

Course Title: State Estimation

Target Group: Graduate students, Engineers and Researchers

Modules: 4

Course Outline:

- **Module I: Training in SCILAB**

- Introduction to SCILAB
- Understanding SCILAB's built-in functions
- Introduction to Matrices
- Scripts and functions; Conditional statements and loops
- Solving linear equations and numerical integration
- Solving single and a system of non-linear equations
- Solving single and a system of differential equations
- Linear and non-linear regression
- Linear programming
- Non-Linear programming

- **Module II: Introduction to State Estimation**

- Introduction to relevant statistical theory
- Introduction to state and parameter estimation
 - * Steady-state perspective
 - * State-space model formulation
- Development of Kalman Filter
 - * Predictor-Corrector form
 - * Analysis of Kalman Filter from various view-points
 - * Kalman Filter algorithms
- Programming/Hands-on session implementing techniques in SCILAB

- **Module III: Extended and Unscented Kalman Filters**

- Extensions to handle: Non-Linearity and Non-Gaussianity
- Extended Kalman Filter
 - * Predictor-Corrector form
 - * Algorithm details
- Unscented Kalman Filter
 - * Concept of unscented sampling
 - * Predictor-Corrector form
 - * Algorithm details
- Brief introduction to Particle Filters

- Enhancements to handle :
 - * Delayed or infrequent measurements
 - * Differential Algebraic Equation systems
- Programming/Hands-on session implementing techniques in SCILAB

- **Module IV: Optimization based approaches to State Estimation**

- Extensions to handle:
 - * Non-Linearity
 - * Constraints
- Moving Horizon Estimator
 - * Problem formulation
 - * Connections to Kalman Filter
 - * Algorithm details
- Receding Horizon Kalman Filter
 - * Problem formulation
 - * Connections to Kalman Filter
 - * Algorithm details
- Programming/Hands-on session implementing techniques in SCILAB