

CSAIL, Room 32-230
Massachusetts Institute of Technology
32 Vassar St.
Cambridge, MA 02139

(678)365-1243
kaess@mit.edu
<http://michaelkaess.com>

Michael Kaess

Research Interests

Mobile Robotics (simultaneous localization and mapping)
Computer Vision (SFM, calibration, multi-camera rigs, large-scale 3D reconstruction)
Probabilistic Methods (Bayesian inference)
Optimization (sparse non-linear systems)

Education

Ph.D. Computer Science Dec 2008
Georgia Institute of Technology, Atlanta, GA

M.S. Computer Science Dec 2002
Georgia Institute of Technology, Atlanta, GA

B.S. Computer Science (Vordiplom Informatik) Sep 1998
University of Karlsruhe, Germany

Employment

Postdoctoral Associate Nov 2008–today
Massachusetts Institute of Technology, CSAIL
Marine Robotics, Dr. John Leonard

Research Assistant May 2003–Oct 2008
Georgia Institute of Technology, BORG Lab
DARPA LAGR Program and NSF Career Award, Dr. Frank Dellaert

Research Intern Sep 2005–Dec 2005
Microsoft Research, Interactive Visual Media Group
Virtual Earth, Dr. Richard Szeliski and Dr. Drew Steedly

Research Assistant (Wissenschaftlicher Angestellter) Sep 2004–Dec 2004
University of Freiburg, Autonomous Intelligent Systems, Germany
Closing the Loop, Dr. Wolfram Burgard

Teaching Assistant Jan 2003–May 2003
Georgia Institute of Technology, College of Computing
Machine Learning, Dr. Frank Dellaert

Research Assistant May 2001–Dec 2002
Georgia Institute of Technology, Mobile Robot Lab
DARPA MARS Program, Dr. Ronald C. Arkin

Undergraduate Research Assistant Aug 1998–Jul 2000
Research Center for Information Technologies (FZI), Karlsruhe, Germany
Electronic Systems and Microsystems, Dr. Stefan Schmerler

Publications

Journal Publications

- [1] M. Kaess and F. Dellaert, “Data association with an information factor matrix,” *Submitted to the special issue of Robotics and Autonomous Systems: Inside Data Association*, 2008.
- [2] M. Kaess and F. Dellaert, “Probabilistic structure matching for visual SLAM with a multi-camera rig,” *Submitted to Computer Vision and Image Understanding, CVIU*, 2008.
- [3] M. Kaess, A. Ranganathan, and F. Dellaert, “iSAM: Incremental smoothing and mapping,” vol. 24, pp. 1365–1378, Dec 2008.
- [4] F. Dellaert and M. Kaess, “Square Root SAM: Simultaneous localization and mapping via square root information smoothing,” *Intl. J. of Robotics Research*, vol. 25, pp. 1181–1204, Dec 2006.

Peer-reviewed Conference Publications

- [5] M. Kaess, K. Ni, and F. Dellaert, “Flow separation for fast and robust stereo odometry,” in *IEEE Intl. Conf. on Robotics and Automation, ICRA*, (Kobe, Japan), May 2009.
- [6] R. Mottaghi, M. Kaess, A. Ranganathan, R. Roberts, and F. Dellaert, “Place recognition-based fixed-lag smoothing for environments with unreliable GPS,” in *IEEE Intl. Conf. on Robotics and Automation, ICRA*, (Pasadena, CA), May 2008.
- [7] A. Ranganathan, M. Kaess, and F. Dellaert, “Fast 3D pose estimation with out-of-sequence measurements,” in *IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems, IROS*, (San Diego, CA), pp. 2486–2493, Oct 2007.
- [8] M. Kaess, A. Ranganathan, and F. Dellaert, “iSAM: Fast incremental smoothing and mapping with efficient data association,” in *IEEE Intl. Conf. on Robotics and Automation, ICRA*, (Rome, Italy), pp. 1670–1677, April 2007.
- [9] M. Kaess, A. Ranganathan, and F. Dellaert, “Fast incremental square root information smoothing,” in *Intl. Joint Conf. on Artificial Intelligence, IJCAI*, (Hyderabad, India), pp. 2129–2134, Jan 2007. Oral presentation acceptance ratio 15.7% (212 of 1353).
- [10] A. Ranganathan, M. Kaess, and F. Dellaert, “Loopy SAM,” in *Intl. Joint Conf. on Artificial Intelligence, IJCAI*, (Hyderabad, India), pp. 2191–2196, Jan 2007. Oral presentation acceptance ratio 15.7% (212 of 1353).
- [11] M. Kaess and F. Dellaert, “A Markov chain Monte Carlo approach to closing the loop in SLAM,” in *IEEE Intl. Conf. on Robotics and Automation, ICRA*, (Barcelona, Spain), pp. 645–650, Apr 2005.
- [12] M. Kaess, R. Zboinski, and F. Dellaert, “MCMC-based multiview reconstruction of piecewise smooth subdivision curves with a variable number of control points,” in *Eur. Conf. on Computer Vision, ECCV*, vol. 3023 of *Lecture Notes in Computer Science*, (Prague, Czech Republic), pp. 329–341, Springer, May 2004. Acceptance ratio 34.2% (190 of 555).
- [13] M. Kaess and F. Dellaert, “Reconstruction of objects with jagged edges through Rao-Blackwellized fitting of piecewise smooth subdivision curves,” in *Proceedings of the IEEE 1st International Workshop on Higher-Level Knowledge in 3D Modeling and Motion Analysis*, (Nice, France), pp. 39–47, IEEE Computer Society, Oct 2003.
- [14] M. Kaess, R. Arkin, and J. Rossignac, “Compact encoding of robot-generated 3D maps for efficient wireless transmission,” in *IEEE Intl. Conf. on Advanced Robotics, ICAR*, (Coimbra, Portugal), pp. 324–331, Jun 2003.
- [15] M. Likhachev, M. Kaess, and R. Arkin, “Learning behavioral parameterization using spatio-temporal case-based reasoning,” in *IEEE Intl. Conf. on Robotics and Automation, ICRA*, vol. 2, (Washington, DC), pp. 1282–1289, IEEE, May 2002.

