Factor Graphs and Automatic Differentiation for Flexible Inference in Robotics and Vision

ABSTRACT: Simultaneous Localization and Mapping (SLAM) and Structure from Motion (SFM) are important and closely related problems in robotics and vision. I will review how SLAM, SFM and other problems in robotics and vision can be posed in terms of factor graphs, which provide a graphical language in which to develop and collaborate on such problems. I will also provide an introduction to reverse automatic differentiation - of which back-propagation is in fact an instance - and how it is built into GTSAM, the open source software toolbox we developed at Georgia Tech. The theme of the talk will be to emphasize the advantages and intuition that come with that. I will show how using these insights we have developed both batch and incremental algorithms defined on graphs in the SLAM/SFM domain, as well as more sophisticated approaches to trajectory optimization, e.g. using polynomial basis expansions inspired by pseudo-spectral optimal control.

BIO: Frank Dellaert is currently at Facebook, on leave from the Georgia Institute of Technology. At Facebook he is a Technical Project Lead at Building 8, Facebook's consumer hardware division. Before that he did a stint as Chief Scientist of Skydio, a startup founded by MIT grads to create intuitive interfaces for micro-aerial vehicles. When not on leave, he is a Professor in the School of Interactive Computing at Georgia Tech, where he previously led the Robotics PhD program. His research interests lie in the overlap of Robotics and Computer vision, and he is particularly interested in graphical model techniques to solve large-scale problems in mapping and 3D reconstruction. The GTSAM toolbox which embodies many of the ideas his group has worked on in the past few years is available for download at http://tinyurl.com/gtsam.

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