CN435 Vector Tracking Theory and Implementation
September 20, 2010, 6:30 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. Matthew Lashley, Navigation Technology Associates

Prerequisite: Some knowledge of mathematics, digital signal processing, GNSS receiver operation, and Kalman filtering will be useful. CN431/432: GNSS Receiver Design I/II are recommended.

Intended Audience: Design and development engineers, academic researchers, scientists, educators, and managers interested in the area of satellite navigation, and GNSS receiver design and implementation; in particular the design and implementation of vector based receiver architectures and deep integration/ultra-tight coupling.

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 an overview of vector tracking receiver algorithms, their performance, and implementation. The course begins with a review of the standard, scalar tracking loop based architecture and then introduces vector tracking. The differences between scalar and vector tracking loops are then explored. The performance of vector tracking relative to scalar tracking loops is discussed in detailed. The course then focuses on the implementation of vector tracking loops addressing: correlator processing, carrier-to-noise power density ratio estimation, and implementation of the vector tracking Kalman filter.

Course Content:

- Traditional receiver architectures (reviewed):
  - principles of GNSS receiver operation
  - tracking loop operation
  - PVT determination from the signal parameters.
- Vector tracking: relation to the traditional receiver: combing signal tracking and PVT estimation into a single algorithm
- Position and pseudorange state formulations of vector tracking: designing the vector tracking Kalman filter
- Performance improvement from vector tracking vs scalar tracking loops
- Predicting the GNSS signals from the vector tracking Kalman filter states
- Correlator processing to produce observable measurements
- Measurement update of the vector tracking Kalman filter
- Federated vector tracking architectures:
  - design and operation of federated vector tracking

  - architectures,
  - Optimization.
- Deep integration/ultra tight coupling: discussion of integrating inertial measurement units with vector tracking algorithms.

Course Outcomes: At the completion of this course, the attendee should have a solid understanding of the fundamentals of vector tracking receiver algorithms and their operation and performance. The attendee should have a sound grasp of how to implement vector tracking algorithms and the issues involved therein. The attendee should leave this course with a clear understanding of the advantages and limitations of vector tracking algorithms. Students interested on expanding their knowledge for future GNSS signal processing techniques are encouraged to attend CN433 and CN434 Receiver Signal Processing for Future GNSS Signals in Track 2. For additional tutorials on GNSS antennas CN441/CN445 GNSS Antennas I&II are recommended.