Gyro and Accelerometer Panel (GAP)

What is It and Why Support It
What Are Standards and Why Are They Important?
What is a Standard?

- An established norm or requirement
- Usually expressed as a formal document that establishes uniform engineering or technical criteria, methods, processes and practices
- Represents industry consensus
  - Balance between users, producers, academia, government and other interested parties
- If it didn’t, it would not be accepted
- Consensus takes time to achieve
- Consensus requires openness, compromise and mutual respect between members
Standards reduce confusion by establishing an accepted way to describe technology and products.

Standards create a common language that can be used by users, producers, academia, government and other interested parties.

Standards improve efficiency in development, production, test, and sales.
Types of Standards

- **Specification Format Guides**
  - Provide manufacturers and users of inertial sensors and systems with recommendations relating to the preparation of a specification.
  - Allow common ground to be established between manufacturers and users such that there will be no misunderstanding as to the meaning of a specified capability or performance requirement.

- **Test Procedures**
  - Provide a compilation of recommended procedures for testing inertial sensors and systems.
  - Derived from those procedures presently used in the industry.
  - Allow common ground to be established between manufacturers and users of inertial sensors and systems such that there will be no misunderstanding as to the method(s) used to test.
• Terminology
  - Provides consistent definitions that result in a common language for development, manufacture, test and use of inertial sensors and systems.
  - Serves as a basic reference for producers and users for preparing industry standards and for the interpretation of published technical reports

• Recommended Practices
  - Provide manufacturers and users of inertial sensors and systems with guidance on a particular aspect of the development, manufacture, test or use of inertial sensors and systems
What is the GAP?
The purpose of the Panel is to create standard terminology, specification formats, and test procedures for, and to promulgate understanding of components and systems for detection or measurement of linear or angular motion.

The Panel is comprised of representatives of industry, government laboratories, educational institutions and professional societies who are knowledgeable of the characteristics, operating principles, sources of error, and areas of application of inertial sensors and systems.
Represented Companies

- 746 Test Squadron
- Acutronic
- AMRDEC
- Analog Devices
- Charles Stark Draper Laboratory
- Cleon Barker Consulting
- Ducommun Miltec
- Erickson Enterprises
- Honeywell
- Lockheed Martin Missiles & Fire Control
- Northrop Grumman
- Raytheon Missile Systems
- Sagem Defense Securite
GAP Organization

- Part of the IEEE Aerospace and Electronics Systems Society
  - Panel in existence for over 50 years (first meeting held in May 1962)
  - Two standing committees (Systems and Sensors)
  - Write and maintain inertial sensor and system standards
  - Yearly membership renewal required
- Bimonthly panel meetings
  - Meet 6 times a year for 2 days at a time
  - Hosted by companies or sometimes individuals
  - Alternate between East and West Coasts
  - Have also been held in Canada, France, Germany, and Russia
- Annually determine panel and committee objectives
  - Drives agenda for GAP meetings
Any interested party may attend the open meetings where standards are developed
  - Work consists of real time efforts plus homework submittals
  - New additions and changes are discussed and voted upon
  - Consensus is critical for standards to be adopted by industry

Project authorization request (PAR)
  - Defines scope, purpose and need
  - Approved by IEEE Standards Association

Work on documents takes place within appropriate committee

Proposed standards, once developed, are sent out for industry survey, then panel ballot (75% affirmative vote required)
- **Format Specification Guides & Test Procedures**
  - Spinning wheel gyros
    - Single degree-of-freedom, spring restraint
    - Single degree-of-freedom, rate integrating
    - Dynamically tuned gyros (DTG)
  - Sagnac effect gyros
    - Ring laser gyros (RLG)
    - Fiber optic gyros (FOG)
  - Coriolis vibratory gyros (CVG)
  - Accelerometers
    - Angular accelerometers
    - Linear accelerometers

- **Terminology**
  - Inertial sensor terminology
  - Inertial systems terminology

- **Recommended Practices**
  - Precision centrifuge testing of linear accelerometers
  - Inertial Sensor Test Equipment, Instrumentation, Data Acquisition, and Analysis
## Gyro and Accelerometer Panel

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<tr>
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<th>Systems Committee</th>
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<td>647 – 2006 Ring Laser Gyro</td>
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<td>1431 – 2004 Coriolis Vibratory Gyro</td>
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<td>528 – 2001 Inertial Sensor Terminology</td>
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<td>1554 – 2005 Inertial Sensor Test Equipment, Instrumentation, Data Acquisition, and Analysis</td>
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* Standard is in development

