Michael Kaess

Associate Professor
Director, Robot Perception Lab

Field Robotics Center, The Robotics Institute
School of Computer Science, Carnegie Mellon University
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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

Associate Professor Jul 2021–today
Carnegie Mellon University, Robotics Institute

Associate Research Professor Jul 2019–Jun 2021
Carnegie Mellon University, Robotics Institute

Assistant Research Professor Nov 2013–Jun 2019
Carnegie Mellon University, Robotics Institute

Research Scientist Jul 2010–Oct 2013
Massachusetts Institute of Technology, MechE/CSAIL
Marine Robotics and Persistent Mapping, Dr. John Leonard

Postdoctoral Associate Nov 2008–Jun 2010
Massachusetts Institute of Technology, MechE/CSAIL
Marine Robotics and Persistent Mapping, Dr. John Leonard

Research Assistant May 2003–Oct 2008
Georgia Institute of Technology, College of Computing
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

Awards

IROS: Outstanding Associate Editor Award   2022
Out of 409 associate editors

ICRA: Outstanding Navigation Paper Award   2022
Title: EDPLVO: Efficient Direct Point-Line Visual Odometry

IROS: Best Paper and Best Student Paper Finalist (one of five)   2021
Title: Ground Encoding: Learned Factor Graph-Based Models for Localizing Ground Penetrating Radar

ICRA: Best Service Robotics Paper Finalist (one of four)   2021
Title: Tactile SLAM: Real-time Inference of Shape and Pose from Planar Pushing

RSS 2020 Test of Time Award (jointly with Frank Dellaert)   2020
"For pioneering an information smoothing approach to the SLAM problem via square root factorization, its interpretation as a graphical model, and the widely-used GTSAM free software repository."

IROS: Best Conference Paper Finalist (one of six)   2018
Title: Information Sparsification in Visual-Inertial Odometry

ICRA: Best Vision Paper Finalist (one of five)   2016
Title: Articulated robot motion for simultaneous localization and mapping (ARM-SLAM)

Google Faculty Research Award   2014
Tightly coupled visual-inertial localization and mapping

ICRA: Best Student Paper Finalist (one of five)   2013
Title: Temporally scalable visual SLAM using a reduced pose graph

Runner-up (top 3) for Dick Volz Best 2008 US Ph.D. Thesis in Robotics and Automation   2012
Delayed award that also considers impact of dissertation

ICRA: Best Automation Paper Finalist (one of five)   2011
Title: Efficient AUV navigation fusing acoustic ranging and side-scan sonar

Marshall D. Williamson Fellowship   2001
College of Computing, Georgia Institute of Technology

Exchange Student Scholarship   2000
Federation of German-American Clubs

Robert Mayer Jugendpreis   1995
City of Heilbronn, Germany

Teaching Experience

CMU Course 16-833: Robot Localization and Mapping   Spring 2017–22, Fall 2019–20, 2022
new graduate course developed and taught over 500 students

CMU Course 16-822: Geometry-based Methods in Vision   Fall 2021
graduate course taught

CMU Course 16-665: Robot Mobility on Air, Land, & Sea   Fall 2018–2022
new graduate course developed and co-taught with
John Dolan, Dimi Apostolopoulos, Nathan Michael, and Hartmut Geyer

CMU Course 16-831, Statistical Techniques in Robotics   Fall 2015, 2016
graduate course co-taught with Kris Kitani

MIT Course 2.017: Design of Electro-Mechanical Robotic Systems   Spring 2013
undergraduate course co-taught with John Leonard

Citations

Retrieved from Google Scholar on October 21, 2022:
Citations: 11,546
h-index: 48
i10-index: 103
top cited paper in IROS (ranking 40)

Publications

Journal Publications

1. W. Dong, Y. Lao, M. Kaess, and V. Koltun, "ASH: A modern framework for parallel spatial hashing in 3D perception," *IEEE Trans. on Pattern Analysis and Machine Intelligence (PAMI)*, 2022, to appear.
2. L. Zhou, G. Huang, Y. Mao, J. Yu, S. Wang, and M. Kaess, "PLC-LiSLAM: LiDAR SLAM with planes, lines and cylinders," *IEEE Robotics and Automation Letters (RA-L)*, vol. 7, no. 3, pp. 7163–7170, Jul. 2022, to be presented at IROS 2022.

3. E. Dexheimer, P. Peluse, J. Chen, J. Pritts, and M. Kaess, "Information-theoretic online multi-camera extrinsic calibration," *IEEE Robotics and Automation Letters (RA-L)*, vol. 7, no. 2, pp. 4757–4764, Apr. 2022, presented at ICRA 2022.

4. L. Zhou, S. Wang, and M. Kaess, "DPLVO: Direct point-line monocular visual odometry," *IEEE Robotics and Automation Letters (RA-L)*, vol. 6, no. 4, pp. 7113–7120, Oct. 2021, presented at IROS 2021.

5. L. Zhou, D. Koppel, and M. Kaess, "LiDAR SLAM with plane adjustment for indoor environment," *IEEE Robotics and Automation Letters (RA-L)*, vol. 6, no. 4, pp. 7073–7080, Oct. 2021, presented at IROS 2021.

6. L. Zhou, D. Koppel, and M. Kaess, "A complete, accurate and efficient solution for the perspective-n-line problem," *IEEE Robotics and Automation Letters (RA-L)*, vol. 6, no. 2, pp. 699–706, Apr. 2021, presented at ICRA 2021.

7. E. Westman and M. Kaess, "Degeneracy-aware imaging sonar simultaneous localization and mapping," *IEEE J. of Oceanic Engineering (JOE)*, vol. 45, no. 4, pp. 1280–1294, Oct. 2020.

8. L. Zhou and M. Kaess, "Windowed bundle adjustment framework for unsupervised learning of monocular depth estimation with u-net extension and clip loss," *IEEE Robotics and Automation Letters (RA-L)*, vol. 5, no. 2, pp. 3283–3290, Apr. 2020, presented at ICRA 2020.

9. S. Mukherjee, M. Kaess, J. Martel, and C. Riviere, "EyeSAM: Graph-based localization and mapping of retinal vasculature during intraocular microsurgery," *Intl. J. of Computer Assisted Radiology and Surgery (JCARS)*, vol. 14, no. 5, pp. 819–828, May 2019.

