Robust and Efficient Real-time Mapping for Autonomous Robots

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ABSTRACT: We are starting to see the emergence of autonomous robots that operate outside of controlled factory environments in various applications ranging from driverless cars, space and underwater exploration to service robots for businesses and homes. One of the very first challenges encountered on the way to autonomy is perception: obtaining information about the environment that allows the robot to efficiently navigate through, interact with and manipulate it. Moreover, in many such applications, models of the environment are either unavailable or outdated, thus necessitating real-time robotic mapping using onboard sensors.

In this talk I will present my recent research on robust and efficient optimization techniques for real-time robotic mapping. I will focus on our recently developed incremental nonlinear least-squares solver, termed incremental smoothing and mapping (iSAM2). Based on our new probabilistic model called the Bayes tree, iSAM2 efficiently updates an existing solution to a nonlinear least-squares problem after new measurements are added. I will describe some of the key aspects of my work and also address robustness in optimization. Lastly, I will present applications enabled by iSAM2 including long-term visual mapping and Kintinuous -- our recent work on dense mapping with RGB-D cameras.

BIO: Michael Kaess is an Assistant Research Professor in the Robotics Institute at Carnegie Mellon University (CMU). Prior to joining CMU in 2013, he was a Research Scientist (2010-2013) and a Postdoctoral Associate (2008-2010) in the Computer Science and Artificial Intelligence Laboratory (CSAIL) at the Massachusetts Institute of Technology (MIT). He received the Ph.D. (2008) and M.S. (2002) degrees in computer science from the Georgia Institute of Technology. His current research focuses on probabilistic methods for robot perception, in particular navigation, mapping, localization and efficient inference algorithms. He was one of the two runner-ups for the 2012 Volz dissertation award for the best U.S. Ph.D. thesis in robotics and automation, and has recently received a Google Faculty Research Award. He is Associate Editor for IEEE Transactions on Robotics (TRO).