

**CN477 Fundamentals of Enhanced Loran**  
**ION GNSS 2007, September 24, 2007, 6:45 pm-9:30 pm, CEU: 2.5**

**Instructor:** Dr. Ben Peterson, Peterson Integrated Geopositioning

**Prerequisite:** Some knowledge of mathematics and electrical engineering will be useful.

**Intended Audience:** Engineers, scientists, and managers interested in the area of low-frequency navigation techniques, and in particular Loran navigation and/or its Enhancements. The course provides a solid basis in the fundamentals of Loran navigation and timing. The course is more advanced than a simple user's course, but not too detailed for the beginner to Loran.

**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 Loran with emphasis on the enhancements currently being made to the system and the impacts of those enhancements on receiver design.

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

- Current policy on the future of Loran in the US and the rest of the world
- Basic Loran Signal Structure
  - Transmitting and Control Equipment
  - System Area Monitor versus Time of Transmission control
- Loran propagation
  - Primary, Secondary, and Additional Secondary Phase factors (PF, SF, & ASF)
  - Millington's method for predicting signal strength and ASF
  - Envelope to Cycle Difference (ECD)
    - Definition and measurement at the transmitter and in the far field
    - Change from transmitter to far field
  - Re-radiation in the vicinity of large metal structures
  - Skywaves
- Loran Receiver Architecture Overview
  - Acquisition
  - Cycle Integrity
  - Impulse noise
  - Hyperbolic navigation & conversion of observations to position and time.
  - Velocity from Loran signals
  - Electric field and magnetic field antennas
    - Solution for static antenna orientation in H field antennas
  - Cross rate interference
- Loran Data Channel

- Modulation and demodulation
- Forward Error Correction Coding
- Message Data Format Descriptions
- Message Integrity
- Differential Loran
- Loran for frequency and timing applications
  - Traceability to UTC
  - Independence of GPS
  - Calibration
  - How leap seconds are handled
  - Differential corrections
  - Indoor applications
- GPS Vulnerability and Integration of Loran and GPS
  - Type of integration as function of threat being addressed

**Course Outcomes:** At the completion of this course, the attendee should have the ability to understand the fundamentals and capabilities of low frequency navigation systems and in particular Enhanced Loran.