10. S. Suresh, E. Westman, and M. Kaess, "Through-water stereo SLAM with refraction correction for AUV localization," *IEEE Robotics and Automation Letters (RA-L)*, vol. 4, no. 2, pp. 692–699, Apr. 2019, presented at ICRA 2019.

11. J. Li, M. Kaess, R. Eustice, and M. Johnson-Roberson, "Pose-graph SLAM using forward-looking sonar," *IEEE Robotics and Automation Letters (RA-L)*, vol. 3, no. 3, pp. 2330–2337, Jul. 2018, presented at ICRA 2018.

12. F. Dellaert and M. Kaess, "Factor graphs for robot perception," *Foundations and Trends in Robotics (FNT)*, vol. 6, no. 1-2, pp. 1–139, Aug. 2017.

13. H. Alismail, M. Kaess, B. Browning, and S. Lucey, "Direct visual odometry in low light using binary descriptors," *IEEE Robotics and Automation Letters (RA-L)*, vol. 2, no. 2, pp. 444–451, Apr. 2017, presented at ICRA 2017.

14. J. Zhang, M. Kaess, and S. Singh, "A real-time method for depth enhanced monocular odometry," *Autonomous Robots (AURO)*, vol. 41, no. 1, pp. 31–43, Jan. 2017.

15. M. Klingensmith, S. Srinivasa, and M. Kaess, "Articulated robot motion for simultaneous localization and mapping (ARM-SLAM)," *IEEE Robotics and Automation Letters (RA-L)*, vol. 1, no. 2, pp. 1156–1163, Jul. 2016, presented at ICRA 2016. **Best vision paper finalist (one of five).**

16. T. Whelan, M. Kaess, H. Johannsson, M. Fallon, J. Leonard, and J. McDonald, "Real-time large scale dense RGB-D SLAM with volumetric fusion," *Intl. J. of Robotics Research (IJRR)*, vol. 34, no. 4-5, pp. 598–626, Apr. 2015.

17. G. Huang, M. Kaess, and J. Leonard, "Consistent unscented incremental smoothing for multi-robot cooperative target tracking," *J. of Robotics and Autonomous Systems (RAS)*, vol. 69, pp. 52–67, Jul. 2015.

18. N. Carlevaris-Bianco, M. Kaess, and R. Eustice, "Generic factor-based node removal: Enabling long-term SLAM," *IEEE Trans. on Robotics (TRO)*, vol. 30, no. 6, pp. 1371–1385, Dec. 2014.

19. D. Rosen, M. Kaess, and J. Leonard, "RISE: An incremental trust-region method for robust online sparse least-squares estimation," *IEEE Trans. on Robotics (TRO)*, vol. 30, no. 5, pp. 1091–1108, Oct. 2014.

20. S. Williams, V. Indelman, M. Kaess, R. Roberts, J. Leonard, and F. Dellaert, "Concurrent filtering and smoothing: A parallel architecture for real-time navigation and full smoothing," *Intl. J. of Robotics Research (IJRR)*, vol. 33, no. 12, pp. 1544–1568, Oct. 2014.

21. M. Fallon, H. Johannsson, M. Kaess, and J. Leonard, "The MIT Stata Center dataset," *Intl. J. of Robotics Research (IJRR)*, vol. 32, no. 14, pp. 1695–1699, Dec. 2013.

22. V. Indelman, S. Williams, M. Kaess, and F. Dellaert, "Information fusion in navigation systems via factor graph based incremental smoothing," *J. of Robotics and Autonomous Systems (RAS)*, vol. 61, no. 8, pp. 721–738, Aug. 2013.

23. J. McDonald, M. Kaess, C. Cadena, J. Neira, and J. Leonard, "Real-time 6-DOF multi-session visual SLAM over large scale environments," *J. of Robotics and Autonomous Systems (RAS)*, vol. 61, no. 10, pp. 1144–1158, Oct. 2013.

24. A. Wu, E. Johnson, M. Kaess, F. Dellaert, and G. Chowdhary, "Autonomous flight in GPS-denied environments using monocular vision and inertial sensors," *AIAA J. of Aerospace Information Systems (JAIS)*, vol. 10, no. 4, pp. 172–186, Apr. 2013.

25. F. Hover, R. Eustice, A. Kim, B. Englot, H. Johannsson, M. Kaess, and J. Leonard, "Advanced perception, navigation and planning for autonomous in-water ship hull inspection," *Intl. J. of Robotics Research (IJRR)*, vol. 31, no. 12, pp. 1445–1464, Oct. 2012.

26. M. Kaess, H. Johannsson, R. Roberts, V. Ila, J. Leonard, and F. Dellaert, "iSAM2: Incremental smoothing and mapping using the Bayes tree," *Intl. J. of Robotics Research (IJRR)*, vol. 31, no. 2, pp. 216–235, Feb. 2012.

27. M. Kaess and F. Dellaert, "Probabilistic structure matching for visual SLAM with a multi-camera rig," *Computer Vision and Image Understanding (CVIU)*, vol. 114, no. 2, pp. 286–296, Feb. 2010.

28. M. Kaess and F. Dellaert, "Covariance recovery from a square root information matrix for data association," *J. of Robotics and Autonomous Systems (RAS)*, vol. 57, no. 12, pp. 1198–1210, Dec. 2009.

29. M. Kaess, A. Ranganathan, and F. Dellaert, "iSAM: Incremental smoothing and mapping," *IEEE Trans. on Robotics (TRO)*, vol. 24, no. 6, pp. 1365–1378, Dec. 2008.

30. F. Dellaert and M. Kaess, "Square Root SAM: Simultaneous localization and mapping via square root information smoothing," *Intl. J. of Robotics Research (IJRR)*, vol. 25, no. 12, pp. 1181–1204, Dec. 2006, **Inaugural RSS 2020 Test of Time Award.**

Book Chapter

31. M. Fallon, H. Johannsson, M. Kaess, J. Folkesson, H. McClelland, B. Englot, F. Hover, and J. J. Leonard, "Simultaneous localization and mapping in marine environments," in *Marine Robot Autonomy*, M. L. Seto, Ed. Springer, 2013, pp. 329–372.

