

**CN413 GNSS Integrity and RAIM**  
**September 20, 2010, 6:45 pm - 9:30 pm, CEU: 2.5**  
**GNSS Solutions® Tutorials prior to ION GNSS 2010, September 20-21, 2010**  
**Oregon Convention Center, Portland, Oregon, USA**

**Instructor:** Dr. Christophe Macabiau, ENAC (Ecole Nationale de l'Aviation Civile)

**Prerequisite:** Some knowledge of mathematics and computer science will be useful.

**Intended Audience:** Engineers, scientists, and managers interested in the area of GNSS using GPS, Galileo, Glonass, and/or other satellite navigation systems. The course provides information on the concept of integrity for GNSS and will focus on the details of the Receiver Autonomous Integrity Monitor (RAIM) approach.

**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 provides information on obtaining integrity in GNSS applications. The course begins with an overview of the different ways to obtain GNSS integrity for civil aviation, followed by details on receiver autonomous integrity monitoring (RAIM) approach. The course concludes addressing future applications of RAIM with Multi-GNSS constellations and other than aviation applications (i.e., land).

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

GNSS Integrity for civil aviation:

- Requirements for civil aviation applications
- Integrity monitoring techniques: ABAS, GBAS, SBAS, Galileo GIC
- RAIM Fault detection, Fault Exclusion

RAIM for NPA and APV

- Nominal measurement model (UERE, nominal biases, correlation time)
- Threat model (single or multiple failures, failure probability distribution)
- Internal probabilities (from application specifications and threat model)
- LSR RAIM Detection criterion (fault detection, fault exclusion)
- LSR RAIM Horizontal and Vertical Protection Level (PL) computation
- Assumptions for RAIM performance evaluation

Future of RAIM:

- GPS/Galileo RAIM for civil aviation
- ARAIM (i.e., Absolute RAIM adapted with low-update rate monitoring)
- RAIM for other applications (e.g. land vehicle).

**Course Outcomes:** At the completion of this course, the attendee should have a good understanding of the fundamental concepts of GNSS integrity, how to attain it for various

applications, and knowledge of RAIM. For additional knowledge on GNSS signal processing, CN433/434 Receiver Signal Processing for Future GNSS Signals I & II are recommended.