Course 135:

# Practical GPS for Professional Users

The basic information for understanding GPS operations and using GPS in your applications.
A highly practical course! (Day 1 gives you GPS background. Days 2-3 are highly practical.)

**On-site only**

**New configuration!**



## Quotes:

"I must commend the manner in which the course was run. The duration was right for covering everything I needed to know about essential GPS. The presenters were among the best in GPS. I now have a better in-depth knowledge about GPS. I now have a high level of confidence to deal with my GPS contractors."
***Sahari Abdul Azia***
***Carigali-Triton Co.,***
***Malaysia***

"Availability of instructors for questions is appreciated. Informal, relaxed presentation style, superb slides."
***Name withheld***

"I am in acquisition engineering. This gives me enough background to know what questions to ask the contractor and the contract officer."
***Kevin L. Williams***
***GPS Joint Program Office, El Segundo***

**Monday only = Course 111** — **Monday - Wednesday = Course 135**

| | Monday | Tuesday | Wednesday |
|---|---|---|---|
| 8:30 | **GPS System Description, Applications and Status** — Mr. Keith McDonald, *Navtech Seminars*<br>Receivers & boards: technology and services<br>GPS characteristics, capabilities, background<br>Navigation solution technique; 4-satellite ranging<br>System segments, interdependence, military/civil dual use<br>GPS configuration; JPO, functions | **Overview** — Mr. Franck Boynton, *Navtech GPS Supply*<br>Signal acquisition & processing<br>Receiver system & hardware types<br>System and hardware integration<br>Augmentations & applications<br>Getting the most out of your equipment<br>**Types of GPS Acquisition & Processing**<br>Post processing: code, carrier phase<br>Real-time: autonomous, DGPS code, DGPS carrier phase, assisted correction (E911)<br>Data links, WAAS, OmniSTAR, StarFire, CORS, USCG<br>Functionality and methods used for applications<br>Review of different correction methods. How to implement and use each one.<br>**Anatomy of a GPS Receiver System**<br>From the GPS satellite transmission antenna to data output; what happens in between?<br>Transmission of GPS signals from spacecraft<br>Atmospheric effects on signal, range loss<br>User equipment: antenna, RF cable, GPS receiver, RF front-end, digital processing<br>Processing, real time DGPS corrections, user settings, data storage types, output information | **GPS Applications: Land** — Mr. Boynton<br>GIS Development: Data Collection Demonstration<br>Geographic Information System (GIS) needs, types<br>• What can it do for me?<br>• How does it typically operate?<br>• Auxiliary systems: laser, optical range finder, camera<br>**Point Position Georeferencing Example: How to Create a Corn Maze**<br>Georeference known earth points to a map to create an "amaizing" working final product<br>Geodetic point acquisition<br>Map creation and georeferencing<br>Application of results<br>**Working Indoors to Test Your Equipment: GPS Signal Repeater and Hardwired Techniques**<br>Equipment needed: antennas, amps, etc.<br>Calculating gain and transmission distances<br>Accuracies and hardwired connections<br>Safety concerns, and RF emission regulations<br>Installation guidelines |
| 9:45 | **GPS Performance and Policy**<br>Accuracy, availability, integrity, SPS, PPS operation<br>DoD & DoT policy, Anti-Spoof, system status, applications<br>**GPS Space Segment; *How satellites, orbits and orbit data affect system operations***<br>Orbital parameters, Kepler's laws; ephemeris, almanac data<br>Block I, II, IIA, IIR, IIR-M, IIF, III spacecraft (S/C) features | | |
| 11:00 | **GPS Constellation; Coverage and Performance; *How satellite geometry affects system performance***<br>Dilution of precision (DOP), visibility, analysis methods<br>**GPS Operational Control Segment (OCS); *How OCS uploads & monitors the GPS constellation***<br>OCS network, functions, operation; vulnerabilities | | |
| 12:00 | | ***Lunch is on your own*** | |
| 1:30 | **GPS System Concept and Operation** — Mr. McDonald<br>Position determination techniques; pseudoranging<br>Signal structure, modulation methods, spectrum use<br>Pseudorandom noise (PRN) codes, C/A, P(Y)-codes<br>GPS data message, format, data transmitted by S/C<br>Correlation processing; signal acquisition and tracking, power levels, signal policy, pseudoranging<br>Navigation solution (x, y, z), velocity vector solution, time det. | **GPS Receiver Hardware Types** — Mr. Boynton<br>Commercial GPS stand-alone receivers<br>GPS boards, antennas, antenna pre-amps<br>Differential receivers and accessories<br>Data link equipment, coverage regions<br>Survey receivers and software<br>**Operations**<br>Equipment operation, observations<br>Data, data logging, GPS analysis programs<br>Processing of data | **New Signals and Systems: GPS Modernization, GLONASS, Galileo** — Mr. Boynton and Mr. McDonald<br>***What will be available in the future***<br>**Practical Equipment Issues: *How to make sure your GPS equipment gives you good results***<br>Things to consider before starting to work<br>Troubleshooting problems in the field<br>How to tell if you're getting the results you need.<br>What you can do yourself and when to call for help<br>Help sources |
| 2:45 | **Error Sources & Receiver Effects**<br>Systematic and random errors; tropospheric effects<br>Ionospheric propagation effects, dispersion<br>AFGD ionospheric model; 2-frequency correction<br>Multipath, mitigation techniques; code & carrier dependence<br>Error budgets; SPS and PPS signals; current & future | **Component Integration Principles: *How to select and combine components to do your job efficiently and effectively***<br>Typical available components<br>Integration guidelines<br>Connectors, adaptors<br>Power requirements, batteries, characteristics<br>Commercial protocols<br>Signal compatibility<br>Typical projects<br>Operating system examples | **GPS Workshop on Applications**<br>Attendees will form special interest groups to discuss a defined implementation/application problem for ~30 minutes. Considerations: definition of needs, cost issues, COTS use, etc.<br>Groups will develop a prototype system solution using GPS. Groups will present results and lead a discussion of results with the attendees.<br>Informal interaction among attendees and instructors is encouraged. |
| 4:00 | **Introduction to DGPS**<br>Precision relative measurements; modes of operation<br>Differential operation, common bias terms, accuracy improv.<br>**GPS Receivers, Architectures and Equipment**<br>Receiver configurations; types & performance<br>Receiver block diagrams; carrier and code tracking loops<br>Carrier smoothing, aiding<br>Receiver sequence of operation | **Discussion - bring in your tasks or problems!** | **Summary of Program**<br>**Q & A, Discussion** |
| 5:00 | | | |