Peer-reviewed Publications

32. S. Suresh, Z. Si, S. Anderson, M. Kaess, and M. Mukadam, "MidasTouch: Monte-Carlo inference over distributions across sliding touch," in *Proc. Conf. on Robot Learning (CoRL)*, Auckland, New Zealand, Dec. 2022, to appear.

33. B. Forsgren, R. Vasudevan, M. Kaess, T. McLain, and J. Mangelson, "Group-k consistent measurement set maximization for robust outlier detection," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Kyoto, Japan, Oct. 2022, to appear.

34. A. Hinduja, Y. Ohm, J. Liao, C. Majidi, and M. Kaess, "Acoustic localization and communication using a MEMS microphone for low-cost and low-power bio-inspired underwater robots," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Kyoto, Japan, Oct. 2022, to appear.

35. E. Potokar, K. Lay, K. Normal, D. Benham, T. Neilsen, M. Kaess, and J. Mangelson, "HoloOcean: Realistic sonar simulation," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Kyoto, Japan, Oct. 2022, to appear.

36. M. Qadri, P. Sodhi, J. Mangelson, F. Dellaert, and M. Kaess, "InCOpt: Incremental constrained optimization using the Bayes tree," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Kyoto, Japan, Oct. 2022, to appear.

37. R. Xu, W. Dong, A. Sharma, and M. Kaess, "Learned depth estimation of 3D imaging radar for indoor mapping," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Kyoto, Japan, Oct. 2022, to appear.

38. M.-F. Chang, Y. Zhao, R. Shah, J. Engel, M. Kaess, and S. Lucey, "Long-term visual map sparsification with heterogeneous GNN," in *Proc. IEEE Conf. on Computer Vision and Pattern Recognition (CVPR)*, New Orleans, LA, USA, Jun. 2022, pp. 2406–2415.

39. Y. Litman, D. McGann, E. Dexheimer, and M. Kaess, "Global visual-inertial ground vehicle state estimation via image registration," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Philadelphia, PA, USA, May 2022, pp. 8178–8184.

40. E. Potokar, S. Ashford, M. Kaess, and J. Mangelson, "HoloOcean: An underwater robotics simulator," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Philadelphia, PA, USA, May 2022, pp. 3040–3046.

41. P. Sodhi, M. Kaess, M. Mukadam, and S. Anderson, "PatchGraph: In-hand tactile tracking with learned surface normals," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Philadelphia, PA, USA, May 2022, pp. 2164–2170.

42. S. Suresh, Z. Si, J. Mangelson, W. Yuan, and M. Kaess, "ShapeMap 3-D: Efficient shape mapping through dense touch and vision," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Philadelphia, PA, USA, May 2022, pp. 7073–7080.

43. L. Zhou, G. Huang, Y. Mao, S. Wang, and M. Kaess, "EDPLVO: Efficient direct point-line visual odometry," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Philadelphia, PA, USA, May 2022, pp. 7559–7565, **Outstanding navigation paper award.**

44. P. Sodhi, M. Mukadam, S. Anderson, and M. Kaess, "LEO: Learning energy-based models in factor graph optimization," in *Proc. Conf. on Robot Learning (CoRL)*, London, UK, Nov. 2021.

45. A. Baikovitz, P. Sodhi, M. Dille, and M. Kaess, "Ground encoding: Learned factor graph-based models for localizing ground penetrating radar," in *Proc. IEEE/RSJ Intl. Conf. on Intelli-*

gent Robots and Systems (IROS), Prague, Czech Republic, Sep. 2021, pp. 5476–5483, **Best paper and best student paper finalist (one of five).**

46. M.-F. Chang, W. Dong, J. Mangelson, M. Kaess, and S. Lucey, "Map compressibility assessment for LiDAR registration," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Prague, Czech Republic, Sep. 2021, pp. 5560–5567.

47. M. Abello, J. Mangelson, and M. Kaess, "A graph-based method for joint instance segmentation of point clouds and image sequences," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Xi'an, China, May 2021, pp. 9565–9571.

48. M.-F. Chang, J. Mangelson, M. Kaess, and S. Lucey, "HyperMap: Compressed 3D map for monocular camera registration," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Xi'an, China, May 2021, pp. 11 739–11 745.

49. A. Sharma, W. Dong, and M. Kaess, "Compositional and scalable object SLAM," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Xi'an, China, May 2021, pp. 11 626–11 632.

50. P. Sodhi, M. Kaess, M. Mukadam, and S. Anderson, "Learning tactile models for factor graph-based estimation," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Xi'an, China, May 2021, pp. 13 686–13 692.

51. S. Suresh, M. Bauza, K.-T. Yu, J. Mangelson, A. Rodriguez, and M. Kaess, "Tactile SLAM: Real-time inference of shape and pose from planar pushing," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Xi'an, China, May 2021, pp. 11 322–11 328, **Best service robotics paper finalist (one of four).**

52. L. Zhou, S. Wang, and M. Kaess, "π-LSAM: LiDAR smoothing and mapping with planes," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Xi'an, China, May 2021, pp. 5751–5757.

53. L. Zhou, D. Koppel, H. Ju, F. Steinbruecker, and M. Kaess, "An efficient planar bundle adjustment algorithm," in *Proc. IEEE Intl. Symp. on Mixed and Augmented Reality (ISMAR)*, Porto de Galinhas, Brazil, Nov. 2020, pp. 136–145.

54. E. Dexheimer, J. Mangelson, S. Scherer, and M. Kaess, "Efficient multiresolution scrolling grid for stereo vision-based MAV obstacle avoidance," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Oct. 2020, pp. 4758–4765.

55. M. Hsiao, J. Mangelson, C. Debrunner, and M. Kaess, "ARAS: Ambiguity-aware robust active SLAM based on multi-hypothesis state and map estimations," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Oct. 2020, pp. 5037–5044.

56. J. Jaekel, J. Mangelson, S. Scherer, and M. Kaess, "A robust multi-stereo visual-inertial odometry pipeline," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Oct. 2020, pp. 4623–4630.

57. V. Viswanathan, E. Dexheimer, G. Li, G. Loianno, M. Kaess, and S. Scherer, "Efficient trajectory library filtering for quadrotor flight in unknown environments," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Oct. 2020, pp. 2510–2517.

