COUNT
CONSORTIUM OF OHIO UNIVERSITIES ON NAVIGATION & TIMEKEEPING

2017 Short Course Series

May 24-26, 2017

Hilton Garden Inn
3520 Pentagon Blvd.
Beavercreek, OH 45431

Wednesday, May 24th	
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	Magnetic Anomaly Field Navigation Capt. Aaron Canciani, Air Force Institute of Technology
Thursday, May 25th	
8:30 – 9:00	Short Course Registration
9:00 – 12:00	Sensors and Sensor Integration in Navigating PN and UAS Platforms Dr. Charles K. Toth, The Ohio State University, SPIN Laboratory
12:00 – 13:00	Lunch (provided)
13:00 – 13:30	Short Course Registration
13:30 – 16:30	Formal Methods for Aviation Software Design and Certification Dr. Maarten Uijt de Haag, Dr. Gordon Stewart, Ohio University
Friday, May 26th	
8:30 – 9:00	Short Course Registration
9:00 – 12:00	Ionospheric Scintillation Monitoring Receivers Dr. Jade Morton, Colorado State University
12:00	Adjourn

2017 COUNT Short Course Series

Wednesday May 24, 2017 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 May 24, 2017 13:30 – 16:30
Magnetic Anomaly Field Navigation
Capt. Aaron Canciani, Air Force Institute of Technology

The near-surface of the Earth has measureable magnetic field variations which have been shown to be stable over time. These fields are frequently mapped for various purposes and consequently provide a useful global navigation signal. This tutorial will provide an overview of techniques and methods needed in order to successfully implement a magnetic anomaly navigation system. First, an overview of map-based particle filtering will be provided. Next, an in-depth discussion of the magnetic anomaly field will given covering topics such as practical upward continuation of 2D magnetic anomaly field data and integration of magnetic maps into particle filters. The performance of magnetic anomaly navigation will then be discussed. Special attention will be paid to the trade-space of performances for magnetic anomaly navigation with respect to altitude and velocity. A discussion on current availability and quality of magnetic anomaly maps will be given as well as methods to navigate using sparse map data.

Thursday May 25, 2017 9:00 – 12:00
Sensors and Sensor Integration in Navigating PN and UAS Platforms
Dr. Charles Toth, The Ohio State University SPIN Laboratory

Navigation and imaging sensor technology advancements as well as integration methods have recently seen remarkable developments, fueled by rapidly advancing sensor performance, increasing processing power, and, most importantly, by growing need from a large number of applications. The classical Extended Kalman filter-based GPS and IMU integration model, introduced two decades ago, has been extended with new sensor input and error models. Moreover, alternative integration solutions have been developed. This course will provide a review of sensors and sensor error models, the theoretical foundation of integration models, and some typical applications in navigation and remote sensing with a focus on Personal Navigation (PN) and Unmanned Airborne Systems (UAS).

Thursday May 25, 2017, 13:30 – 16:30
Formal Methods for Aviation Software Design and Certification
Dr. Maarten Uijt de Haag, Dr. Gordon Stewart, Ohio University

This course discusses the design of safety-critical software for avionics systems using development and assurance standards and formal methods. Topics include a brief overview of systems engineering practices and the avionics certification processes; system safety assessment processes required for safety critical applications such as avionics systems and the role of software and hardware within these processes; hierarchical software design, validation and verification of software requirements and code; a brief introduction to formal methods such as interactive theorem proving and model checking; case studies exploring the use of formal methods to certify avionics systems and supporting tools such as compilers. The course concludes with a look ahead at advanced applications of formal methods for top-to-bottom verification of whole systems.

Friday May 26, 2017 9:00 – 12:00
Ionospheric Scintillation Monitoring Receivers
Dr. Jade Morton, Colorado State University

It has been over two decades since the first generation of GPS receivers designed for ionospheric scintillation monitoring (ISM) were deployed in the field. Today, there are numerous stations around the world equipped with these legacy and new multi-GNSS receivers. These receivers have played an important roles not only for ionosphere and space weather studies, but also advanced our understandings of ionospheric effects on satellite navigation. This short course will provide a review of the critical design elements of ISM receivers, the evolution of the systems, and lessons learned.