Hole, MA  
Postdoc Scholar, Aug 2014 - Jan 2016.

## 3 Appointments

- Woods Hole Oceanographic Institution, Assistant Scientist, Jan 2016.
- OBT SesameVault (startup), Troy, NY, Lead Developer, 2006 - 2007.
- Kitware Inc., Clifton Park, NY, R&D Engineer, 2005 - 2006.

## 4 Experience

- Assistant Scientist, Woods Hole Oceanographic Institution, Woods Hole, MA Jan. 2016 - present
  - Visual, acoustic, and environmental information guided autonomous exploration robots.
  - Deep learning and Bayesian nonparametric techniques for automatic scene understanding, and scientific hypothesis generation from observation data.
- Postdoc Scholar, Woods Hole Oceanographic Institution, Woods Hole, MA Aug. 2014 - Jan 2016
  - Developed unsupervised computer vision techniques for characterizing underwater habitats and detecting anomalies, using Bayesian nonparametric topic modeling techniques.
  - Developed automated techniques for detection and tracking of wildlife in videos with dynamic background.
  - Conducted experiments to quantify avoidance behavior of reef fish to mobile video survey platforms.

- Designed and developed the software architecture for an underwater robot capable of autonomous under-ice operation.
- PhD Candidate / Research Assistant, McGill University, Montreal, Canada Sep. 2007 - July 2014
  - Developed ROST - a realtime online spatiotemporal topic model for streaming audio and video data. <http://cim.mcgill.ca/~yogesh/rost>
  - Developed aquaros - ROS (Robot Operating System) based software tools for controlling Aqua amphibious robot.
  - Developed biowatch - a particle filter based multiple target tracker. This was successfully used to visually track ants in a video for conducting behavior research. Open source implementation available at <https://code.google.com/p/biowatch/>
  - Developed roscopter - a ROS based abstraction layer for the Arducopter open source aerial platform. Open source implementation available at <https://code.google.com/p/roscopter/>
  - Teaching assistant - COMP417 Introduction to Mobile robotics (2008, 2010).
  - Teaching assistant - COMP765B Spatial Representation and Mobile Robotics (2008, 2010).
- Software Developer, Open Box Technologies, Troy, NY May 2006 - May 2007
  - Designed and developed a cross-platform Ruby/C++/OpenGL based toolkit for rapid development of rich vector graphics, video and 3D graphics based UI applications.
  - Designed and developed SesameVault, a video sharing, tagging and managing system using Rails. [https://youtu.be/Y7mq\\_jPKmzE](https://youtu.be/Y7mq_jPKmzE)
- R&D Engineer, Kitware Inc., Clifton Park, NY May 2005 - Feb 2006
  - Designed and developed algorithms to visualize 3D data, and contributed to open source VTK Visualization Toolkit [www.vtk.org](http://www.vtk.org).
  - Designed and developed VisualJournal, a tool for visualizing images with geographic information, on a 3D map.
  - Developed GPU implementable approximations to efficiently visualize 3D streamline data.
  - Conducted a workshop on GPU programming, funded by National Alliance for Medical Image Computing (NAMIC).
- Rensselaer Polytechnic Institute, Troy, NY 2002 - 2005
  - Developed a technique for modeling 3D protein folding pathways using Probabilistic Roadmaps (PRM) path planning.
  - Developed a Micro Electro Mechanical Systems (MEMS) simulator and 3D visualizer.
  - Teaching Assistant - 3D Computer Graphics.
  - Teaching Assistant - Data Structures and Algorithms.

## 5 Scientific Cruises

- NOAA Untrawable Habitat Strategic Initiative cruise, Gulf of Mexico, RV Weatherbird II. Aug. 2015
- Hannibal Bank seamount, Panama, MV Alucia. April 2015
- NOAA Untrawable Habitat Strategic Initiative cruise, Gulf of Mexico, RV Pelican. Aug. 2014

