

# Stephen T. Tully

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## CONTACT INFORMATION

Carnegie Mellon University  
Robotics Institute  
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## OBJECTIVE

My objective is to apply my extensive research experience in robotics, SLAM, filtering theory, and computer vision to develop novel solutions to real-world robotics problems.

## RESEARCH INTERESTS

Robot localization and mapping, medical robots, probabilistic filtering, sensor fusion, computer vision, machine learning, and state estimation.

## EDUCATION

### **Carnegie Mellon University**, Pittsburgh, Pennsylvania USA

Ph.D., Electrical and Computer Engineering, May 2012 (GPA 3.94)

- Research Topic: “BodySLAM: Localization and Mapping for Surgical Guidance”
- Research Area: nonlinear state estimation, robot localization and mapping, surgical robotics, probabilistic filtering, kinematics, robot navigation, and medical imaging.

M.S., Electrical and Computer Engineering, May 2007 (GPA 3.91)

- Research Topic: “Hybrid Localization Using the Hierarchical Atlas”
- Research Area: robot localization, topological graphs, Bayesian filtering.
- Coursework: machine learning, computer vision, numerical optimization, digital signal processing, state estimation, image processing, and computer security.

### **Yale University**, New Haven, Connecticut USA

B.S., Electrical Engineering and Computer Science, May 2005 (GPA 3.60)

- Senior Topic: “Design and Control of a Two-Wheeled Balancing Robot”
- Area of Study: embedded systems, controls, signals and systems, algorithms, data structures, differential equations, linear algebra, multi-variable calculus, computer architecture, systems programming, electronic circuits, and economics.

## EXPERIENCE

### **The Robotics Institute at CMU**, Pittsburgh, Pennsylvania USA

*Post-Doctoral Fellow*

**June, 2012 - present**

- Implemented vision-based SLAM (localization and mapping) algorithms for canine search and rescue applications, fusing accelerometer and gyroscope data with monocular vision
- Extended surgical localization algorithm from Ph.D. work to estimate tissue compliance
- Implemented Lie derivative analysis to demonstrate observability for surgical estimation problems

### **Carnegie Mellon University**, Pittsburgh, Pennsylvania USA

*Graduate Research Assistant*

**September, 2005 - May, 2012**

- Implemented novel Kalman filtering-based SLAM algorithms for estimating the pose and configuration of a surgical robot by fusing data from magnetic tracking sensors with kinematic models
- Developed distributed C++ software for cooperative multi-robot path planning and localization
- Implemented new monocular SLAM approach for vision-based robotic mapping and localization
- Introduced new Bayesian approach to SLAM using hybrid metric/topological robotic navigation
- Presented new method for surgical localization/registration using inequality constraints within a Kalman filter for aligning a surgical tool to preoperative organ models

- Developed system for estimating physiological motion of cardiac tissue with a monocular camera

**Yale University**, New Haven, Connecticut USA

*Undergraduate Research Assistant*

**May, 2003 - May, 2005**

- Implemented FFT-based algorithm on embedded system for characterizing acoustic signals
- Designed electronics, hardware, and embedded control software for two-wheeled balancing robot
- Led team of undergraduates working on sensing and perception for autonomous robot
- Developed intelligent golf club to aid athletes with audio feedback from in-club accelerometers

HONORS AND  
AWARDS

- Best Video Finalist, IEEE ICRA Conference, May 2012
- Travel Award, IEEE IROS, National Science Foundation (NSF), October 2011
- Edward Lanphier Prize for Excellence in Electrical Engineering, May 2005
- Distinction in the Degree of EECS, Yale University, May 2005
- Yale Student IEEE Chairman, August 2004 to May 2005

TEACHING

**Carnegie Mellon University**, Pittsburgh, Pennsylvania USA

- 18-220 Electronic Devices and Analog Circuits, Fall 2010  
Head grad-level TA, taught 3 recitation sessions per week.
- 18-100 Introduction to Electrical Engineering, Fall 2006  
Head grad-level TA, taught 3 recitation sessions per week.

**Yale University**, New Haven, Connecticut USA

- EENG-229 Circuits and Systems Laboratory, Spring 2005  
Undergraduate Assistant TA, coordinated labs on circuit design.
- EENG-227 Circuits and Electronics Laboratory, Fall 2004  
Undergraduate Assistant TA, coordinated labs on circuit design.

JOURNAL  
PUBLICATIONS

- [1] P.J. Johnson, C.M. Serrano, M. Castro, R. Kuenzler, H. Choset, S. Tully, U. Duvvuri. Demonstration of Transoral Surgery in Cadaveric Specimens with the Medrobotics Flex System. *The Laryngoscope*, Vol. 123, Pages 1168-1172, May 2013.
- [2] S. Tully, G. Kantor, H. Choset. A Unified Bayesian Framework for Global Localization and SLAM in Hybrid Metric/Topological Maps. *Int. Journal of Robotics Research (IJRR)*, Vol. 31, No. 3, March 2012.
- [3] C.M. Rivera-Serrano, P. Johnson, B. Zubiate, R. Kuenzler, H. Choset, M.A. Zenati, S. Tully, and U. Duvvuri. A Transoral Highly Flexible Robot. *The Laryngoscope*, Vol. 122, Pages 1067-1071, March 2012.
- [4] R. Kuc, S. Tully. Estimating Reaction Time Delay in Vehicle Operation. *Journal of Japan Society for Early Stage of Dementia*, Vol. 1, No. 1, 2007.

