Random Finite Sets for Robot Mapping & SLAM: New Concepts in Autonomous Robotic Map Representations (Springer Tracts in Advanced Robotics)

By John Stephen Mullane, Ba-Ngu Vo, Martin David Adams, Ba-Tuong Vo

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The monograph written by John Mullane, Ba-Ngu Vo, Martin Adams and Ba-Tuong Vo is devoted to the field of autonomous robot systems, which have been receiving a great deal of attention by the research community in the latest few years. The contents are focused on the problem of representing the environment and its uncertainty in terms of feature based maps. Random Finite Sets are adopted as the fundamental tool to represent a map, and a general framework is proposed for feature management, data association and state estimation. The approaches are tested in a number of experiments on both ground based and marine based facilities.

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- Sales Rank: #5670874 in Books
- Brand: Springer
- Published on: 2011-05-23
- Original language: English
- Number of items: 1
- Dimensions: 9.21" h x .44" w x 6.14" l, .85 pounds
- Binding: Hardcover
- 148 pages

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Editorial Review

From the Back Cover

Simultaneous Localisation and Map (SLAM) building algorithms, which rely on random vectors to represent sensor measurements and feature maps are known to be extremely fragile in the presence of feature detection and data association uncertainty. Therefore new concepts for autonomous map representations are given in this book, based on random finite sets (RFSs). It will be shown that the RFS representation eliminates the necessity of fragile data association and map management routines. It fundamentally differs from vector based approaches since it estimates not only the spatial states of features but also the number of map features which have passed through the field(s) of view of a robot's sensor(s), an attribute which is necessary for SLAM.

The book also demonstrates that in SLAM, a valid measure of map estimation error is critical. It will be shown that under an RFS-SLAM representation, a consistent metric, which gauges both feature number as well as spatial errors, can be defined.

The concepts of RFS map representations are accompanied with autonomous SLAM experiments in urban and marine environments. Comparisons of RFS-SLAM with state of the art vector based methods are given, along with pseudo-code implementations of all the RFS techniques presented.

John Mullane received the B.E.E. degree from University College Cork, Ireland, and Ph.D degree from Nanyang Technological University (NTU), Singapore.

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Martin Adams is Professor in autonomous robotics research, University of Chile. He holds bachelors, masters and doctoral degrees from Oxford University.

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