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Ryan M. Eustice

Research Interests

Theoretical and experimental research in large-scale mapping and navigation using underwater vehicles. Specific topics include vision-based simultaneous localization and mapping, underwater computer vision and image processing, data fusion, underwater vehicle navigation, and autonomous underwater vehicles.

Education

- Ph.D. Ocean Engineering, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program, Cambridge, MA, 2005.
Dissertation: "Large-Area Visually Augmented Navigation for Autonomous Underwater Vehicles."
- B.S. Mechanical Engineering, Michigan State University, East Lansing, MI, 1998.
Distinguished Graduate.

Experience

- 2006–Present **Assistant Professor**, University of Michigan, Department of Naval Architecture & Marine Engineering.
- 2006–Present **Adjunct Assistant Professor**, Johns Hopkins University, Department of Mechanical Engineering.
- 2005–Present **Guest Investigator**, Woods Hole Oceanographic Institution, Department of Applied Ocean Physics & Engineering.
- 2005–2006 **Postdoctoral Investigator**, Johns Hopkins University, Department of Mechanical Engineering, Dynamical Systems & Control Laboratory.
- 1999–2005 **Graduate Research Assistant**, Woods Hole Oceanographic Institution, Department of Applied Ocean Physics & Engineering, Deep Submergence Lab.

Honors & Awards

- 2007 King-Sun Fu Memorial Best Transactions on Robotics Paper Award for 2006 of the IEEE Robotics and Automation Society.

Honors & Awards (continued)

- 2005 Best Student Paper Award, IEEE International Conference on Robotics & Automation.
- 2001 Student Poster Winner, “A Short Summary of SeaBED and Some Data Highlights”
NSF ERC CenSSIS Research and Industrial Collaboration Conference, Boston, MA.
- 1999 Recipient of NDSEG Fellowship.
- 1998 Graduate of Michigan State Honors College.
- 1994 Recipient of Lumsdren-Valrence Scholarship.

Publications

JOURNAL PUBLICATIONS

- [J8] M. R. Walter, R. M. Eustice, and J. J. Leonard, “Exactly sparse extended information filters for feature-based SLAM,” *Intl. J. Robotics Research*, 2007, Accepted, To Appear.
- [J7] H. Singh, C. Roman, O. Pizarro, R. Eustice, and A. Can, “Towards high-resolution imaging from underwater vehicles,” *Intl. J. Robotics Research*, vol. 26, no. 1, pp. 55–74, Jan. 2007.
- [J6] R. M. Eustice, O. Pizarro, and H. Singh, “Visually augmented navigation for autonomous underwater vehicles,” *IEEE J. Oceanic Eng.*, 2007, Accepted, To Appear.
- [J5] R. M. Eustice, H. Singh, and J. J. Leonard, “Exactly sparse delayed-state filters for view-based SLAM,” *IEEE Trans. Robot.*, vol. 22, no. 6, pp. 1100–1114, Dec. 2006.
2006 King-Sun Fu Memorial Best Transactions on Robotics Paper Award of the IEEE Robotics and Automation Society.
- [J4] R. M. Eustice, H. Singh, J. J. Leonard, and M. R. Walter, “Visually mapping the RMS Titanic: conservative covariance estimates for SLAM information filters,” *Intl. J. Robotics Research*, vol. 25, no. 12, pp. 1223–1242, 2006.
- [J3] R. Armstrong, H. Singh, J. Torres, R. Nemeth, A. Can, C. Roman, R. Eustice, L. Riggs, and G. Garcia-Moliner, “Characterizing the deep insular shelf coral reef habitat of the Hind Bank marine conservation district (US Virgin Islands) using the Seabed autonomous underwater vehicle,” *Continental Shelf Research*, vol. 26, no. 2, pp. 194–205, Feb. 2006.
- [J2] H. Singh, R. Armstrong, F. Gilbes, R. Eustice, C. Roman, O. Pizarro, and J. Torres, “Imaging coral I: imaging coral habitats with the SeaBED AUV,” *J. Subsurface Sensing Tech. Apps.*, vol. 5, no. 1, pp. 25–42, Jan. 2004.
- [J1] H. Singh, A. Can, R. Eustice, S. Lerner, N. McPhee, O. Pizarro, and C. Roman, “SeaBED AUV offers new platform for high-resolution imaging,” *EOS, Trans. Amer. Geophysical Union*, vol. 85, no. 31, pp. 289,294–295, Aug. 2004.

REFEREED CONFERENCE PUBLICATIONS

- [C17] R. M. Eustice, L. L. Whitcomb, H. Singh, and M. Grund, “Experimental results in synchronous-clock one-way-travel-time acoustic navigation for autonomous underwater vehicles,” in *Proc. IEEE Intl. Conf. Robot. Auto.*, Rome, Italy, Apr. 2007, Accepted, To Appear.