PEER-REVIEWED  
CONFERENCE  
PUBLICATIONS

- [1] S. Tully, G. Kantor, H. Choset. Monocular Feature-Based Periodic Motion Estimation for Surgical Guidance. *Proc. 2013 IEEE International Conference on Robotics and Automation (ICRA)*, May, 2013.
- [2] S. Tully, A. Bajo, G. Kantor, H. Choset, N. Simaan. Constrained Filtering with Contact Detection Data for the Localization and Registration of Continuum Robots in Flexible Environments. *Proc. 2012 IEEE International Conference on Robotics and Automation (ICRA)*, May, 2012.
- [3] C. Gong, S. Tully, G. Kantor, H. Choset. Multi-Agent Deterministic Graph Mapping via Robot Rendezvous. *Proc. 2012 IEEE International Conference on Robotics and Automation (ICRA)*, May, 2012.
- [4] S. Tully, G. Kantor, H. Choset. Inequality Constrained Kalman Filtering for the Localization and Registration of a Surgical Robot. *Proc. 2011 IEEE International Conference on Intelligent Robots and Systems (IROS)*, Sept, 2011.

- [5] S. Tully, G. Kantor, M.A. Zenati, H. Choset. Shape Estimation for Image-Guided Surgery with a Highly Articulated Snake Robot. Proc. 2011 IEEE International Conference on Intelligent Robots and Systems (IROS), Sept, 2011.
- [6] Y. Fu, S. Tully, G. Kantor, H. Choset. Monte Carlo Localization using 3D Texture Maps. Proc. 2011 IEEE International Conference on Intelligent Robots and Systems (IROS), Sept, 2011.
- [7] T. Tao, S. Tully, G. Kantor, H. Choset. Incremental Construction of the Saturated-GVG for Multi-Hypothesis Topological SLAM. Proc. 2011 IEEE International Conference on Robotics and Automation (ICRA), May, 2011.
- [8] S. Tully, G. Kantor, H. Choset. A Single-Step Maximum A Posteriori Update for Bearing-Only SLAM. Proc. 2010 AAAI Conference on Artificial Intelligence, July, 2010.
- [9] S. Tully, G. Kantor, H. Choset, F. Werner. A Multi-Hypothesis Topological SLAM Approach for Loop Closing on Edge-Ordered Graphs. Proc. 2009 IEEE International Conference on Intelligent Robots and Systems (IROS), Oct, 2009.
- [10] F. Werner, F. Maire, J. Sitte, H. Choset, S. Tully, G. Kantor. Topological SLAM using Neighbourhood Information of Places. Proc. 2009 IEEE International Conference on Intelligent Robots and Systems (IROS), Oct, 2009.
- [11] S. Tully, G. Kantor, H. Choset. Leap-Frog Path Design for Multi-Robot Cooperative Localization. Proc. 2009 Field and Service Robotics, FSR 2009, Cambridge, Mass, July, 2009.
- [12] S. Tully, H. Moon, G. Kantor, H. Choset. Iterated Filters for Bearing-Only SLAM. Proc. 2008 IEEE International Conference on Robotics and Automation (ICRA), May, 2008.
- [13] H. Moon, S. Tully, G. Kantor, H. Choset. Square-Root Iterated Kalman Filter for Bearing-Only SLAM. The 4th International Conference on Ubiquitous Robots and Ambient Intelligence, 2007.
- [14] S. Tully, H. Moon, D. Morales, G. Kantor, H. Choset. Hybrid Localization using the Hierarchical Atlas. Proc. 2007 IEEE International Conference on Intelligent Robots and Systems (IROS), Oct, 2007.

ABSTRACTS, VIDEOS,  
AND WORKSHOPS

- [1] A. Degani, S. Tully, B. Zubiato, H. Choset. Over-tube Apparatus for Increasing the Capabilities of an Articulated Robotic Probe. Proc. 2012 IEEE International Conference on Robotics and Automation (ICRA), May, 2012.
- [2] S. Tully, G. Kantor, M.A. Zenati, H. Choset. Image Guidance and Semi-Autonomous Navigation for Robot Assisted Epicardial Interventions. Annual Meeting of the International Society for Minimally Invasive Cardiothoracic Surgery (ISMICS), June, 2011.
- [3] M. Chapman, T. Yokota, T. Ota, S. Tully, D. Schwartzman, B. Zubiato, C. Wright, H. Choset, M.A. Zenati. A Highly Articulated Robotic System (CardioARM) is Safer than a Rigid System for Intrapericardial Intervention in a Porcine Model. Workshop 2010 IEEE International Conference on Robotics and Automation (ICRA), May, 2010.
- [4] C.M. Rivera-Serrano, B. Zubiato, R. Kuenzler, H. Choset, M.A. Zenati, S. Tully, U. Duvvuri. Transoral Highly Articulated Robotic Surgery (THARS) of the Larynx: A Novel Technology and Application. Annual Meeting of the American Head and Neck Society, April, 2010.
- [5] R. Kuc, S. Tully. Cybernetic Model for Monitoring Early Dementia From Vehicle Operation Data. Proc. 7th Annual Conf. Japan Society for Early Stage of Dementia, Sept, 2005.

TECHNICAL SKILLS

- Languages: Matlab, C, C++, Mathematica,  $\LaTeX$
- Applications: Powerpoint, Adobe Illustrator, Adobe Photoshop
- Operating Systems: Mac OS, Microsoft Windows, Unix/Linux