Other Publications

- [16] F. Dellaert, T. Balch, M. Kaess, R. Ravichandran, F. Alegre, M. Berhault, R. McGuire, E. Merrill, L. Moshkina, and D. Walker, "The Georgia Tech Yellow Jackets: A marsupial team for urban search and rescue," in *AAAI Mobile Robot Competition*, (Edmonton, Alberta, Canada), pp. 44–49, AAAI Press, 2002.
- [17] M. Kaess and F. Dellaert, "Visual SLAM with a multi-camera rig," Tech. Rep. GIT-GVU-06-06, Georgia Institute of Technology, Feb 2006.

Invited Talk

iSAM: Incremental Smoothing and Mapping, University of Bremen and University of Freiburg, Germany, 2007

Research Experience

Incremental Smoothing and Mapping

Advisor: Dr. Frank Dellaert

Thesis research: Devised and implemented a fast incremental SLAM algorithm, that performs full optimization and provides efficient access to the exact covariances needed for data association. The algorithm has been used with both cameras and laser-range sensors on multiple platforms. See [3], [4], [8], [9], [10].

Visual Odometry

Advisor: Dr. Frank Dellaert

Developed a real-time system and demonstrated it live to the DARPA LAGR program manager in San Antonio, Texas. Devised an algorithm that robustly handles degenerate data. See [5], [7].

Multi-planar Stereo

Advisor: Dr. Drew Steedly

Implemented a graph-cut based multi-planar stereo reconstruction to synthesize oblique urban views from multiple images and laser-range data.

Probabilistic Data Association for SLAM

Advisor: Dr. Frank Dellaert

Deployed the probabilistic framework of Dr. Dellaert's thesis work to the incremental correspondence problem of SLAM for both laser-range sensors and a multi-camera rig. See [2], [11].

Multi-view Subdivision Curve Fitting

Advisor: Dr. Frank Dellaert

Developed a Markov chain Monte Carlo approach to fit a 3D subdivision curve to multiple images of an object with both jagged and round edges. See [12], [13].

3D Mapping and Compression

Advisor: Dr. Ronald C. Arkin, Dr. Jarek Rossignac

Implemented 3D laser-based mapping of a building with a focus on data compression for efficient wireless transmission. See [14].

Skills

Languages: German, English

Programming: OCaml, C, C++, Matlab, Java, 8086 Assembly

Tools and Libraries: Intel Image Processing Libraries, OpenCV, OpenGL

Environments: Linux/UNIX, Windows

Awards

Marshall D. Williamson Fellowship College of Computing, Georgia Institute of Technology	2001
Exchange Student Scholarship Federation of German-American Clubs	2000
Robert Mayer Jugendpreis City of Heilbronn, Germany	1995

Service

Program Committee, Workshop: Inside Data Association, RSS 2008

Reviewer for:

TRO (IEEE Trans. on Robotics) 2004, 2007, 2008

PAMI (IEEE Trans. on Pattern Analysis and Machine Intelligence) 2008

JFR (Journal of Field Robotics) 2006, 2009

ICCV (International Conference on Computer Vision) 2005, 2007

ECCV (European Conference on Computer Vision) 2004, 2006

CVPR (Computer Vision and Pattern Recognition) 2004-2008

RSS (Robotics Science and Systems) 2005, 2006

ICRA (International Conference on Robotics and Automation) 2005, 2007-2009

IROS (International Conference on Intelligent Robots and Systems) 2007

NIPS (Neural Information Processing Systems) 2003, 2004

IJCAI (International Joint Conference on Artificial Intelligence) 2003

ICML (International Conference on Machine Learning) 2004

References

References are available upon request.