Publications (continued)

- [C16] J. Kinsey, R. Eustice, and L. Whitcomb, “Underwater vehicle navigation: recent advances and new challenges,” in *IFAC Conf. on Manoeuvring and Control of Marine Craft*, Lisbon, Portugal, Sept. 2006, In Press.
- [C15] R. Eustice, L. Whitcomb, H. Singh, and M. Grund, “Recent advances in synchronous-clock one-way-travel-time acoustic navigation,” in *Proc. IEEE/MTS OCEANS Conf. Exhib.*, Boston, MA, USA, Sept. 2006, pp. 1–6.
- [C14] M. Ludvigsen, R. Eustice, and H. Singh, “Photogrammetric models for marine archaeology,” in *Proc. IEEE/MTS OCEANS Conf. Exhib.*, Boston, MA, Sept. 2006, pp. 1–6.
- [C13] M. Walter, R. Eustice, and J. Leonard, “A provably consistent method for imposing sparsity in feature-based SLAM information filters,” in *Proc. Intl. Symp. Robotics Research*, San Francisco, CA, Oct. 2005, In Press.
- [C12] H. Singh, C. Roman, O. Pizarro, and R. Eustice, “Advances in high-resolution imaging from underwater vehicles,” in *Proc. Intl. Symp. Robotics Research*, Oct. 2005, In Press.
- [C11] R. Eustice, R. Camilli, H. Singh, R. Eustice, R. Camilli, and H. Singh, “Towards bathymetry-optimized Doppler re-navigation for AUVs,” in *Proc. IEEE/MTS OCEANS Conf. Exhib.*, Washington D.C., Sept. 2005, pp. 1430–1436.
- [C10] R. Eustice, M. Walter, and J. Leonard, “Sparse extended information filters: insights into sparsification,” in *Proc. IEEE/RSJ Intl. Conf. Intell. Robots Systems*, Aug. 2005, pp. 3281–3288.
- [C9] R. Eustice, H. Singh, J. Leonard, M. Walter, and R. Ballard, “Visually navigating the RMS Titanic with SLAM information filters,” in *Proc. Robotics: Science & Systems*. Cambridge, MA: MIT Press, June 2005, pp. 57–64.
- [C8] R. Eustice, H. Singh, and J. Leonard, “Exactly sparse delayed-state filters,” in *Proc. IEEE Intl. Conf. Robot. Auto.*, Barcelona, Spain, 2005, pp. 2417–2424.
Best Student Paper Award ICRA’05.
- [C7] O. Pizarro, R. Eustice, and H. Singh, “Large area 3D reconstructions from underwater surveys,” in *Proc. IEEE/MTS OCEANS Conf. Exhib.*, vol. 2, Kobe, Japan, Nov. 2004, pp. 678–687.
- [C6] R. Eustice, O. Pizarro, and H. Singh, “Visually augmented navigation in an unstructured environment using a delayed state history,” in *Proc. IEEE Intl. Conf. Robot. Auto.*, vol. 1, New Orleans, USA, Apr. 2004, pp. 25–32.
- [C5] O. Pizarro, R. Eustice, and H. Singh, “Relative pose estimation for instrumented, calibrated imaging platforms,” in *Proc. Digital Image Computing Apps.*, Sydney, Australia, Dec. 2003, pp. 601–612.
- [C4] H. Singh, G. Salgian, R. Eustice, and R. Mandelbaum, “Sensor fusion of structure-from-motion, bathymetric 3D, and beacon-based navigation modalities,” in *Proc. IEEE Intl. Conf. Robot. Auto.*, vol. 4, Washington, D.C., May 2002, pp. 4024–4031.

Publications (continued)

- [C3] R. Eustice, O. Pizarro, H. Singh, and J. Howland, "UWIT: underwater image toolbox for optical image processing and mosaicking in Matlab," in *Proc. Intl. Symp. Underwater Tech.*, Tokyo, Japan, Apr. 2002, pp. 141–145.
- [C2] C. Roman, O. Pizarro, R. Eustice, and H. Singh, "A new autonomous underwater vehicle for imaging research," in *Proc. IEEE/MTS OCEANS Conf. Exhib.*, vol. 1, Sept. 2000, pp. 153–156.
- [C1] R. Eustice, H. Singh, and J. Howland, "Image registration underwater for fluid flow measurements and mosaicking," in *Proc. IEEE/MTS OCEANS Conf. Exhib.*, vol. 3, Sept. 2000, pp. 1529–1534.