58. E. Westman, I. Gkioulekas, and M. Kaess, "A theory of Fermat paths for 3D imaging sonar reconstruction," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Oct. 2020, pp. 5082–5088.

59. D. Fourie, A. Espinoza, M. Kaess, and J. Leonard, "Characterizing marginalization and incremental operations on the Bayes tree," in *Proc. Intl. Workshop on the Algorithmic Foundations of Robotics (WAFR)*, Oulu, Finland, Jun. 2020.

60. P. Sodhi, S. Choudhury, J. Mangelson, and M. Kaess, "ICS: Incremental constrained smoothing for state estimation," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, May 2020, pp. 279–285.

61. S. Suresh, P. Sodhi, J. Mangelson, D. Wettergreen, and M. Kaess, "Active SLAM using 3D submap saliency for underwater volumetric exploration," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, May 2020, pp. 3132–3138.

62. E. Westman, I. Gkioulekas, and M. Kaess, "A volumetric albedo framework for 3D imaging sonar reconstruction," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, May 2020, pp. 9645–9651.

63. L. Zhou, S. Wang, and M. Kaess, "A fast and accurate solution for pose estimation from 3D correspondences," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, May 2020, pp. 1308–1314.

64. W. Dong, J. Park, Y. Yang, and M. Kaess, "GPU accelerated robust scene reconstruction," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Macao, Nov. 2019, pp. 7863–7870.

65. A. Hinduja, B. Ho, and M. Kaess, "Degeneracy-aware factors with applications to underwater SLAM," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Macao, Nov. 2019, pp. 1293–1299.

66. P. Sodhi, B. Ho, and M. Kaess, "Online and consistent occupancy grid mapping for planning in unknown environments," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Macao, Nov. 2019, pp. 7879–7886.

67. P. Teixeira, D. Fourie, M. Kaess, and J. Leonard, "Dense sonar-based reconstruction of underwater scenes," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Macao, Nov. 2019, pp. 8060–8066.

68. E. Westman and M. Kaess, "Wide aperture imaging sonar reconstruction using generative models," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Macao, Nov. 2019, pp. 8067–8074.

69. L. Zhou and M. Kaess, "An efficient and accurate algorithm for the perspective-n-point problem," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Macao, Nov. 2019, pp. 6245–6252.

70. M. Hsiao and M. Kaess, "MH-iSAM2: Multi-hypothesis iSAM using Bayes tree and hypo-tree," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Montreal, Canada, May 2019, pp. 1274–1280.

71. Z. Li, P. Gogia, and M. Kaess, "Dense surface reconstruction from monocular vision and LiDAR," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Montreal, Canada, May 2019, pp. 6905–6911.

72. R. Madaan, M. Kaess, and S. Scherer, "Multi-view reconstruction of wires using a catenary model," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Montreal, Canada, May 2019, pp. 5657–5664.

73. Y. Yang, W. Dong, and M. Kaess, "Surfel-based dense RGB-D reconstruction with global and local consistency," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Montreal, Canada, May 2019, pp. 5238–5244.

74. L. Zhou, Y. Yang, M. Abello, and M. Kaess, "A robust and efficient algorithm for the PnL problem using algebraic distance to approximate the reprojection distance," in *Proc. AAAI Conference on Artificial Intelligence (AAAI)*, Honolulu, Hawaii, USA, Jan. 2019, pp. 9307–9315.

75. L. Zhou, J. Ye, and M. Kaess, "A stable algebraic camera pose estimation for minimal configurations of 2D/3D point and line correspondences," in *Proc. Asian Conf. on Computer Vision (ACCV)*, Perth, Australia, Dec. 2018, pp. 273–288.

76. B. Ho, P. Sodhi, P. Teixeira, M. Hsiao, T. Kusnur, and M. Kaess, "Virtual occupancy grid map for submap-based pose graph SLAM and planning in 3D environments," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Madrid, Spain, Oct. 2018, pp. 2175–2182.

77. J. Hsiung, M. Hsiao, E. Westman, R. Valencia, and M. Kaess, "Information sparsification in visual-inertial odometry," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Madrid, Spain, Oct. 2018, pp. 1146–1153, **Best conference paper finalist (one of six).**

78. P. Teixeira, M. Kaess, F. Hover, and J. Leonard, "Multibeam data processing for underwater mapping," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Madrid, Spain, Oct. 2018, pp. 1877–1884.

79. L. Zhou, Z. Li, and M. Kaess, "Automatic extrinsic calibration of a camera and a 3D LiDAR using line and plane correspondences," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Madrid, Spain, Oct. 2018, pp. 5562–5569.

80. M. Hsiao, E. Westman, and M. Kaess, "Dense planar-inertial SLAM with structural constraints," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Brisbane, Australia, May 2018, pp. 6521–6528.

81. E. Westman, A. Hinduja, and M. Kaess, "Feature-based SLAM for imaging sonar with underconstrained landmarks," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Brisbane, Australia, May 2018, pp. 3629–3636.

82. P. Puri, D. Jia, and M. Kaess, "GravityFusion: Real-time dense mapping without pose graph using deformation and orientation," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Vancouver, Canada, Sep. 2017, pp. 6506–6513.

83. M. Hsiao, E. Westman, G. Zhang, and M. Kaess, "Keyframe-based dense planar SLAM," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Singapore, May 2017, pp. 5110–5117.

84. M. C. Koval, M. Klingensmith, S. S. Srinivasa, N. S. Pollard, and M. Kaess, "The manifold particle filter for state estimation on high-dimensional implicit manifolds," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Singapore, May 2017, pp. 4673–4680.

85. S. Zhang, W. Xie, G. Zhang, H. Bao, and M. Kaess, "Robust stereo matching with surface normal prediction," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Singapore, May 2017, pp. 2540–2547.

86. D. Fourie, J. Leonard, and M. Kaess, "A nonparametric belief solution to the Bayes tree," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Daejeon, Korea, Oct. 2016, pp. 2189–2196.

87. G. Hemann, S. Singh, and M. Kaess, "Long-range GPS-denied aerial inertial navigation with LIDAR localization," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Daejeon, Korea, Oct. 2016, pp. 1659–1666.

