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**FUSION 2008**  
**Tutorial Workshop (1 Day)**  
**Multitarget Tracking and Multisensor Fusion**

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**Objectives:** To provide to the participants the latest state-of-the art techniques to estimate the states and classifications of multiple targets with multisensor information fusion. Tools for algorithm selection, design and evaluation will be presented. These form the basis of automated decision systems for *advanced surveillance* and *targeting*. The various information processing configurations for fusion are described. A number of practical problems in multisensor tracking/fusion are also discussed.

**Eligibility:** Engineers/scientists with prior knowledge of basic probability and state estimation. This is an intensive course in order to cover several important recent advances.

## OUTLINE

### **Morning**

#### **Introduction**

(OV) Overview of the course.

#### **Review of the Basic Techniques for Tracking**

[mttvf07: 1.5.1–1.5.3] The Kalman, the Alpha-Beta(-Gamma) and the Extended Kalman filters: their capabilities and limitations.

#### **Tracking Targets with Multiple Behavior Modes**

[mttvf07: 1.5.4] The Interacting Multiple Model (IMM) estimation algorithm — a real-time implementable, self-adjusting variable-bandwidth, tracking filter.

#### **Multiple Hypothesis Tracker (MHT) and Multidimensional Assignment (MDA)**

[290v] The score function in the MHT and its use with MDA.

#### **Air Traffic Control Tracking**

[200C] IMM vs. KF on real data (800 targets, from 5 FAA/JSS radars). How to evaluate estimation improvement without knowing the ground truth. Why multisensor tracking is cheaper computationally than single sensor tracking.

#### **Multisensor Data Fusion**

[mttvf07: 8.2] Information Processing Configurations in Multisensor Tracking.

Type I: Single sensor or reporting responsibility.

Type II: Single sensor tracking followed by track-to-track fusion.

Type III: Measurement-to-measurement association followed by central dynamic association and tracking.

Type IV: Centralized association and tracking.

A Hybrid Configuration: hierarchical sensor/platform/center setup.

## Afternoon

### Multisensor Data Fusion (Cont'd)

[mttvf07: 8.3,8.4] Common origin testing and fusion of local tracks.

[286v] Multisensor track-to-track association for tracks with dependent errors.

### Use of Classification Information in Tracking

[267v] Tracking and data association with kinematic and classification information.

### Tracking and Radar Management

[mttvf07: 1.8] Agile beam radar allocation: adaptive revisit time for minimum radar energy with the IMM.

[mttvf07: 3.4.11] Tracking in Clutter: the Probabilistic Data Association filter (PDAF).

[186A] Benchmark Problem for high-g targets in the presence of ECM (RGPO and jamming). Detection threshold, waveform, and revisit time selection, target RCS and jammer power estimation and tracking with the IMM-PDAF. Comparison with the MHT (Multiple Hypothesis Tracker). The real-time experiment with an Aegis SPY-1 and F-14s at Wallops.

The course is based on the book **Multitarget-Multisensor Tracking: Principles & Techniques** by Y. Bar-Shalom and X.R. Li (YBS Publishing, 1995) and additional notes.

Background text:

Y. Bar-Shalom, X. R. Li and T. Kirubarajan, **Estimation with Applications to Tracking and Navigation: Algorithms and Software for Information Extraction**, Wiley, 2001.