Localization and Mapping Software for Diverse/Remote Robotic Operations.

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Introduction: NavAbility is a young robotics software company, who partners with robotic integrators and equipment manufacturers who require localization/mapping/navigation software. NavAbility is developing next generation algorithms and techniques that fundamentally support distributed system design and robustness. NavAbility is working to make it easier, faster, and more cost effective to bring advanced navigation AI software to new or existing platforms. NavAbility products include open libraries, the NavAbility Platform, and domain expertise. NavAbility started from the community at MIT [1,2].

Conventional to Next-Gen Navigation: The software for navigation systems today are highly fragmented, yet share many fundamental ideas and constructs. NavAbility was established to better harmonize the common scientific aspects across most localization and mapping systems by embracing a hybrid open-source and proprietary philosophy. We at NavAbility, along with the community, continue to develop and advance a common algorithmic implementation that can perform algebraically equivalent operations to conventional attitude heading reference systems (i.e. Kalman Filter), inertial (preintegration) navigation systems [3], INS/GPS, visual odometry systems, terrain relative navigation, range-only systems, simultaneous localization and mapping (SLAM), structure from motion and bundle adjustment systems, as well as envisioned future methods that rely heavily machine learning and neural network techniques. NavAbility uses a factor graph modeling language as the scientific underpinning that allows algorithmic consolidation of many existing methods. NavAbility freely shares its core solver source code [4] for better transparency, community involvement, and ultimately higher quality solutions.

Distributed / Remote Architectures: Navigation systems form an integral part of robotic automation systems and can therefore significantly benefit from a architectural design that fundamentally enables distributed operations over varying quality network connections [4]. By again leveraging the factor graph abstraction, NavAbility is able to develop systems that exhibit strong harmony and symmetry in design, communication, compute, and memory over divergent nodes in a network. Our approach significantly simplifies how various agents interact with the NavAbility Platform.

Robustness: Distributed for us also implies a wide aperture in terms of multi-sensor data. The origin of measurement data, including human input cues, or (possibly contradictory) prior data should all be available for joint inference towards a stable, reliable, robust localization and mapping solution. Furthermore, the timeliness of computation and results too are major factors for design, and can vary from application to application. NavAbility uses state of the art algorithms for performing non-Gaussian (multi-modal) inference on factor graphs, with a variety of advanced features for recycling older computation or future trajectory planning and multi-robot data sharing.

Non-Gaussian Factor Graphs are a probabilistic modeling language which is well suited to describing measurement events in both human and machine readable form. NavAbility is working to develop the premier open standard for factor graph based data fusion software of the future. Especially for cases with ambiguous and uncertain data. Our approach supports both batch and real-time processing use-cases.

References:

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[3] Fourie D., Leonard J. (1996): “Inertial Odometry with retroactive sensor calibration”. US Patent 10,317,214.

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