88. T. Huang and M. Kaess, "Incremental data association for acoustic structure from motion," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Daejeon, Korea, Oct. 2016, pp. 1334–1341.

89. P. Teixeira, M. Kaess, F. Hover, and J. Leonard, "Underwater inspection using sonar-based volumetric submaps," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Daejeon, Korea, Oct. 2016, pp. 4288–4295.

90. S. Yang, Y. Song, M. Kaess, and S. Scherer, "Pop-up SLAM: Semantic monocular plane SLAM for low-texture environments," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Daejeon, Korea, Oct. 2016, pp. 1222–1229.

91. J. Zhang, M. Kaess, and S. Singh, "On degeneracy of optimization-based state estimation problems," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Stockholm, Sweden, May 2016, pp. 809–816.

92. T. Huang and M. Kaess, "Towards acoustic structure from motion for imaging sonar," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Hamburg, Germany, Sep. 2015, pp. 758–765.

93. H.-C. Wang, C. Finn, L. Paull, M. Kaess, R. Rosenholtz, S. Teller, and J. Leonard, "Bridging text spotting and SLAM with junction features," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Hamburg, Germany, Sep. 2015, pp. 3701–3708.

94. M. Kaess, "Simultaneous localization and mapping with infinite planes," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Seattle, WA, USA, May 2015, pp. 4605–4611.

95. P. Ozog, G. Troni, M. Kaess, R. Eustice, and M. Johnson-Roberson, "Building 3D mosaics from an autonomous underwater vehicle and 2D imaging sonar," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Seattle, WA, USA, May 2015, pp. 1137–1143.

96. J. Zhang, M. Kaess, and S. Singh, "Real-time depth enhanced monocular odometry," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Chicago, IL, USA, Sep. 2014, pp. 4973–4980.

97. T. Whelan, M. Kaess, R. Finman, M. Fallon, H. Johannsson, J. Leonard, and J. McDonald, "3D mapping, localisation and object retrieval using low cost robotic platforms: A robotic search engine for the real-world," in *RSS Workshop on RGB-D: Advanced Reasoning with Depth Cameras*, Berkeley, CA, USA, Jul. 2014.

98. R. Finman, T. Whelan, M. Kaess, and J. Leonard, "Efficient incremental map segmentation in dense RGB-D maps," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Hong Kong, Jun. 2014, pp. 5488–5494.

99. G. Huang, M. Kaess, and J. Leonard, "Towards consistent visual-inertial navigation," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Hong Kong, Jun. 2014, pp. 4926–4933.

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101. T. Whelan, M. Kaess, J. Leonard, and J. McDonald, "Deformation-based loop closure for large scale dense RGB-D SLAM," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Tokyo, Japan, Nov. 2013, pp. 548–555.

102. G. Huang, R. Truax, M. Kaess, and J. Leonard, "Unscented iSAM: A consistent incremental solution to cooperative localization and target tracking," in *Proc. European Conf. on Mobile Robots (ECMR)*, Barcelona, Spain, Sep. 2013, pp. 248–254.

103. G. Huang, M. Kaess, and J. Leonard, "Consistent sparsification for graph optimization," in *Proc. European Conf. on Mobile Robots (ECMR)*, Barcelona, Spain, Sep. 2013, pp. 150–157.

104. R. Finman, T. Whelan, M. Kaess, and J. Leonard, "Toward lifelong object segmentation from change detection in dense RGB-D maps," in *Proc. European Conf. on Mobile Robots (ECMR)*, Barcelona, Spain, Sep. 2013, pp. 178–185.

105. G. Huang, M. Kaess, J. Leonard, and S. Roumeliotis, "Analytically-selected multi-hypothesis incremental MAP estimation," in *Proc. Intl. Conf. on Acoustics, Speech, and Signal Processing (ICASSP)*, Vancouver, Canada, May 2013, pp. 6481–6485.

106. H. Johannsson, M. Kaess, M. Fallon, and J. Leonard, "Temporally scalable visual SLAM using a reduced pose graph," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Karlsruhe, Germany, May 2013, pp. 54–61, **Best student paper finalist (one of five).**

107. D. Rosen, M. Kaess, and J. Leonard, "Robust incremental online inference over sparse factor graphs: Beyond the Gaussian case," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Karlsruhe, Germany, May 2013, pp. 1025–1032.

108. T. Whelan, H. Johannsson, M. Kaess, J. Leonard, and J. McDonald, "Robust real-time visual odometry for dense RGB-D mapping," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Karlsruhe, Germany, May 2013, pp. 5724–5731.

109. A. Walcott-Bryant, M. Kaess, H. Johannsson, and J. Leonard, "Dynamic pose graph SLAM: Long-term mapping in low dynamic environments," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Vilamoura, Portugal, Oct. 2012, pp. 1871–1878.

110. T. Whelan, J. McDonald, M. Kaess, M. Fallon, H. Johannsson, and J. Leonard, "Kintinuous: Spatially extended KinectFusion," in *RSS Workshop on RGB-D: Advanced Reasoning with Depth Cameras*, Sydney, Australia, Jul. 2012.

111. H. Johannsson, M. Kaess, M. Fallon, and J. Leonard, "Temporally scalable visual SLAM using a reduced pose graph," in *RSS Workshop on Long-term Operation of Autonomous Robotic Systems in Changing Environments*, Sydney, Australia, Jul. 2012.

112. V. Indelman, S. Williams, M. Kaess, and F. Dellaert, "Factor graph based incremental smoothing in inertial navigation systems," in *Proc. Intl. Conf. on Information Fusion (FUSION)*, Singapore, Jul. 2012, pp. 2154–2161.

113. M. Kaess, S. Williams, V. Indelman, R. Roberts, J. Leonard, and F. Dellaert, "Concurrent filtering and smoothing," in *Proc. Intl. Conf. on Information Fusion (FUSION)*, Singapore, Jul. 2012, pp. 1300–1307.

114. D. Rosen, M. Kaess, and J. Leonard, "An incremental trust-region method for robust online sparse least-squares estimation," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, St. Paul, MN, USA, May 2012, pp. 1262–1269.