## 6 Publications

### 6.1 Journal publications

- [J.1] Raanan, B., Bellingham, J., Zhang, Y., Kemp, M., Kieft, B., Singh, H., & **Girdhar, Y.** (2017). Detection of Unanticipated Faults for Autonomous Underwater Vehicles Using Online Topic Models. *Journal of Field Robotics*.
- [J.2] St-Onge, D., Breches, P.-Y., Shar, I., Reeve, N., Rekleitis, I., Abouzakh, P., **Girdhar, Y.** ... Giguere, P. (2016). Control, localization and human interaction with an autonomous lighter-than-air performer. *Robotics and Autonomous Systems*.
- [J.3] J. Pineda, W. Cho, V. Starczak, A. F. Govindarajan, H. M. Guzman, **Y. Girdhar**, R. C. Holleman, J. Churchill, H. Singh, and D. K. Ralston, A crab swarm at an ecological hotspot: patchiness and population density from AUV observations at a coastal, tropical seamount, *PeerJ*, 2016.
- [J.4] **Y. Girdhar** and G. Dudek, Modeling curiosity in a mobile robot for long-term autonomous exploration and monitoring, *Autonomous Robots*, Sep. 2015.
- [J.5] **Y. Girdhar**, P. Giguere, and G. Dudek, Autonomous adaptive exploration using realtime online spatiotemporal topic modeling, *The International Journal of Robotics Research*, vol. 33, no. 4, pp. 645-657, Nov. 2013.

### 6.2 Fully peer reviewed conference publications

- [C.1] (*SUBMITTED*) Flaspohler, G., Roy, N., & **Girdhar, Y.** (2017). Feature discovery and visualization of robot mission data using convolutional autoencoders and Bayesian nonparametric topic modeling. In *Intelligent Robots and Systems (IROS)*.
- [C.2] Kalmbach A, **Girdhar Y**, Sosik H, Dudek G. Phytoplankton Hotspot Prediction Using an Unsupervised Spatial Community Model. In: *IEEE International Conference on Robotics and Automation.*; 2017.
- [C.3] **Girdhar Y**, Cho W, Campbell M, Pineda J, Clarke E, Singh H. Anomaly Detection in Unstructured Environments using Bayesian Nonparametric Scene Modeling. In: *IEEE International Conference on Robotics and Automation (ICRA)*, 2016.
- [C.4] Koreitem K, **Girdhar Y**, Cho W, Singh H, Pineda J, Dudek G. Subsea fauna enumeration using vision-based marine robots. *Conference on Computer and Robot Vision (CRV)*, 2016.
- [C.5] Kalmbach A, Hoeberechts M, Albu AB, Glotin H, Paris S, **Girdhar Y**. Learning Deep-Sea Substrate Types With Visual Topic Models. In: *IEEE Winter Conference on Applications of Computer Vision*, 2016.
- [C.6] **Girdhar, Y.**, and Dudek, G., Exploring Underwater Environments with Curiosity. *Canadian Conference on Computer and Robot Vision*, 2014, pp. 104-110.
- [C.7] **Girdhar, Y.**, Whitney, D. & Dudek, G., Curiosity Based Exploration for Learning Terrain Models. *IEEE International Conference on Robotics and Automation (ICRA)*, 2014, pp. 578-584.
- [C.8] Kalmbach, A., **Girdhar, Y.**, & Dudek, G., Unsupervised Environment Recognition and Modeling using Sound Sensing. In *IEEE International Conference on Robotics and Automation (ICRA)*, 2013, pp. 2699-2704.
- [C.9] Giguere, P., **Girdhar, Y.**, & Dudek, G., Wide-Speed Autopilot System for a Swimming Hexapod Robot. In *Canadian Conference on Computer and Robot Vision (CRV)*, 2013, pp. 9-15.
- [C.10] Shkurti, F., Xu, A., Meghjeni, M., Higuera, J. C. G., **Girdhar, Y.**, Giguere, P., ..., Dudek, G., Multi-Domain Monitoring of Marine Environments using a Heterogeneous Robot Team. In

Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2012, pp. 1747-1753.

