Multimodal Sensor Fusion and Navigation

1. SYLLABUS INFORMATION

1.1. Course title
Multimodal Sensor Fusion and Navigation

1.2. University
Pázmány Péter Catholic University

1.3. Semester
1st year, 1st semester

2. COURSE DETAILS

2.1. Course nature
Pooled elective

2.2. ECTS Credit allotment
5

2.3. Faculty data
Dr. Horváth András

3. COMPETENCES AND LEARNING OUTCOMES

3.1. Course objectives
The main goal of the course is to give an overview about real time algorithms and architectures used in multi-sensor data fusion and navigation.

The focus is the course is multi-parallel processing and target tracking.

The course introduces estimation theory, the necessary definitions in static, dynamics linear and non-linear cases and also in discrete and continuous systems. Reveals and explains such generally used algorithms like the Kalman- and the Bootstrap-filter. Also the limitations and applications of these algorithms in practical problems.

The course gives comprehensive knowledge about system level computations in both top-down and bottom up design of adaptive algorithmic solutions. Examines the topographic and non-topographic partitioning of data-flows regarding the modern multi-parallel architectures.

3.2. Course contents
1. Data-fusion in the human nervous system
2. Definition and basics of estimation theory, MLE, MSE estimators
3. Estimation in static systems, Estimation of: Gaussian random vectors, least squares estimation, polynomial fitting etc.

4. Filtering, Prediction, Smoothing, State estimation in discrete state spaces (Viterbi, Forward-Backward, Baum)
5. State estimation methods in linear dynamic systems/ Kalman Filter, kinematic models
6. State estimation methods in non-linear dynamic (but linearizable) systems / Extended Kalman filter, Unscented Kalman Filter
7. State estimation methods in non-linear dynamic systems I.: Particle Filter
8. State estimation methods in non-linear dynamic systems II: Sampling, Resampling, Bootstrap Filter
9. Data association and data matching / SNF, NNF, PDA, JPDA, JVC, MHT methods and algorithms
10. Image fusion:Topographic and non-topographic (rigid Non-rigid, registration)
11. Adaptive tracking of maneuvering targets / IMM model and applications, IMM-JVC and IMM-JPDA models

3.3. Course bibliography

Compulsory and/or recommended literature:

Yaakov Bar-Shalom: Estimation with Applications to Tracking and

NavigationJitendra R. Raol: Multi-Sensor Dat Fusion with MATLAB

Ramon van Händel: Hidden Markov Models

4. EVALUATION

Exam