

**CN 473 Autonomous Land Navigation using GPS/INS**  
**ION GNSS 2007, September 24, 2006, 1:30 pm-5:00 pm, CEU: 3.0**

**Instructor:** Dr. David M. Bevly, Assistant Professor, Auburn University

**Prerequisite:** Some knowledge of GPS, INS, and dynamics will be useful.

**Intended Audience:** Engineers, scientists, and managers interested in unmanned vehicle technologies. The course provides an overview of GPS and IMU measurements used for navigation and control of ground vehicles as well as the fundamental dynamics used to describe the motion of ground vehicles.

**Notes Provided:** Slides presented will be professionally spiral bound, with clear plastic cover, including color to add clarity where needed.

**Reference List:** A reference list will be provided as part of the note package for completeness and to allow the interested attendee to obtain additional information.

**Course Overview:** This course emphasizes the fundamentals of GPS/INS navigation for ground vehicles. The basic vehicle dynamics are also covered in order for users to integrate the GPS/INS solutions for vehicle control systems. Various vehicle dynamic properties that can be measured using the GPS/INS solution will be discussed. The course also introduces other sensors that can be used to augment the GPS solution, such as vision and Lidar, for navigation in GPS denied environments. The course includes examples of work on a variety of vehicles with illustrations of navigation and estimation results.

**Course Content:** The main topics to be covered by this course are:

- GPS/INS Integration for Vehicle dynamics
  - Brief overview of GPS and its errors
  - IMU modeling and ground vehicle dead-reckoning errors
  - Introduction of the Kalman Filter
- Ground Vehicle Dynamics
  - Ground vehicle models
  - Estimation of vehicle navigation states
  - Estimation of vehicle parameters
- Integration of additional navigational signals
  - Vision
  - Lidar
  - Doppler Radar
  - Odometer
- Application Examples
  - DARPA Grand Challenge
  - John Deere Auto Steer Tractor
  - Other UGVs

**Course Outcomes:** At the completion of this course, the attendee should have an understanding of how to use GPS and INS measurements for navigation and control of ground vehicles. The user will also obtain knowledge of the core vehicle dynamics and how they can be measured using GPS and INS measurements.