

**CN410 Fundamentals of Differential GNSS Applications**  
**ION GNSS 2007, September 25, 2007, 8:30 am-12:00 pm, CEU: 3.0**

**Instructor:** Dr. Hans-Jürgen Euler, inPosition gmbh, Switzerland

**Prerequisite:** Knowledge of mathematics, computer science, and introduction to satellite navigation systems (e.g., CN406 Fundamentals of GNSS II with emphasis on GPS) will be useful.

**Intended Audience:** Engineers, scientists, and managers involved with the design, development, implementation, and/or use of GNSS using GPS, Galileo, Glonass and/or other satellite navigation systems. The course provides a solid basis in the fundamentals of differential satellite navigation and in particular details on various error mitigation techniques and method for applications of various baseline lengths and performance requirements. The course is more advanced than a simple introduction to GNSS course, but not too advanced for the beginner to GNSS.

**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 differential GNSS baseline techniques with focus on DGPS and an introduction differential GPS RTK applications. The course will explore the various error mitigation techniques and methods for improving the navigation position based on GNSS. While in general DGPS provides sub-meter accuracy, will the second half of the course also target an introduction to high precision positioning. Performance aspects with respect to accuracy, integrity, continuity, and availability will be presented.

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

- Introduction to differential GPS techniques and different ways to implement-(overview)
- Mitigation of error sources in GNSS applications
  - Satellite and receiver dependent errors
  - Atmospheric refraction
  - Antenna and multi-path errors
- Differential pseudo range based navigation error mitigation techniques
- Overview of differential services available
  - Wide Area Augmentation Systems (e.g., WAAS, EGNOS, etc.)
  - Local Area Augmentation Systems
  - Commercial services
- Data link: RTCM SC104 standard for DGNSS
  - Message outline and philosophy
  - The different messages for DGNSS
- Introduction to Precise Differential Techniques
- Carrier phase ambiguity resolution

- Multi-frequency advantages
- Summary of standards for RTK applications
  - RTCM SC104 V2
  - RTCM SC104 V3

**Course Outcomes:** At the completion of this course, the attendee should have the ability to understand the fundamentals of differential GNSS systems in the presence of measurement errors. The different services for providing correction information can be differentiated. The principle concept of RTK can be rated in comparison with the lower precision DGNSS. For additional information on DGNSS RTK applications, CN415 Fundamentals of DGPSS for Baseline and Network RTK applications is recommended.