Introduction to Estimation and Kalman Filtering

Agenda
(1-day Course)

Day 1: Kalman Filter Algorithms and Implementation

09.00 **L1_1 Introduction to Modeling, Stochastic Processes and Signals** (Probability, Disturbances and Noise and State-Equations)

09.45 **H1_1 Hands-on Session:** Implementation of Disturbance & Noise in State-Space Model

10.30 *TEA/COFFEE*

10.45 **L1_2 State-Space Modelling of Linear Systems** (Linear system modelling using state space equations and stability, controllability and observability)

11.30 **L1_3 Introduction to the Kalman Filter** (Continuous and Discrete-Time)

12.30 *LUNCH*

13.30 **L1_4 Discrete Time Kalman Filter** (Derivation, Properties, Riccati Equation and Tuning)

14.30 **H1_2 Hands-on Session:** Application of Observers and Building the Kalman Filter

15.15 *TEA/COFFEE*

15.30 **L1_5 Nonlinear Filtering & Parameter Estimation Using Extended Kalman Filters** (For Condition Monitoring, Model Based Fault Detection Methods)

16.30 **H1_3 Hands-on Session:** Kalman Filtering for Parameter Estimation

17.00 *CLOSE*

ISC Limited
36 Renfield Street
Glasgow G2 1LU
Scotland UK

t +44 (0) 141 847 0515
f +44 (0) 141 221 1706
e iscmail@isc-ltd.com
w www.isc-ltd.com

Nonlinear Control Systems

Agenda
(1-day Course)

Day 2: Introduction to Nonlinear System Modelling and Control

09.00 **L2_1 Introduction to Nonlinear Systems and Modelling Methods**

09.45 **L2_2 Introduction to Nonlinear Control Design Techniques** (Overview of Nonlinear Control Design Methods)

10.30 *TEA/COFFEE*

10.45 **L2_3 Introduction to Time-Varying, State-Dependent, LPV, Approximate Nonlinear and Hybrid Systems Modelling**

11.30 **H2_1 Hands-On Session:** Nonlinear System Modelling (e.g. Engine Control)

12.30 *LUNCH*

13.30 **L2_4 Introduction to Simple Nonlinear Control Design Methods and Nonlinear Generalized Minimum Variance (NGMV) Control**
(System Models, Cost Definition, Design, Implementation)

14.30 **L2_5 Advanced Nonlinear Controls Including Sliding Mode and the NGMV Family of Control Design Methods**
(Factorization based, Nonlinear Quadratic Generalized Minimum Variance, H∞ control approaches)

15.15 *TEA/COFFEE*

15.30 **L2_6 Gain Scheduling and Restricted Structure Controllers Using Multiple Models**

16.30 Demonstration of Solving Design Problems Using NGMV toolbox

17.00 *CLOSE*

ISC Limited
36 Renfield Street
Glasgow G2 1LU
Scotland UK

t +44 (0) 141 847 0515
f +44 (0) 141 221 1706
e iscmail@isc-ltd.com
w www.isc-ltd.com

Linear and Nonlinear Predictive Control Systems

MPC Design and Applications – Agenda (2-days Course)

Day 3: Optimal and MPC for Linear and Nonlinear Systems

09.00 L3_1 Introduction to Predictive Control Main Principles and Concepts
(Motivation, Prediction, Cost-functions, Receding horizon, state-space solution)

10.00 TEA/COFFEE

10.15 L3_2 Linear Optimal Model Predictive Control
(Polynomial and State-Space approaches, MPC basic principles and features)

11.15 H3_1 Hands-On Session: Linear Predictive Control – MPC example

12.00 LUNCH

13.00 L3_3 Practical Aspects of Linear MPC Design and Implementation
(Integral action, Disturbances & Robustness, Tuning and Constraint handling)

14.00 H3_2 Hands-On Session: Designing Model Predictive Controls and Tuning

14.45 TEA/COFFEE

15.00 L3_4 Model Estimation Using Neural Networks (Applications in linear and non-linear predictive control)

16.00 H3_3 Hands-On Session: Nonlinear System Modeling
(Control and modelling problems for nonlinear systems)

17.00 CLOSE

ISC Limited
36 Renfield Street
Glasgow G2 1LU
Scotland UK

t +44 (0) 141 847 0515
f +44 (0) 141 221 1706
e iscmail@isc-ltd.com
w www.isc-ltd.com

Day 4: Nonlinear Predictive Control Systems Design and Implementation

09.00 L4_1 Introduction to the Predictive Control of Nonlinear Systems
(Simple nonlinear controls, Nonlinear optimal controls, Control design features and Philosophy/justification).

10.00 TEA/COFFEE

10.15 L4_2 Design Guidelines for Predictive Control of Nonlinear Systems
(Dynamic cost-function weightings, use of LPV models to solve MPC problems).

11.15 Hands-On Session: Advanced Nonlinear Control Design

12.15 LUNCH

13.15 L4_3 Optimal Predictive and Robust Control and Examples
(Robustness to uncertainties & disturbances and use of LMI's).

14.15 TEA/COFFEE

14.30 L4_4 Application Example: Supervisory Multiple-Model Approach to Lambda and Torque Control (Multiple models for automotive engine control)

15.15 L4_5 Emerging Trends in Nonlinear Predictive Control
(Summary of the trends in nonlinear MPC, Implicit and explicit schemes, Promising algorithms, Reference governors, Monte Carlo validation methods, Adaptive Predictive Control).

16.30 CLOSE

ISC Limited
36 Renfield Street
Glasgow G2 1LU
Scotland UK

t +44 (0) 141 847 0515
f +44 (0) 141 221 1706
e iscmail@isc-ltd.com
w www.isc-ltd.com