COUNT
CONSORTIUM OF OHIO UNIVERSITIES ON NAVIGATION & TIMEKEEPING

2016 Short Course Series

May 18-20, 2016

Hilton Garden Inn
3520 Pentagon Blvd.
Beavercreek, OH 45431

Wednesday, May 18th	
8:30 – 9:00	Short Course Registration
9:00 – 12:00	Array Signal Processing for Geolocation of RF Emitters 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	Survey of Alternative Navigation Techniques, Dr. John Raquet, Air Force Institute of Technology
Thursday, May 19th	
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	Simultaneous Localization and Mapping for Ground and Aerial Robots, Dr. Maarten Uijt de Haag, Ohio University, Avionics Engineering Center
Friday, May 20th	
8:30 – 9:00	Short Course Registration
9:00 – 12:00	Ionospheric Scintillation Monitoring Receivers Dr. Jade Morton, Colorado State University
12:00	Adjourn

2016 COUNT Short Course Series

Wednesday May 18, 2015 9:00 – 12:00
Array Signal Processing for Geolocation of RF Emitters
Dr. Inder (Jiti) Gupta, The Ohio State University ElectroScience Laboratory

There is significant interest in locating RF emitters using a single platform. To accomplish this objective, an antenna array is mounted on the platform and the digitized signals received by various elements of the antenna are processed to geolocate the RF emitters. The conventional approach is based on Angle of Arrival (AoA) estimation at various locations and orientation of the platform, multiple target tracking and drawing lines of bearing. Note that AoA estimation is the backbone of the conventional approach. In this short course, we will discuss various methods for AoA estimations. The discussion will include spectral-based techniques as well as parametric methods. We will describe the degradation in the performance of these methods due to mismatches in the available antenna array manifold and true in situ array manifold of the antenna. The discussion will include polarization of the signals incident on the antenna. Finally, we will present a novel method called 'Direct Mapping Method' for the geolocation of the RF emitters. This method bypasses the AoA estimation step and multiple target tracking. The method is quite robust to mismatches in the antenna array manifold.

Wednesday May 18, 2015 13:30 – 16:30
Survey of Alternative Navigation Techniques
Dr. John Raquet, Air Force Institute of Technology

This course will provide a survey of several different non-GNSS navigation techniques. First, an overall framework that describes all navigation systems will be covered. Then, the various non-GNSS alternatives will be covered at the phenomenology level, describing the overall characteristics of each of the possible phenomenologies that can be used to navigate, including the limits of performance that result from use of these phenomenologies (where they can be used, when they can be used, expected accuracies, etc.). Then, for some of the more common approaches, we will describe some of the practical implementation issues that are faced when implementing a real-world system. Examples of phenomenologies useful for navigation to be covered include vision, signals of opportunity, lidar, pseudolites/beacons, magnetic field variations, and star trackers.

Thursday May 19, 2015 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 19, 2015, 13:30 – 16:30
Simultaneous Localization and Mapping for Ground and Aerial Robots
Dr. Maarten Uijt de Haag, Ohio University, Avionics Engineering Center
This course will cover the fundamentals of simultaneous localization and mapping (SLAM). In SLAM the ground or aerial robot operates in an unknown and static environment and tries to estimate its pose (position and orientation) while at the same time building a map of its environment. Topics of this course include: robot motion and perception (i.e. through electro-optical or laser scanning sensors); recursive state estimation (i.e. Bayesian filters); a short reference to Gaussian filters; nonparametric filters such as the particle filter; mobile robot localization using Markov, Gaussian Grid and Monte-Carlo methods; occupancy grid mapping, SLAM, GraphSLAM, and FastSLAM. The theory will be illustrated using examples from practice using ground and aerial robots such as UAVs.

Friday May 20, 2015 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.