BERMAN
CONSULTING & TRAINING
NAVIGATION | SYSTEM ENGINEERING

Navigation Course, 10-13 November 2014
Daniel Hotel, Herzliya, Israel

Advanced navigation system design

Objectives

To provide tools for the effective design of reliable navigation systems. The focus is on the relationship between establishing a reliable error model, designing calibration procedures, predicting performance, designing an effective reduced-order Kalman filter, and designing and analyzing tests.

Emphasis

To describe an integrated methodology to support all development tasks. The standard methods are enhanced by original tools (mathematical definitions and software) to carry out the presented methodology [references 1-4]. The presented methodology and tools have been applied successfully in several industrial development projects, including the challenging integration of low-cost sensors.

Course material

Printed course slides, a USB drive with course slides, m-files for examples presented in the course. Bringing a laptop with installed Matlab is highly recommended.

Who should attend

Navigation system designers. Familiarity with navigation error models, reference frame notations and Kalman filter nomenclature is recommended.

References:

[1] Z. Berman, "The design process for navigation Kalman filters: striving for performance and quality," PLANS 2014.

[2] Z. Berman, "Outliers rejection in Kalman filtering–some new observations," PLANS 2014.

[3] Z. Berman, "Inertial sensors–further developments in low-cost calibration and testing," PLANS 2012.

[4] Z. Berman, "Efficient error model construction," Itzhack Y. Bar-Itzhack Memorial Symposium on Estimation, Navigation and Spacecraft Control, Haifa, 14-17 October 2012. To appear in Advances in Navigation, Estimation, and Spacecraft Control, Selected Papers from the I.Y. Bar-Itzhack Memorial Symposium, D. Choukroun, Y. Oshman, J. Thienel, and M. Idan, Eds. Springer Verlag, in press.

Price

6000 NIS
If paid till September 10th, 2014
7000 NIS
If paid after September 10th, 2014

Contact

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Instructor:

Dr. Zeev Berman

Dr. Berman has broad industrial experience in navigation-system development. He has led several sensor-integration projects, based on Kalman filtering, from concept design to customer support.

Dr. Berman received his PhD degree from the University of Maryland (1992). He graduated from the Technion, Haifa, in both Electrical Engineering and Mathematics. From 1982 to 2009, **Dr. Berman** worked at Rafael Advanced Defense Systems Ltd. in Haifa, Israel, in a variety of managerial and research-related positions.

In 2009, **Dr. Berman** founded **Berman Consulting and Training Ltd.** This company provides expert consulting services: advanced algorithm development, performance evaluation, sensor-calibration design and implementation, and navigation courses. All leading Israeli defense corporations, as well as many commercial startups are among his satisfied customers. Dr. Berman has published many papers in professional journals and conference proceedings.

Detailed program

Day 1	Day 2	Day 3	Day 4
Morning			
Introduction: Navigation system, Navigation error model, Kalman filters	Reduced order Kalman filter design Optimal tuning in the context of MVRO (minimum variance reduced-order) estimator	Error-model extraction The analyzing function, the concept of DP (direct predictor) as Allan Variance extension	Measurement rejections as nonlinear dynamic effect, the need for a recovery scheme and its implementation
A general structure for sensor error model Sensor integration in Kalman filter notation	Different tuning methods: Optimal, suboptimal, no additional tuning Trade-off between complexity and tuning method	The concept of DB (direct bound), matching versus bounding, hard and soft bounds	Nonlinear estimation: review of existing algorithms, introduction of MM IEKF (multi-measurement iterated extended Kalman filter) An example
System modeling and parameterization: trajectory, scenario, error model An example of system description	Simulation architecture to support effective reduced-order Kalman filter design	Optimization scheme An example	
Afternoon			
Truth covariance analysis	Low-cost vehicle INS/GPS (case-study) design, analysis, and discussion)	Thermal calibration: Stabilized versus changing temperatures Design and performance analysis for thermal calibration during changing temperatures An example and discussion	Design process, test design and analysis
Error budget and sensitivity study			The error model update based on tests results
An example			Summary: Discussion, literature and other references review

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