115. J. McDonald, M. Kaess, C. Cadena, J. Neira, and J. Leonard, "6-DOF multi-session visual SLAM using anchor nodes," in *Proc. European Conf. on Mobile Robots (ECMR)*, Orebro, Sweden, Sep. 2011, pp. 69–76.

116. M. Kaess, H. Johannsson, R. Roberts, V. Ila, J. Leonard, and F. Dellaert, "iSAM2: Incremental smoothing and mapping with fluid relinearization and incremental variable reordering," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Shanghai, China, May 2011, pp. 3281–3288.

117. M. Fallon, M. Kaess, H. Johannsson, and J. Leonard, "Efficient AUV navigation fusing acoustic ranging and side-scan sonar," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Shanghai, China, May 2011, pp. 2398–2405, **Best automation paper finalist (one of five).**

118. M. Kaess, V. Ila, R. Roberts, and F. Dellaert, "The Bayes tree: An algorithmic foundation for probabilistic robot mapping," in *Proc. Intl. Workshop on the Algorithmic Foundations of Robotics (WAFR)*, Singapore, Dec. 2010, pp. 157–173.

119. H. Johannsson, M. Kaess, B. Englot, F. Hover, and J. Leonard, "Imaging sonar-aided navigation for autonomous underwater harbor surveillance," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, Taipei, Taiwan, Oct. 2010, pp. 4396–4403.

120. B. Kim, M. Kaess, L. Fletcher, J. Leonard, A. Bachrach, N. Roy, and S. Teller, "Multiple relative pose graphs for robust cooperative mapping," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Anchorage, Alaska, USA, May 2010, pp. 3185–3192.

121. M. Kaess, K. Ni, and F. Dellaert, "Flow separation for fast and robust stereo odometry," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Kobe, Japan, May 2009, pp. 3539–3544.

122. R. Mottaghi, M. Kaess, A. Ranganathan, R. Roberts, and F. Dellaert, "Place recognition-based fixed-lag smoothing for environments with unreliable GPS," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Pasadena, CA, USA, May 2008, pp. 1862–1867.

123. A. Ranganathan, M. Kaess, and F. Dellaert, "Fast 3D pose estimation with out-of-sequence measurements," in *Proc. IEEE/RSJ Intl. Conf. on Intelligent Robots and Systems (IROS)*, San Diego, CA, USA, Oct. 2007, pp. 2486–2493.

124. M. Kaess, A. Ranganathan, and F. Dellaert, "iSAM: Fast incremental smoothing and mapping with efficient data association," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Rome, Italy, Apr. 2007, pp. 1670–1677.

125. M. Kaess, A. Ranganathan, and F. Dellaert, "Fast incremental square root information smoothing," in *Proc. Intl. Joint Conf. on Artificial Intelligence (IJCAI)*, Hyderabad, India, Jan. 2007, pp. 2129–2134, **Oral presentation acceptance ratio 15.7% (212 of 1353)**.

126. A. Ranganathan, M. Kaess, and F. Dellaert, "Loopy SAM," in *Proc. Intl. Joint Conf. on Artificial Intelligence (IJCAI)*, Hyderabad, India, Jan. 2007, pp. 2191–2196, **Oral presentation acceptance ratio 15.7% (212 of 1353)**.

127. M. Kaess and F. Dellaert, "A Markov chain Monte Carlo approach to closing the loop in SLAM," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, Barcelona, Spain, Apr. 2005, pp. 645–650.

128. M. Kaess, R. Zboinski, and F. Dellaert, "MCMC-based multiview reconstruction of piecewise smooth subdivision curves with a variable number of control points," in *Proc. European Conf. on Computer Vision (ECCV)*, ser. Lecture Notes in Computer Science, vol. 3023. Prague, Czech Republic: Springer, May 2004, pp. 329–341, acceptance ratio 34.2% (190 of 555).

129. 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: IEEE Computer Society, Oct. 2003, pp. 39–47.

130. M. Kaess, R. Arkin, and J. Rossignac, "Compact encoding of robot-generated 3D maps for efficient wireless transmission," in *Proc. IEEE Intl. Conf. on Advanced Robotics (ICAR)*, Coimbra, Portugal, Jun. 2003, pp. 324–331.

131. M. Likhachev, M. Kaess, and R. Arkin, "Learning behavioral parameterization using spatio-temporal case-based reasoning," in *Proc. IEEE Intl. Conf. on Robotics and Automation (ICRA)*, vol. 2, Washington, DC, USA, May 2002, pp. 1282–1289.

Other Publications

132. E. Westman and M. Kaess, "Underwater AprilTag SLAM and calibration for high precision robot localization," Robotics Institute, Carnegie Mellon University, Tech. Rep. CMU-RI-TR-18-43, Oct. 2018.

133. J. Hsiung, A. Tallaksen, L. Papincak, S. Suresh, H. Jones, W. Whittaker, and M. Kaess, "Localized imaging and mapping for underwater fuel storage basins," in *Proc. of the Symposium on Waste Management*, Phoenix, Arizona, Mar. 2018.

134. H. Liu, C. Li, G. Chen, G. Zhang, M. Kaess, and H. Bao, "Robust keyframe-based dense SLAM with an RGB-D camera," arXiv, Tech. Rep. arXiv:1711.05166, Nov. 2017.

135. M. Klingensmith, M. Koval, S. Srinivasa, N. Pollard, and M. Kaess, "The manifold particle filter for state estimation on high-dimensional implicit manifolds," arXiv, Tech. Rep. arXiv:1604.07224, Apr. 2016.

136. S. Singh, H. Cover, A. Stambler, B. Grocholsky, J. Mishler, B. Hamner, K. Strabala, G. Sherwin, M. Kaess, G. Hemann, M. Bergerman, and S. Spiker, "Perception for safe autonomous helicopter flight and landing," in *72nd Annual Forum and Technology Display, American Helicopter Society (AHS)*, May 2016.

137. T. Whelan, M. Kaess, M. Fallon, H. Johannsson, J. Leonard, and J. McDonald, "Kintinuous: Spatially extended KinectFusion," Computer Science and Artificial Intelligence Laboratory, MIT, Tech. Rep. MIT-CSAIL-TR-2012-020, Jul. 2012.