- [C.11] **Girdhar, Y.**, & Dudek, G., Efficient on-line data summarization using extremum summaries. In IEEE International Conference on Robotics and Automation (ICRA), 2012, pp. 3490-3496.
- [C.12] **Girdhar, Y.**, Gigure, P., & Dudek, G., Autonomous Adaptive Underwater Exploration using Online Topic Modelling. In International Symposium on Experimental Robotics (ISER), 2012.
- [C.13] **Girdhar, Y.**, & Dudek, G., Offline Navigation Summaries. In IEEE International Conference on Robotics and Automation (ICRA), 2011, pp. 5769-5775.
- [C.14] **Girdhar, Y.**, & Dudek, G., Online Visual Vocabularies. In CRV 11: Proceedings of the 2011 Canadian Conference on Computer and Robot Vision. IEEE Computer Society, 2011, pp. 191-196.
- [C.15] **Girdhar, Y.**, Xu, A., Dey, B. B., Meghjani, M., Shkurti, F., Rekleitis, I., & Dudek, G., MARE: Marine Autonomous Robotic Explorer. In Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2011, pp. 5048-5053.
- [C.16] **Girdhar, Y.**, & Dudek, G., ONSUM: A System for Generating Online Navigation Summaries. In Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2010, pp. 746-751. [**Best Application Paper Award Finalist**]
- [C.17] **Girdhar, Y.**, & Dudek, G., Online Navigation Summaries. In IEEE International Conference on Robotics and Automation (ICRA), 2010, pp. 5035-5040.
- [C.18] **Girdhar, Y.**, & Dudek, G., Optimal Online Data Sampling or How to Hire the Best Secretaries. In CRV 09: Proceedings of the 2009 Canadian Conference on Computer and Robot Vision, pp. 292-298.
- [C.19] Sattar, J., Dudek, G., Chiu, O., Rekleitis, I., Gigure, P., Mills, A., Plamondon, N., Prahacs, C., **Girdhar, Y.**, Nahon, M., Lobos, J.-P., Enabling Autonomous Capabilities in Underwater Robotics. In Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, (IROS), 2008, pp. 3628-3634.

### 6.3 Non-refereed posters and other contributions

[O.1]

- [O.2] Raanan, B. Y., Bellingham, J., Zhang, Y., Kemp, M., Kieft, B., Singh, H., & Girdhar, Y. (2016). Automatic Fault Diagnosis for Autonomous Underwater Vehicles using Online Topic Models. In Oceans '16.
- [O.3] Girdhar, Y., & Singh, H. (2016). Unsupervised Lifelong Learning for a Curious Underwater Exploration Robot. In ICRA 2016 Workshop: AI for Long-term Autonomy.
- [O.4] M. Campbell, A. Frappier, D. Somerton, M. E. Clarke, S. Murawski, J. C. Taylor, W. W. Wakefield, H. Singh, D. A. Jacques, E. Ebert, Y. **Girdhar**, E. Fruh, J. Taylor, and C. Lembke, Towards Quantifying Avoidance and Attraction of Reef Fish to Mobile Video Survey Platforms, in 145th Annual Meeting of the American Fisheries Society, 2015.
- [O.5] Rabinovich, M., & **Girdhar, Y.**, Gaining Insight Into Films Via Topic Modeling & Visualization. Parsons Journal for Information Mapping (PJIM), 2015, vol. 7, no. 1.
- [O.6] **Girdhar, Y.**, & Dudek, G., Topic Modeling for Robots. Neural Information Processing Systems (NIPS) demonstration, 2013, Lake Tahoe, Nevada.
- [O.7] **Girdhar, Y.**, Adam, R. & Dudek, G., Realtime Online Spatiotemporal Topics for Navigation Summaries. 7th Annual Machine Learning Symposium, 2012, The New York Academy of Sciences, New York, NY. [**Spotlight Presentation 3rd Prize**]

- [O.8] **Girdhar, Y.**, Xu, A., Shkurti, F., Camilo, J., Higuera, G., Meghjani, M., Dudek, G., Monitoring Marine Environments using a Team of Heterogeneous Robots. In RSS 2012 Workshop on Robotics for Environmental Monitoring. Sydney, Australia.
- [O.9] Rabinovich, M., & **Girdhar, Y.**, SoYummy: real-time temporal semantic compression to further the Synopticon, Subtle Technologies Festival, 2011, Toronto. Poster.
- [O.10] **Girdhar, Y.**, Bystroff, C., & Akella, S., Efficient sampling of protein folding pathways using HMMSTR and probabilistic roadmaps. In IEEE Computational Systems Bioinformatics Conference, 2005, pp. 222 - 223. Workshops and Poster Abstracts.

## 6.4 Book chapters

- [B.1] **Girdhar, Y.**, & Dudek, G., A surprising problem in navigation. In L. R. Harris & M. R. M. Jenkin (Eds.), Vision in 3D Environments. 2011, Cambridge University Press.

