Navigation System Design (KC-4) Course Content

Day 1: Introductory Topics

1. Introduction to Navigation Systems

2. Introduction to vehicle modelling

2.1 The importance of the vehicle model

2.2 Kinematics

2.3 Dynamics

2.4 Lumped parameters

3. Introduction to Beacon Based Navigation

3.1 Sensor used for beacon based navigation

3.2 Bearing only navigation systems

3.3 Range / Bearing / Intensity navigation systems

3.4 Sensor Characterisation

3.5 Landmark and environment design

3.6 Vehicle and observation models

3.7 Non-linear filter design and tuning

3.8 Implementation issues

4. Global Positioning System (GPS

4.1 Basic principles

4.2 Coordinate Transformation

4.3 Description of GPS and DGPS (Differential GPS)

4.4 Most common GPS errors

Laboratory 1: Implementation of beacon-based navigation algorithm using laser/encoder data in outdoor applications.

Day 2: GPS/Inertial Navigation

5. Inertial Sensors

5.1 Fundamental principles of Accelerometers and Gyroscopes

5.2 Application of Inertial sensors

5.3 Six degree of freedom Inertial Measurement Units (IMU)

5.4 Calibration and alignment of IMU

5.5 Position, velocity and attitude algorithms

6. GPS / INS integration

6.1 Error propagation Model and Observation Equations

6.2 Data fusion algorithm

6.3 On line alignment and calibration

6.4 Use of vehicular modelling constraints

6.5 Tightly coupled GPS/INS

Laboratory 2: GPS/Inertial navigation system design and implementation.

Day 3: Advanced Topics: SLAM

7. Simultaneous Localisation and Map Building

10.1 Introduction

10.2 State model description

10.3 Efficient algorithms for real time SLAM implementation

10.4 Implementation issues

Laboratory 3: SLAM implementation.