

CN560C Introduction to Strapdown Inertial Navigation Systems (6.0 CEUs)

Instructor: Dr. Andrey Soloviev, Research Assistant Professor, University of Florida

Prerequisite: Knowledge of science, engineering and/or mathematics will be helpful.

Intended Audience: Engineers, scientists, and managers interested in the area of strapdown inertial navigation systems (INS). The course provides a solid basis in the physics and mathematics of inertial navigation. It serves as a useful introduction to courses covering GPS and INS integration. The course is taught at a seminar level.

Course Overview: This course emphasizes the physics and mathematics of strapdown inertial navigation systems. This course details the types of strapdown inertial navigation sensors, their errors and behavior. The course also discusses sensor and system specifications. It provides sufficient information for the user to construct their own inertial navigation solution. The main topics to be covered by this course are:

Morning Session:

- Introduction to inertial navigation:
 - Basic Principles
 - Sensor measurements
 - Main computational procedures
 - 1D case
 - 2D case
- Coordinate frames
 - Inertial
 - Earth-Centered, Earth-Fixed
 - Local-level (East/North/Up, North/East/Down, Wander)
 - Body
- Strapdown inertial navigation in two-dimensions:
 - Initialization
 - Attitude determination
 - Gravity compensation
 - Coordinate transformation
 - Integration
 - Case study
- Strapdown INS mechanization: from 2D to 3D
 - Overall mechanization overview
 - Attitude computations in 3D
 - Matlab implementation example

Afternoon Session:

- Sculling and coning effects
- Non inertial effects
- Inertial sensors

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- gyroscopes
- accelerometers
- operational principles
- Sensor errors and error models
 - Gauss-Markov random process
 - bias
 - scale factor
 - misalignment
 - non-orthogonality
- INS error propagation
 - Basic error propagation
 - Shuller effect
 - Instability of the vertical channel
- Inertial navigation system performance and specifications

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 to allow the interested attendee to obtain additional information. Additionally, an acronym list will be 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.

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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 include the dates, location, number of attendees, and any exceptions, tailoring or special requests in your [request for quote](#).