## 6.5 Thesis

- [T.1] **Girdhar, Y.**, Unsupervised Semantic Perception, Summarization, and Autonomous Exploration for Robots in Unstructured Environments, PhD Thesis, McGill University, 2014.
- [T.2] **Girdhar, Y.**, Efficient Sampling of Protein Folding Funnels using HMMSTR, and Pathway Generation using Probabilistic Roadmaps, MS Thesis, Rensselaer Polytechnic Institute, 2005.

## 6.6 Patent applications

- [P.1] Brain, C., Rabinovich, M., Di-Cianno, A., Andkjar, A., **Girdhar, Y.**, Media transaction system. US Patent App. 11/392,261, 2006.

## 7 Awards

- The CIPPRS Doctoral Dissertation Award 2014 Honorable Mention. 2015
- Postdoc Scholar Award, Woods Hole Oceanographic Institution. 2014
- Postdoc Fellowship, Fonds de recherche du Québec - Nature et technologies. 2014
- Google Spotlight Presentation 3rd Prize, 7th Annual Machine Learning Symposium, New York Academy of Sciences, New York. Oct 2012
- Best Application Paper Award Finalist, 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems, Taipei, Taiwan. Oct 2010
- Paul A. McGloin Prize for most outstanding academic achievement in Computer Science, Rensselaer Polytechnic Institute. May 2002
- Certificate of Achievement in recognition of a perfect 4.0 academic record, Rensselaer Polytechnic Institute. May 2002
- Founders Award of Excellence, RPI Fall 2001
- Dean's List, RPI
- 17th LITEC Invitational Robotics Competition, RPI - Second Prize. Spring 2001
- RPI/ACM Programming Competition - Third Prize. Spring 2001
- Rensselaer Dean's Scholar Award. Fall 1999

## 8 Invited Talks

- ICPR Workshop on Computer Vision for Analysis of Underwater Imagery Dec 2016.
- Monterey Bay Aquarium Research Institute (MBARI), CA. April 2016.
- Graduate School of Oceanography, University of Rhode Island, RI. Feb 2015
- CSAIL, Massachusetts Institute of Technology, Cambridge, MA. Jan 2014
- Woods Hole Oceanographic Institution, Falmouth, MA. Jan 2014

## 9 Other activities

- Associate Editor - IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2017).
- Reviewer for Int. J. of Robotics Research (IJRR), Autonomous Robots, J. Field Robotics (JFR), J. of Geophysical Research (JGR), ICRA, IROS.
- Review Panelist - NASA CLDTCH 2016.
- Associate Editor - IEEE Conference on Robotics and Automation (ICRA) 2017.
- Program committee member - IEEE WACV Automated Analysis of Video Data for Wildlife Surveillance Workshop 2017.
- Program committee member - CRV 2015, 2016: Conference on Computer and Robot Vision.
- Program committee member - EMR 2015: 2nd International Workshop on Environmental Multimedia Retrieval.
- Program committee member - ICRA 2014 Workshop on “Robots in Homes and Industry: Where to Look First?”
- Panelist - NSERC Canadian Field Robotics Network (NCFRN) ROS Workshop, Toronto. Apr 2013
- Volunteer for International Symposium on Experimental Robotics (ISER). June 2012
- Managed a week long robotics field trial event in Barbados involving marine and aerial vehicles, and a team of over 20 students and researchers . The results of this field trial were published in IROS2011 and IROS2012. Jan 2011
- Keynote speaker, McGill high school summer camp: “Be A Computer Scientist for a Week”
- Judge for final robotic design projects presented by students of ECSE211: Design Principles and Methods. 2011,2012
- Computational Astrobiology Summer School, University of Hawaii NASA Astrobiology Institute, 2011.
- Volunteer for ICML/UAI/COLT conference. 2009

## 10 Media Coverage

- Cape Cod Times, January 13, 2016, “Aquaculture holds economic potential in changing world”.
- New Scientist, October 2, 2015, “Undersea robot learns to ferret out the unusual and interesting”.
- NASA Astrobiology Magazine, March 9, 2015, “Robotic SPACE Explorers Need Smarts to Survive”.
- Oceanus Magazine, January 16, 2014, “A Smarter Undersea Robot”.