138. M. Fallon, H. Johannsson, M. Kaess, D. Rosen, E. Muggler, and J. Leonard, "Mapping the MIT Stata Center: Large-scale integrated visual and RGB-D SLAM," in *RSS Workshop on RGB-D: Advanced Reasoning with Depth Cameras*, Jul. 2012.

139. M. Kaess, H. Johannsson, B. Englot, F. Hover, and J. Leonard, "Towards autonomous ship hull inspection using the Bluefin HAUV," in *Ninth Intl. Symposium on Technology and the Mine Problem*, Naval Postgraduate School, Monterey, CA, May 2010.

140. M. Kaess, V. Ila, R. Roberts, and F. Dellaert, "The Bayes tree: Enabling incremental reordering and fluid relinearization for online mapping," Computer Science and Artificial Intelligence Laboratory, MIT, Tech. Rep. MIT-CSAIL-TR-2010-021, Jan. 2010.

141. E. Olson and M. Kaess, "Evaluating the performance of robot mapping systems," in *Workshop on Good Experimental Methodology in Robotics*, 2009.

142. M. Kaess, "Incremental smoothing and mapping," Ph.D. dissertation, Georgia Institute of Technology, Dec. 2008.

143. M. Kaess and F. Dellaert, "Visual SLAM with a multi-camera rig," Georgia Institute of Technology, Tech. Rep. GIT-GVU-06-06, Feb. 2006.

144. 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: AAAI Press, 2002, pp. 44–49, **Award for best mapping.**

Invited Talks and Seminars

Factor Graphs and Robust Perception, Technion, 2021

Factor Graphs and Robust Perception, Tartan SLAM Series, 2021

Factor Graphs for Robot Perception, University of Zurich, Switzerland, 2020

Localization and Mapping with Imaging Sonar, Schlumberger Robotics Symposium, MIT, Cambridge, MA, 2019

Factor Graphs for Robot Perception, West Virginia University, Morgantown, WV, 2019

Localization and Mapping with Imaging Sonar, ICRA Workshop on Underwater Robotics Perception, Montreal, Canada, 2019

Factor Graphs for Robot Perception, Carnegie Mellon University, Pittsburgh, PA, 2018

Efficient Incremental Smoothing, ICRA SLAM Tutorial, Stockholm, Sweden, 2016

Localization and Mapping in Confined Areas with a Hovering AUV, ICRA Workshop on Marine Robot Localization, Stockholm, Sweden, 2016

Robust and Efficient Real-time Mapping for Autonomous Robots, University of Michigan, Ann Arbor, MI and Duke University, Durham, NC, 2015

Real-Time Dense 3D Mapping, Reality Computing Pittsburgh, Pittsburgh, PA, 2014

Robust and Efficient Real-time Mapping for Autonomous Robots, George Washington University, Washington, DC, 2013

Towards Persistent Mapping for Long-Term Autonomy, ICRA Workshop on Long-Term Autonomy, Karlsruhe, Germany, 2013

Incremental Inference and Applications, ICRA Workshop on Robust and Incremental Inference in Factor Graphs, Karlsruhe, Germany, 2013

Robust and Efficient Real-time Mapping for Autonomous Robots, Univ. of Texas, Austin, TX and Carnegie Mellon Univ., Pittsburgh, PA and Univ. of Southern California, CA, 2013

Incremental Smoothing and Mapping, Brown University, Providence, RI, 2012

Temporally Scalable Visual SLAM using the Reduced Pose Graph, University of Technology, Sydney, Australia, 2012

Incremental Smoothing and Mapping, Sarnoff/SRI International, Princeton, NJ, 2012

Towards Life-long Mapping and Navigation, ICRA Workshop on Long-term Autonomy, Shanghai, China, 2011

Incremental Smoothing and Mapping and Applications to Ship Hull Inspection, SMART Center, National University of Singapore, Singapore, 2010

iSAM and the Bayes Tree, IROS Workshop on Probabilistic Graphical Models in Robotics (GraphBot), Taipei, Taiwan, 2010

iSAM: Incremental Smoothing and Mapping, German Research Center for Artificial Intelligence (DFKI), Bremen, Germany, 2007

Student Advising

Ph.D. Students
Easton Potokar, 2022–
Akash Sharma, 2021–
Mohamad Qadri, 2021–
Dan McGann, 2020–
Sudharshan Suresh, 2019–
Akshay Hinduya, 2018–
Wei Dong, 2018–
Allie Chang (co-advisor Simon Lucey), 2018–
Montiel Abello, 2017–
Paloma Sodhi, 2017–2022, now ASAPP
Ming Hsiao, 2014–2020, now Facebook Reality Labs
Eric Westman, 2014–2019, now ArgoAI
Matthew Klingensmith (co-advisor Siddhartha Srinivasa), 2015–2016, now Boston Dynamics

M.S. Students
Jui-Te Huang, 2022–
Taylor Pool, 2022–
Lihong Jin, 2021–
Talha Faiz (co-advisor Christoph Mertz), 2021–
Samiran Gode, 2021–
Tianxiang Lin, 2021–
Yehonathan Litman, 2020–2022, now CMU RI Ph.D. student
Andrew VanOsten, 2020–2022, now US Air Force
Ruoyang Xu, 2020–2022, now ArgoAI
Alexander Baikovitz, 2020–2021, now Mach9 Robotics
Akash Sharma, 2019–2021, now CMU RI Ph.D. student
Allison Wong, 2019–2021, now Martin Defense Group
Chenfeng Tu, 2018–2020, now Apple
Eric Dexheimer, 2018–2020, now CMU software engineer
Joshua Jaekel, 2018–2020, now ArgoAI
Yi Yang, 2017–2019, now Phiar
Zimo Li, 2017–2019, now AutoNavi
Sudharshan Suresh, 2017–2019, now CMU RI Ph.D. student
Bing-Jui Ho, 2016–2018, now Aptiv
Jerry Hsiung, 2016–2018, now Dusty Robotics
Puneet Puri, 2015–2017, now Stanford Business School
Garrett Hemann (co-advisor Sanjiv Singh), 2014–2016, now AirWorks
Tiffany Huang, 2014–2016, now Nuro

