COUNT
CONSORTIUM OF OHIO UNIVERSITIES ON NAVIGATION & TIMEKEEPING

2018 Short Course Series

June 18-20, 2018

Hilton Garden Inn
3520 Pentagon Blvd.
Beavercreek, OH 45431

Monday, June 18th	
8:30 – 9:00	Short Course Registration
9:00 – 12:00	Antenna Induced Biases in GNSS Receiver Measurements Dr. Inder (Jiti) Gupta, The Ohio State University, ElectroScience Laboratory
12:00 – 13:00	Lunch (provided)
13:00 – 13:30	Short Course Registration
13:30 – 16:30	Kalman Filter Introduction Dr. Frank van Graas, Ohio University
Tuesday, June 19th	
8:30 – 9:00	Short Course Registration
9:00 – 12:00	Vision Navigation with OpenCV Dr. John Raquet, Air Force Institute of Technology
12:00 – 13:00	Lunch (provided)
13:00 – 13:30	Short Course Registration
13:30 – 16:30	Navigation Components of Mobile Mapping Systems Dr. Charles K. Toth, The Ohio State University, SPIN Laboratory
Wednesday, June 20th	
8:30 – 9:00	Short Course Registration
9:00 – 12:00	Advanced GNSS Receivers Dr. Jade Morton, University of Colorado Boulder
12:00	Adjourn

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Wednesday June 18, 2018 9:00 – 12:00
Antenna Induced Biases in GNSS Receiver Measurements
Dr. Inder (Jiti) Gupta, The Ohio State University ElectroScience Laboratory

It is well known that antennas can cause biases in code phase and carrier phase measurements in GNSS receivers, and these biases are aspect dependent in that the biases vary from one satellite to the next in view of a GNSS receiver. This results in errors in the position and time solutions.Fixed reception pattern GNSS antennas can be calibrated for these biases in GNSS measurements. The same is not true for controlled reception pattern (adaptive) antennas which are needed for electronics protection in GNSS receivers. In this short course, we will describe the latest methods to estimate and mitigate adaptive antenna induced biases in GNSS receivers. The methods will include optimum filtering in GNSS antenna electronics as well as modification of GNSS receivers.

Wednesday June 18, 2018 13:30 – 16:30
Kalman Filter Introduction
Dr. Frank van Graas, Ohio University

The focus of this course is on the basic theory, an intuitive understanding as well as practical considerations, for the design and implementation of Kalman filters. Although many new types of filters are published in the literature, the Kalman filter is still the optimal and most efficient solution for the majority of navigation and timing systems. The course starts with a review of statistics and detailed insights into the most important noise processes, including random walk and Gauss-Markov processes. This is followed by a review of state variables and an overview of Kalman filters, including linear, linearized and extended filters. Matlab®-based examples are used to facilitate hand-on experience with Kalman filters.

Thursday June 19, 2018 9:00 – 12:00
Vision Navigation with OpenCV
Dr. John Raquet, Air Force Institute of Technology

This course will cover the fundamentals of vision navigation, with an emphasis on showing how OpenCV can be used to solve practical vision navigation problems. The course will involve both describing the theory and then demonstrating the practical application of that theory using OpenCV. Topics to be covered include camera modeling and calibration, image feature detection, feature matching approaches, epipolar geometry, and calculation of rotation and translation using essential matrix decomposition.

Thursday June 19, 2018, 13:30 – 16:30
Navigation Components of Mobile Mapping Systems
Dr. Charles K. Toth, The Ohio State University, SPIN Laboratory

This short course will provide an overview of the state-of-the-art navigation sensors and techniques suitable for various close range navigation and georeferencing of mobile mapping systems, including UAS, wearable/personal navigation, and driverless vehicle platforms. First, the technology trends and developments are reviewed, and then a short analysis is provided on sensors and algorithms. While there are many technologies to facilitate navigation indoors or in any GPS-challenged environments, the mostly widely used techniques are based on imaging sensors, including active and passive sensors. The main part of the course is the discussion on current navigation solutions available on the three platforms with a focus on the imaging sensors and vision techniques used. The examples presented will include performance assessments and brief discussion on the operational conditions.

Friday Jun 20, 2018 9:00 – 12:00
Advanced GNSS Receivers
Dr. Jade Morton, University of Colorado Boulder

This short course will focus on advanced GNSS receiver signal processing techniques developed for challenging applications. In recent years, there are increasing demands for GNSS receivers to generate navigation solutions in urban and indoor environments, on LEO satellites or aircrafts. Moreover, GNSS signals are highly sought-after signals-of-opportunity for remote sensing of the ionosphere, troposphere, and Earth surface. For these navigation and sensing applications, conventional GNSS receiver signal processing techniques are not adequate to produce desired solutions. In this short course, we will first provide an analysis of fundamentals of GNSS receiver signal processing, followed by discussions of several types of challenging applications, including ionospheric scintillation, radio occultation, and GNSS reflectometry. Finally, we will present several advanced processing techniques, including Kalman filter-based receiver tracking, inter-frequency aiding, and vector processing for weak signal and high dynamics receiver platforms.