ON-SITE COURSE

Courses 356: GPS / GNSS and DGPS Operations for Engineers & Technical Professionals: Principles, Technology, Applications and DGPS Concepts (3.0 CEUs)

(Similar to Course 346, but with three additional hours of Differential GPS and two additional hours of Kalman filtering.)

**DAY 1**
- **Fundamentals of GPS Operation:** Overview of how the system works, U.S. policy and current status.
- **GPS System Description:** Overview and terminology, principles of operation, augmentations, teletracking, performance overview, modernization.
- **GPS Policy and Context:** Constrained navigation system history, GPS policy and governance, modernization program, ground segment, other satellite navigation systems.
- **GPS Applications:** Land, marine, aviation, science, personal navigation, accuracy measures, error sources.

**DAY 2**
- **GPS Principles and Technologies:** Clocks and Timing, importance of GPS, timescales, clock types, stability measures, relativistic effects.
- **Geodesy and Satellite Orbits:** Coordinate frames and geodesy, satellite orbits, GPS constellation, constellation maintenance.
- **Satellites and Control Segment:** GPS satellite blocks, control segment components and operation, monitor stations, MCS, and ground antennas, upload operations, ground control modernization.

**DAY 3**
- **Error Sources and Models:** Sources of error and correction models, GPS signals in space performance, ionospheric and tropospheric effects, multipath, error budgets.
- **Augmentations and Other Constellations:** Augmentations, local-area, satellite-based, and regional, Russia’s GLONASS, Europe’s Galileo, China’s COMPASS (BeiDou).
- **Precise Positioning:** Precise positioning concepts, reference station networks, RINEX data format.

**DAY 4**
- **Differential GPS Overview:** Local-area, regional-area, wide-area architectures, code vs. carrier-phase based systems, pseudolites, performance overview.
- **Differential Error Sources:** Satellite ephemeris errors, satellite clock errors, selective availability, ionospheric, tropospheric delay, multipath, receiver internal noise, biases.
- **Observeable Modeling:** Code pseudorange and carrier-phase outputs, code-minus-carrier observables, carrier-smoothed code operation, double difference operation, system error budgets.

**DAY 5**
- **Case Study: Tracing a GPS Signal Through a Receiver:** Received signal, digitized signal, correlator outputs, code-phase estimate, carrier-phase estimate, data demodulation.
- **GPS Navigation Algorithms:** Point Solutions, pseudorange measurement models, point solution methods and examples.

**Materials You Will Keep**
- A color electronic copy of all course notes will be provided on a USB Drive or CD-ROM. Bringing a laptop to this class is highly recommended for taking notes using the Adobe® Acrobat® sticky notes feature; power access will be provided.
- A black and white hard copy of the course notes will also be provided.

**Course Fee Entitles Your Group to a Book Allowance**
Any book allowances for on-site group contracts are negotiated as part of the contract.

**Instructor:**
- Dr. Stephen Happe
- Dr. Chris Hegarty

**Who Should Attend?**
Excellent for engineering staff who need to be rapidly brought up to speed on GPS, and for those already working in GPS who need exposure to the system as a whole in order to work more effectively.

**Prerequisites**
Familiarity with engineering terms and analysis techniques. General familiarity with matrix operations is desirable for Thursday and Friday, and familiarity with signal processing techniques is desirable for Wednesday through Friday. (The materials for days 3, 4, and 5 of Course 356 are more intensive than what is taught in Course 346.)

**To REGISTER or for MORE INFORMATION,** Contact Carolyn McDonald at (703) 256-8900 or cmcdonald@navtechgps.com.