Ph.D. Thesis Committee
Brian Jackson, 2022
Weikun Zhen, 2021
John Yao, 2020

Eugene Fang, 2020
Kumar Shaurya Shankar, 2020
Shichao Yang, 2018
Abhijeet Tallavajhula, 2018
Arun Srivatsan, 2018
Ji Zhang, 2017
Hatem Alismail, 2016
Heather Jones, 2016

Ph.D. Quals Committee
Suhail Saleem, 2022
Srinivasan Vijayarangan, 2020
Shohin Mukherjee, 2019
Cormac O'Meadhra, 2018
Eugene Fang, 2017
Minh Vo, 2017
Nick Rhinehart, 2016
Kristen Holtz, 2015
Humphrey Hu, 2015

M.S. Thesis Committee
Manash Pratim Das, 2022
Vivek Roy, 2022
Mohamad Qadri, 2021
Daqian Cheng, 2021
Hengrui (Henry) Zhang, 2021
Dennis Melamed, 2021
Hans Kumar, 2021
Haidar Jamal, 2021
Scott Sun, 2020
Harsh Agarwal, 2020
Vaibhav Viswanathan, 2020
Aditya Dhawale, 2020
Naman Gupta, 2019
Cong Li, 2019
Kevin Pluckter, 2019
Weizhao Shao, 2019
Hunter Goforth, 2019
Jack Buffington, 2018
Michael Sukyung Lee, 2018
Ratnesh Madaan, 2018
Allie Chang, 2018
Hadi Salman, 2018
Wei-Hsin Chou, 2017
Sarah Tan, 2017
Debidatta Dwibedi, 2017

Shehzaman Khatib, 2016
Samuel Yim, 2016
Shiyuan Chen, 2016
Ben Holden, 2016
Adam Werries, 2016
Daniel Lu, 2016
Wennie Tabib, 2014

External
Krishna Murthy Jatavallabhula, University of Montreal (external examiner), 2022
Kevin Doherty, MIT (external evaluator), proposal 2021
Mina Heinen, Australian National University (external examiner), 2020
Antonio Teran Espinoza, MIT (external reader), 2020
Zichao Zhang, University of Zurich (external examiner), 2020
Chen Zhu, Technical University of Munich (external examiner), 2019
Pedro Nuno Vaz Teixeira, MIT (mentor, external Ph.D. committee member), 2013–2019
Renaud Dubee, ETH Zurich (external examiner), 2018
Dehann Fourie, MIT (mentor, external Ph.D. committee member), 2012–2017
Jie Li, University of Michigan (external Ph.D. committee member), 2017
Stephen M. Chaves, University of Michigan (external Ph.D. committee member), 2016
Raul Mur Artal, University of Zaragoza (external reader), 2016
John Vial, University of Sydney (external reader), 2013

Service

University Service and Committee Work
Robotics Institute Ph.D. Admissions Committee 2018, 2021, Chair 2020
Faculty Senate 2016–2018
Robotics Institute Program Committee 2015–today
Robotics Institute Undergraduate Major Committee 2015, 2017
Field Robotics Center Seminar Committee 2014–today
School of Computer Science Fellowship Committee 2014

Associate Editor
RA-L (IEEE Robotics and Automation Letters) 2020–today
TRO (IEEE Transactions on Robotics) 2015–2019
ICRA (International Conference on Robotics and Automation) 2013–2015, 2017–2020
IROS (International Conference on Intelligent Robots and Systems) 2010, 2012–2015, 2020–2022

NSF Panel
Proposal Review Panel 2016, 2020, 2021

Workshop Organizer
Workshop on Visual-Inertial Navigation Systems, ICRA 2021
Workshop on Visual-Inertial Navigation: Challenges and Applications, IROS 2019

International Workshop on Lines, Planes and Manhattan Models for 3-D Mapping, IROS 2017, ICRA 2019

Automated SLAM Evaluation Workshop, RSS (Robotics: Science and Systems) 2011

Tutorial Organizer
Visual Simultaneous Localization and Mapping Tutorial at CVPR (Computer Vision and Pattern Recognition) 2014

Senior Program Committee Member
IJCAI (International Joint Conference on Artificial Intelligence) 2017

Program Committee Member
RSS (Robotics: Science and Systems) 2011–2016
AAAI Robotics Track 2012
RSS Workshop: Long-term Operation of Autonomous Robotic Systems 2012
DARS (International Symposium on Distributed Autonomous Robotic Systems) 2010
RSS Workshop: Inside Data Association 2008

Journal Reviewer
T-ASE (IEEE Transactions on Automation Science and Engineering) 2022
TRO (IEEE Transactions on Robotics) 2004, 2007–2009, 2011–2019
RAL (IEEE Robotics Automation Letters) 2017, 2018
JOE (IEEE Journal of Oceanic Engineering) 2017, 2018
JFR (Journal of Field Robotics) 2006, 2009, 2010, 2017
RAS (Journal of Robotics and Autonomous Systems) 2009, 2012, 2016
IJRR (International Journal of Robotics Research) 2010, 2012–2014
IJCV (International Journal of Computer Vision) 2015
MVAP (Machine Vision and Applications) 2015
PAMI (IEEE Transactions on Pattern Analysis and Machine Intelligence) 2008, 2014
TAES (IEEE Transactions on Aerospace and Electronic Systems) 2014
AURO (Autonomous Robots) 2009, 2011, 2013
FTR (Foundations and Trends in Robotics) 2011
IVC (Image and Vision Computing) 2010
IEEE Pervasive Computing 2010

Conference Reviewer
IROS (International Conference on Intelligent Robots and Systems) 2007, 2009–2017, 2019
ICRA (International Conference on Robotics and Automation) 2005, 2007–2016, 2022
IJCAI (International Joint Conference on Artificial Intelligence) 2003, 2017
RSS (Robotics Science and Systems) 2005, 2006, 2010–2016
SIGGRAPH Asia 2016
AAAI (AAAI Conference on Artificial Intelligence) 2012
ICCV (International Conference on Computer Vision) 2005, 2007
ECCV (European Conference on Computer Vision) 2004, 2006
CVPR (Computer Vision and Pattern Recognition) 2004–2008

Professional Memberships

IEEE Senior Member (Computer Society, Robotics and Automation Society)
AAAI
ACM