

**CN415 Fundamentals of GNSS for Baseline and Network RTK applications**  
**ION GNSS 2007, September 25, 2007, 1:30 pm-5:00 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., CN410 Fundamentals of Differential GNSS applications) will be useful.

**Intended Audience:** Engineers, scientists, operators and managers involved with the design, development, implementation, and/or use and/or operation of precise RTK applications. The course provides a solid basis in the fundamentals of Baseline RTK/Network RTK based navigation and positioning. In particular it details on various methods used in today's RTK applications. Since Network RTK is influencing nowadays these applications, towards the second part the focus will be on Network RTK installations as well as the RTCM standards for Network RTK. This is more advanced course intended to deepen basic knowledge of differential baseline applications. It is recommended for participants to have a basic understanding of differential GNSS applications and their short-coming either through working experience or through previous tutorials (i.e., CN410 Fundamentals of Differential GNSS applications).

**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 GNSS Baseline RTK techniques with focus on GPS Baseline RTK applications. An additional focus will be in the second part on GPS Network RTK applications. The course will explore the various methods developed in the past for error mitigation. The different techniques for Network RTK are investigated in detail. The short-comings and merits of different approaches are analysed.

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

- Differential (DGNSS) techniques and their limits (overview)
- Algorithms for Integer Ambiguity Searches as the key for precise positioning
- Error sources of RTK and their mitigation
  - Antenna phase center variations
  - Absolute and relative antenna phase center representation
  - Tropospheric residual errors
  - Ionospheric residual errors
- Limitations of Baseline RTK
- General idea of Network RTK to overcome baseline length-dependent influences
- Analysis of different concepts (proprietary and non-proprietary)
  - Virtual Reference Stations (also called VRS, iMAX and similar)
  - Area Correction Parameters (FKP German abbreviation)
  - Master-Auxiliary Concept as used for RTCM SC1040301 standard
- Why is interoperability important when providing a Network RTK service
- The impact to Galileo on Network RTK

- What are the new trends in Network RTK? Artificial carrier phases.

**Course Outcomes:** At the completion of this course, the attendee should have the ability to understand the fundamentals of GNSS Baseline RTK and Network RTK systems and their advantages and disadvantages. For users as well as for service providers the course will assist in finding the solution for their intended target application depending on the concept used. Personal carrying out precise positioning will be enabled to analyse their results and the associated short-comings. Personal of Network Service providers involved in maintenance and customer support should be able to effectively analyse short-comings and assist their customer basis in resolving the problems.