The numbers on this slide are the standard number followed by the year of publication.
Gyro Standards
IEEE Std 528

- Standard for Inertial Sensor Terminology
  - 293 definitions, acronyms, abbreviations, and synonyms
  

- Published in 2001
- Alphabetical order
- Cross linked definitions

- Purpose
  - Compile and standardize terminology used in the development, manufacture, test, and use of inertial sensors
  
  - Serve as a basic reference for producers and users of inertial sensors
Standard for Inertial Systems Terminology
- 262 definitions, acronyms, abbreviations, and synonyms
- Companion to IEEE Std 528 “IEEE Standard for Inertial Sensor Terminology”

Published in 2009
Alphabetical order
Cross linked definitions

Purpose
- Compile and standardize terminology used in the development, manufacture, test, and use of inertial systems
- Serve as a basic reference for producers and users of inertial systems
IEEE Std 836

- Recommended Practice for Precision Centrifuge Testing of Linear Accelerometers
- Published in 2009
- Addresses possible error sources
- Provides guidance for each phase of the testing
  - Beginning with planning
  - Ending with typical methods of data analysis
- Provides a detailed understanding of the various factors affecting accuracy of measurement
  - Those associated with the centrifuge
  - Those associated with the data collection process
IEEE Std 1554

- Recommended practice for carrying out gyro and accelerometer tests
- Published in 2005
- Inertial sensor test equipment
  - Fixtures, test tables, centrifuges, environmental chambers, and radiation test facilities
- General and inertial sensor specific electronics
  - Continuous counters, phase-locked loops, voltage-to-frequency converters, voltmeters and A/D converters, etc.
- Data acquisition computers and software
  - Including real-time digital filtering and automatic test equipment
- Data analysis techniques
  - Graphical, least squares, power spectral density (PSD), Allan variance
Scope
- Provide guidelines for the preparation of an IMU specification document

Purpose
- Provide the specifications, typical units, format and terminology for manufacturers and users to specify inertial measurement units (IMU) in a manner that provides a common meeting ground
- Allows each user to select which specifications are relevant to their particular application
- The terminology is that which is commonly used by the inertial navigation community

Need
- To standardize both manufacturer and user specifications for inertial measurement units (IMU)
- Establish common ground will be between manufacturers and users such that there will be no misunderstanding as to the meaning of a specified capability or performance requirement
Why Support the GAP?
Company Benefits

- Opportunity to influence the Inertial Community
- Opportunity to influence inertial standards
  - Ensure standard is compliant with your product or needs
  - Ensure that a standard is not adopted without your input
  - Ensure common terminology and practices so a user knows what they are getting
- Opportunity to know why a standard is the way it is and the context of it
  - Allows you to extrapolate
  - Allows you to apply the standard to another application
- Opportunity to enhance company image amongst the Inertial Community
- Opportunity to interact with customers to understand their needs
- Opportunity to promote new technologies

The GAP provides a non-threatening environment where a company’s intellectual property is protected by focusing on common practices
Personnel Development

- Opportunity for employees to be in a leadership role
- Opportunity for employees to learn how to write inertial specifications
- Opportunity for employees to learn common terminology and practices
- Opportunity for employees to stay current with technology
- Opportunity for employees to interact with others that have different expertise levels and skill sets
- Opportunity for employees to learn how to negotiate
  - Reach mutual agreement
  - Develop character
  - Resolve conflict

The GAP provides opportunities for employees to learn and grow professionally
Personal Benefits

- Opportunity to be productive and give back to the Inertial Community
- Opportunity for Camaraderie
  - Change of pace
  - Interact with others in the inertial community
- Opportunity to get your name in the standards
- Opportunity to enhance your recognition and visibility in the inertial community
- Opportunity to distinguish yourself from your coworkers
- Opportunity for a leadership role
- Opportunity for exposure to a wide range of inertial technologies
- Opportunity to visit other inertial community organizations

The GAP provides opportunities for a wide range of personal benefits
GAP Website

- **Public Page** ([http://ieee.grouper.org/groups/gap](http://ieee.grouper.org/groups/gap))
  - Charter
  - Bylaws
  - Objectives
  - Membership application form
  - Elected officers
  - Scheduled meetings

- **Private Page** (password protected)
  - Meeting Minutes
  - Drafts of standards
  - Membership lists