

Navigation course, 4-6 November 2014  
Daniel Hotel, Herzliya, Israel

## Navigation Systems: Principles, Components and Integrations



### Objectives

To provide a basic understanding of navigation systems to help integrate, test and manage the implementation of such systems. The focus is on principles of operation, life cycle (calibration, initialization, and sensor integration), specifications, performance analysis, design process and testing.

### Emphasis

To describe systems using basic engineering principles without getting into mathematical descriptions. Mathematical details are left for the 4-day course "Advanced navigation system design".

### Scope

The course covers mainly inertial navigation systems (algorithms and sensors), GNSS (Global Navigation Satellite System) and their integrations. Additional navigation systems are briefly touched upon: dead reckoning, attitude reference unit, magnetic compass, and air data. Methods of designing and analyzing algorithms are presented in the scope of the Kalman filter, error models, Monte Carlo simulations and covariance analysis. The course presents engineering aspects of the development process: specifications (sensor and system level), test design and analysis.

### Course material

Printed course slides, and a USB drive with course slides.

### Who should attend

Users of navigation systems: project managers, systems engineers, software and hardware engineers, engineers involved with test design and analysis, novice and intermediate navigation development engineers.

### Price

4000 NIS

If paid till September 10<sup>th</sup>, 2014

5000 NIS

If paid after September 10<sup>th</sup>, 2014

### Contact

email:

[berman.consult@gmail.com](mailto:berman.consult@gmail.com)

website:

<http://www.bermanconsult.com>

Tel:

+(972)528017517

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
<b>Morning</b>		
Introduction: Navigation systems review—sea, air, ground, weapons	GNSS - principle of operation	Kalman filter: Application for navigation systems, sensor integration
System examples: DR (Dead Reckoning), ARU (attitude reference unit), magnetometer, air-data system, TERCOM (Terrain Contour Matching)	GNSS - Error Model Receiver types, code/phase tracking, aiding	Filter design example Factors that influence system performance System specifications
Principles of radio navigation	GNSS - additional topics: vulnerability, attitude calculation, modernization	Dual-model approach for Kalman filter performance analysis Monte Carlo simulation and covariance analysis
<b>Afternoon</b>		
Principles of inertial navigation Inertial navigation equations	Inertial sensors: Principles of operation Sensor types - mechanical, optical, MEMS (Micro-Electro-Mechanical Systems)	The design process: error models, simulations, performance evaluation
Inertial navigation error model	Sensor error models and specifications Sensor calibration and testing	Tests: their dependency tree. Test design and analysis
Applications of navigation error model: Sensor types, behavior of position and velocity errors, operational cycle (calibration, initialization)	Introduction to estimation: Mean and covariance, random vectors (random constant, white process, first-order Gaussian-Markov process), linear stochastic system	Summary: Discussion, literature and other references review

**BERMAN**  
CONSULTING & TRAINING

NAVIGATION | SYSTEM ENGINEERING

TEL: +972 (0)52-801-7517 / +972 (0)4-675-1040

EMAIL: BERMAN.CONSULT@GMAIL.COM

MOSHAVAT KINNERET, 15105, ISRAEL