CN541C GNSS Antennas
Fundamentals & Special Topics (6.0 CEUs)

Instructor: Dr. Chris G. Bartone, P.E., Professor, Ohio University, School of Electrical Engineering and Computer Science

Prerequisite: Knowledge of mathematics, engineering, physics or electromagnetics and introduction to satellite navigation systems (e.g., CN505 and/or CN506 Fundamentals of GNSS I & II with emphasis on GPS) will be helpful, but not required. (Knowledge of vector calculus and Maxwell's Equations is not needed.)

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 a solid basis in the fundamentals of antennas and in particular for applications in systems where GNSS is used. The course is considered as an introduction to GNSS antennas course.

Course Overview: This course emphasizes the fundamentals of antennas for GNSS applications. The course will present a solid basis for understanding fundamentals of antennas, antenna types, design, development, tests, and implementation aspects of GNSS antennas. The second part of this course presents 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, including details on adaptive antenna arrays.

Morning Session:

- Fundamentals of Antennas:
  - Antenna pattern and field descriptions
  - Mismatch losses (Γ, SWR, polarization)
  - Wave and antenna polarization
  - Antenna and receiver noise figure considerations
  - Antenna aperture
  - The Friis transmission equation
- Antenna Types: linear, helix, patches, arrays
- GNSS SV Antennas & the SV49 Issues.
- Common GNSS User Antennas
- Antenna Siting Issues: Mask angle, multipath, etc.
- Antenna Multipath considerations: design, metrics, and technology comparison (patch, survey, advanced multipath limiting antennas)
- Test/Design and Evaluation:
  - Computer simulation tools
  - Component level evaluations
  - Antenna test range options
  - Field test characterization
- Phase and group delay calibration

Afternoon Session:

- 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.)
- Ground Plane effects on GNSS antennas
- Antennas for Assisted-GPS
- Active GPS Antennas specification of the G/T Ratio
- 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 Topic Tailoring: GNSS Solutions can tailor the above course outline to meet your special needs or market. We can provide you more or less emphasis in specific areas, add or subtract topic areas. Feel free to contact us and discuss options for your course outline to maximize your benefit. Be sure to include any requested modifications when you request a quote.

Handout Booklet: A booklet of the slide material presented will be provided. One Handout Booklet will be provided per student. The Handout Booklet will be professionally spiral bound with clear protective vinyl on the front and back cover (clear on front, navy blue on back). References will be provided on slides, as appropriate, and a reference list of significant material will be provided. Color will be provided on a limited basis where it is needed for clarity. This information will be copyrighted by the author and cannot be reproduced without the written permission of the author or GNSS Solutions if associated with this course. All color and/or password protected slide copies may be requested at additional cost.

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. Additionally, an acronym list will provided.

Location: On-site at the Government and/or contractor facility. A local commercial location can be arranged by GNSS Solutions if requested.

Host Responsibilities:

Facilities: Room, restrooms, seats, chairs, etc.
Refreshments access or provided (coffee, soda, snacks, etc.)
Scheduling of students and fund coordination.
LCD projector with screen and white/chalkboard (or equivalent).
No audio or video taping of the presentation is allowed.

GNSS Solutions can provide the above items with proper coordination.

Day Schedule: The class room shall be available no later than 07:30 on class day, with presentation beginning at 08:30. A 15 min break will be scheduled every hour. One hour for lunch will be scheduled. The course will end at 16:30 every day. A total of 6 hrs of presentation time will occur each day. Different start, stop, break, and duration times can be accommodated.

Scheduling: A lead time of at least 3 weeks shall be used to schedule the course. A 10% deposited is required when ordering the course.

Rescheduling or Cancellation: Once the course has been ordered, the course can be rescheduled or canceled but fees may occur. The amount of these fees can be negotiated at the time of course rescheduling or cancellation. Generally, non-recoverable expenses (e.g., travel costs) may be forfeited in the event the course is rescheduled. If the course is cancelled, a 10% cancellation fee will apply.

Request a Quote: Please have in mind the dates, location, number of attendees, and any exceptions, tailoring or special requests in your request for quote.