

**CN445 GNSS Antennas II – Special Topics**  
**September 21, 2010, 1:30 pm-5:00 pm, CEU: 3.0**  
**GNSS Solutions® Tutorials prior to ION GNSS 2010, September 20-21, 2010**  
**Oregon Convention Center, Portland, Oregon, USA**

**Instructor:** Dr. Chris G. Bartone, P.E., Professor, Ohio University and  
Dr. Jiti Gupta, Research Professor, The Ohio State University

**Prerequisite:** Knowledge of mathematics, antennas, electromagnetics and GNSS will be useful. Additionally, knowledge from a GNSS antennas course (i.e., CN441 GNSS Antenna I) will be useful. (Knowledge of vector calculus and Maxwell's Equations is not required.)

**Intended Audience:** Engineers, scientists and managers interested in the design, development, implementation, and/or use of GNSS antenna for GPS, Galileo, Glonass and/or other satellite navigation systems. The course provides an introduction to advances in antenna technology needed for meeting new and emerging GNSS applications. This course is a sequel to CN441 GNSS Antennas I.

**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 present information on special and advanced topics related to GNSS for particular applications, which are important to many users. Antenna measurement effects and specialized antennas to maximize GNSS performance will be presented.

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

- Multi-band GNSS Antennas for Modernized GPS, Galileo & Glonass:
  - Broadband and Multi-band antennas: Spiral, Helical Antennas, etc.
  - Some Industry Examples (e.g, Pinwheel spiral antenna, Geodetic type antenna, Multi-band stacked patch antennas, etc.)
- Multipath Considerations for GNSS Antennas
- Ground Plane effects on GNSS antennas
- Antennas for Assisted-GPS
- Active GPS Antennas specification of the G/T Ratio
- Break (Dr. Bartone to Dr. Gupta transition)
- Adaptive Antenna Arrays:
  - Arrays for Reducing Interference and Jamming,
  - Introduction to Power Inversion
  - Nulling Antenna Arrays
  - Space Time Adaptive Processing (STAP)
  - Space Frequency Adaptive Processing (SFAP)
  - Digital Beam Forming Antenna Arrays
- Antenna Effects on GNSS Observables:

- Phase center variation and it's effects on GNSS observations
- Phase Wrap-up in Spinning vehicles
- Mitigation techniques for phase center measurement error
- Group delay and antenna bandwidth effects on GPS code measurements
- Measurement Techniques for group delay calibration.

**Course Outcomes:** At the completion of this course, the attendee should have a better understand of special and advanced considerations for GNSS antennas in particular applications to enable enhanced performance.