## Objectives

- To provide a practical and conceptual grasp of GPS and DGPS principles, applications and equipment. The course is designed such that an engineering background is not required but is helpful. Terms are described.
  Almost no math will be committed in this course!
- To address GPS concepts, equipment and applications with informative, easy-to-follow presentations using clear figures, computer simulations, and actual GPS equipment demonstrations.
- To bring professional GPS users, technical sales staff, and others up to speed quickly on GPS, DGPS and related topics.
- To offer practical engineering guidance and data to attendees making decisions regarding equipment use, selection, purchase and applications.

## Who Should Attend

- Those entering the GPS field who need a rapid grounding in GPS and DGPS principles, techniques, status & applications.
- Professional users who wish to better understand new developments in GPS and DGPS, as well as the future capabilities of GPS and related systems.
- Those involved in making business decisions about GPS.
- Sales, marketing and advanced development staff requiring a better understanding of GPS and DGPS operation, applications, and potential markets.

## Instructors:

Mr. Keith McDonald

Mr. Franck Boynton

## Materials You Will Keep

- A notebook containing all materials presented in the course.
- A CD-ROM containing a variety of GPS references and practical, supplementary materials to help you in your ongoing, applications-related activities.

Course 111:

- A voucher for the following text or a substitute of your choice:
  ***GPS Positioning Guide,*** Geodetic Survey Div., EMR Canada, 1993.

Course 135:

- A voucher for the following items, or substitutions of your choice:
  ***The GPS Manual, Principles & Applications,*** Dye & Baylin, Baylin Publications, 1997.

**To register, or for more information, call Navtech at 1-800-NAV-0885 or 703-256-8900, or fax to 703-256-8988, or e-mail to courses@navtechgps.com. For updated information, look on our home page: www.GPSetc.com.**