OTHER CONFERENCE PUBLICATIONS

- [O3] J. Hill, N. Driscoll, J. Weissel, M. Kastner, H. Singh, M. Cormier, R. Camilli, R. Eustice, R. Lipscomb, N. McPhee, K. Newman, G. Robertson, E. Solomon, and K. Tomanka, "A detailed near-bottom survey of large gas blowout structures along the US Atlantic shelf break using the autonomous underwater vehicle (AUV) SeaBED," in *EOS: Trans. Amer. Geophysical Union Fall Meeting Supplement*, 2004, Abstract.
- [O2] K. Newman, N. Driscoll, J. Weissel, M. Kastner, H. Singh, M. Cormier, R. Camilli, R. Eustice, R. Lipscomb, N. McPhee, J. Hill, G. Robertson, E. Solomon, and K. Tomanka, "A potential link between fluid expulsion and slope stability: geochemical anomalies measured in the gas blowouts along the U.S. Atlantic margin provide new constraints on their formation," in *EOS: Trans. Amer. Geophysical Union Fall Meeting Supplement*, 2004, Abstract.
- [O1] H. Singh, R. Eustice, C. Roman, and O. Pizarro, "The SeaBED AUV – a platform for high resolution imaging," in *Unmanned Underwater Vehicle Showcase*, Southampton Oceanography Centre, UK, Sept. 2002.

Grants

Pending	Agency:	Office of Naval Research 2007 Young Investigator Program
	Title:	Real-Time Visually Augmented Navigation for Autonomous Search and Inspection of Ship Hulls and Port Facilities
	PI:	Ryan M. Eustice (single PI)
	Institution:	University of Michigan
	Amount:	\$460,000
	Dates:	June 2007 – June 2010
	Status:	Submitted, Under Review

Grants (continued)

1. Agency: Ford Motor Company
Title: High-definition LIDAR mapping for active safety vehicle situational awareness
PI: Ryan M. Eustice (single PI)
Institution: University of Michigan
Grant #: N008265
Amount: \$286,382
Dates: November 2007 – May 2008
Status: Current
2. Agency: Internal College of Engineering Competitive Grant
Title: Multi Autonomous Underwater Vehicle Testbed
PI: Ryan M. Eustice (PI), (Co-PIs) Guy Meadows, Jing Sung and Anouck Girard
Institution: University of Michigan
Amount: \$108,400
Dates: November 2007
Status: Current

Invited Lectures and Seminars

- Stanford AI Lab, Stanford University, Palo Alto, California
- Control Seminar Series, University of Michigan, Ann Arbor, Michigan
- Dept. of Naval Architecture & Marine Engineering, University of Michigan, Ann Arbor, Michigan
- Dept. of Computer Science, Johns Hopkins University, Baltimore, Maryland
- SLAM Workshop, 2005 IEEE International Conference on Robotics and Automation

Professional Activities

MEMBERSHIP

- Institute of Electrical and Electronics Engineers (IEEE)
- IEEE Oceanic Engineering Society (OES)
- IEEE Robotics and Automation Society (RAS)
- Society of Naval Architects and Marine Engineers (SNAME)

APPOINTMENTS

- Program Committee, Robotics: Science and Systems (2005, 2006, 2007)
- Session Chair, AUVSA: Autonomous Underwater Vehicles for Scientific Applications (2006)
- Session Chair, IEEE/MTS OCEANS Conf. & Exhibition (2005)

TECHNICAL REVIEWS

1. Computer Vision and Image Understanding
2. IEEE Transaction on Robotics
3. IEEE Journal of Oceanic Engineering

Professional Activities (continued)

4. Journal of Ship Research
5. Journal of Field Robotics
6. International Journal of Computer Vision
7. International Journal on Robotics and Autonomous Systems
8. International Journal of Robotics Research
9. IEEE International Conference on Robotics and Automation (ICRA)
10. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
11. IEEE Industrial Electronics Society Conference (IECON)
12. Robotics: Science and Systems (RSS)
13. International Symposium of Robotics Research (ISRR)
14. International Symposium of Offshore and Polar Engineering (ISOPE)

Oceanographic Deployments

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| 2006 | Seabed AUV Deep Water Archaeology off of Santorini, Greece, aboard R/V Aegaeo |
| 2005 | Seabed AUV Deep Water Archaeology off of Chios, Greece, aboard R/V Aegaeo |
| 2004 | Seabed AUV Coral Habitat Mapping off of Puerto Rico aboard the R/V Cape Hatteras |
| 2004 | Seabed AUV Investigations of Gas Blowout Structures off of North Carolina, R/V Cape Hatteras |
| 2003 | SeaBED AUV deep water coral mapping off of US Virgin Islands on R/V Chapman |
| 2003 | SeaBED AUV habitat mapping of the Stellwagen Bank on the R/V Oceanus |
| 2002 | SeaBED AUV deep water coral mapping off of Bermuda on the R/V Weatherbird II |
| 2002 | SeaBED AUV deep water coral mapping transects off of Puerto Rico |
| 2001 | DSL120A evaluation trials off of Bermuda on the R/V Atlantis |

Teaching Experience

UNIVERSITY OF MICHIGAN

NA320 Marine Hydrodynamics I
NA340 Marine Dynamics I

Fall 2006
Winter 2007

References

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