acamp
ALBERTA CENTRE FOR ADVANCED MNT PRODUCTS

ACAMP Inertial Test & Characterization

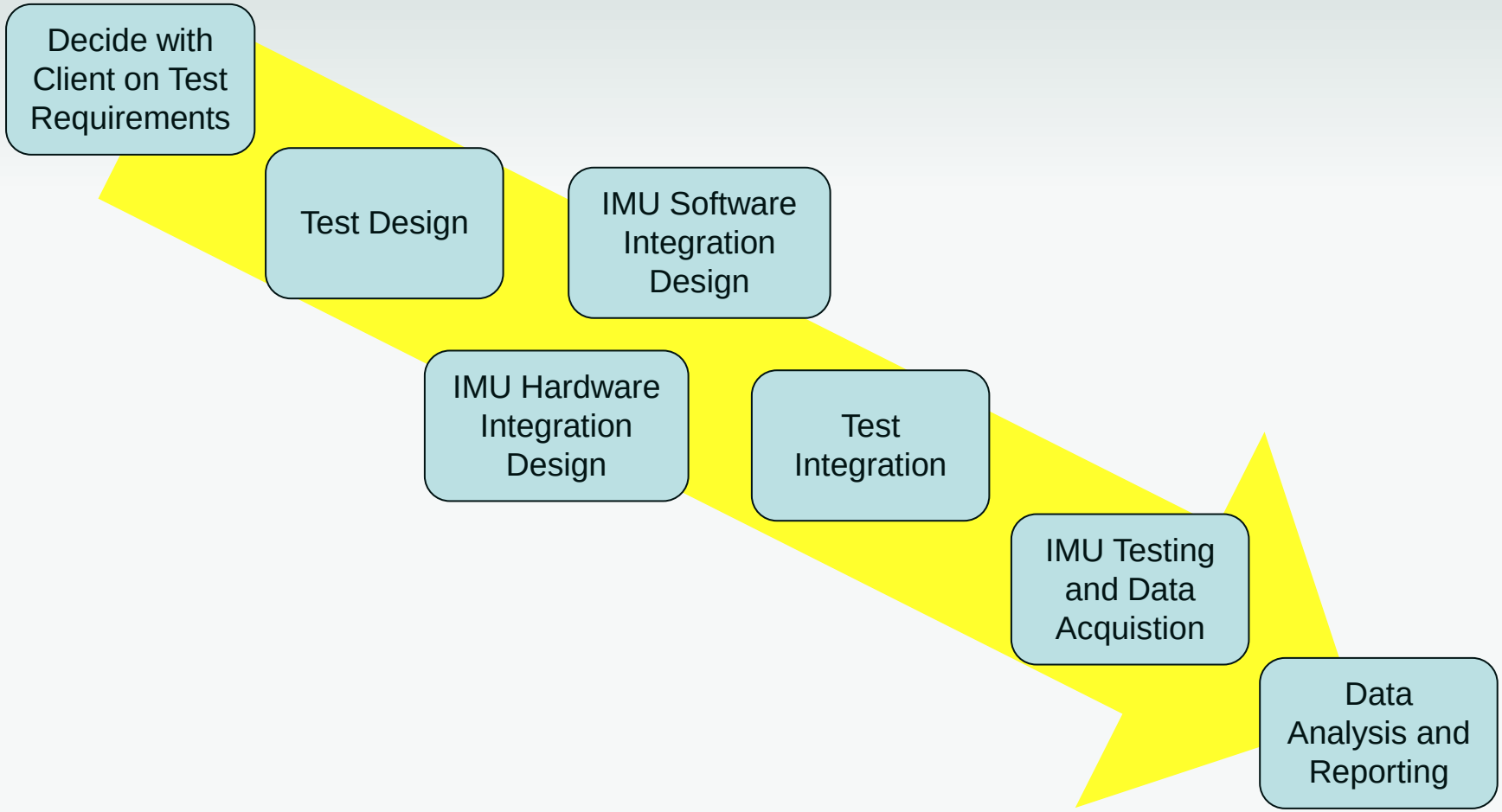
Working with ACAMP

ACAMP INERTIAL DEVELOPMENT

Presentation Agenda

- Inertial Client Interaction, and Test System Overview
- Rate Table Testing: Specific Inertial Testing Available

Rate Table Testing Process

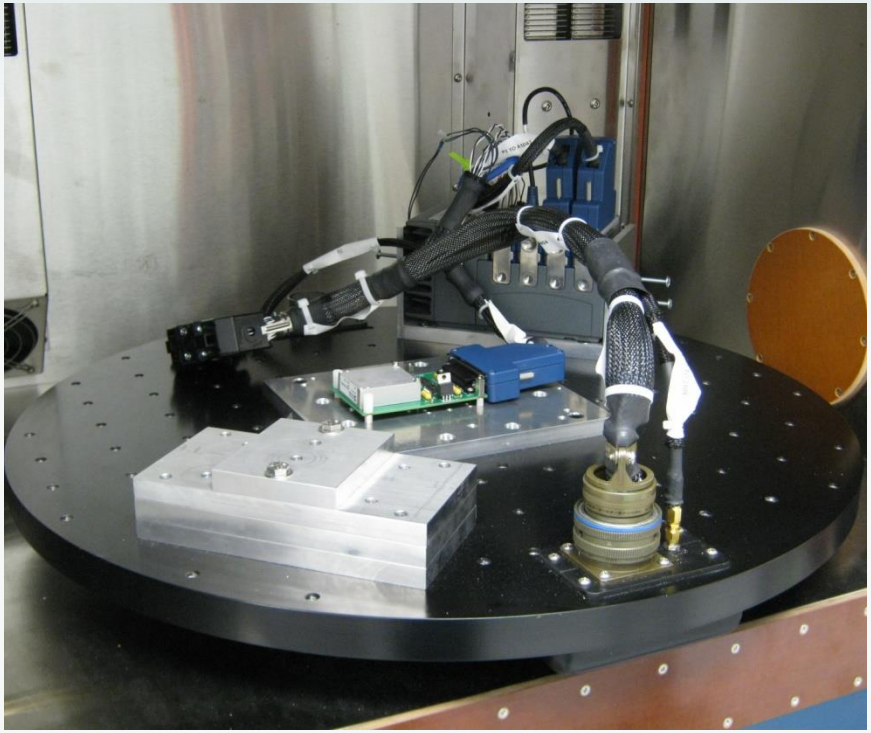


Test Design

- Discuss with client what tests are to be done
- Work out a test process to provide optimal solution
- ACAMP provides detailed test plan for client approval and provides costing information
  - Testing plans are taken as much as possible from applicable standards documents

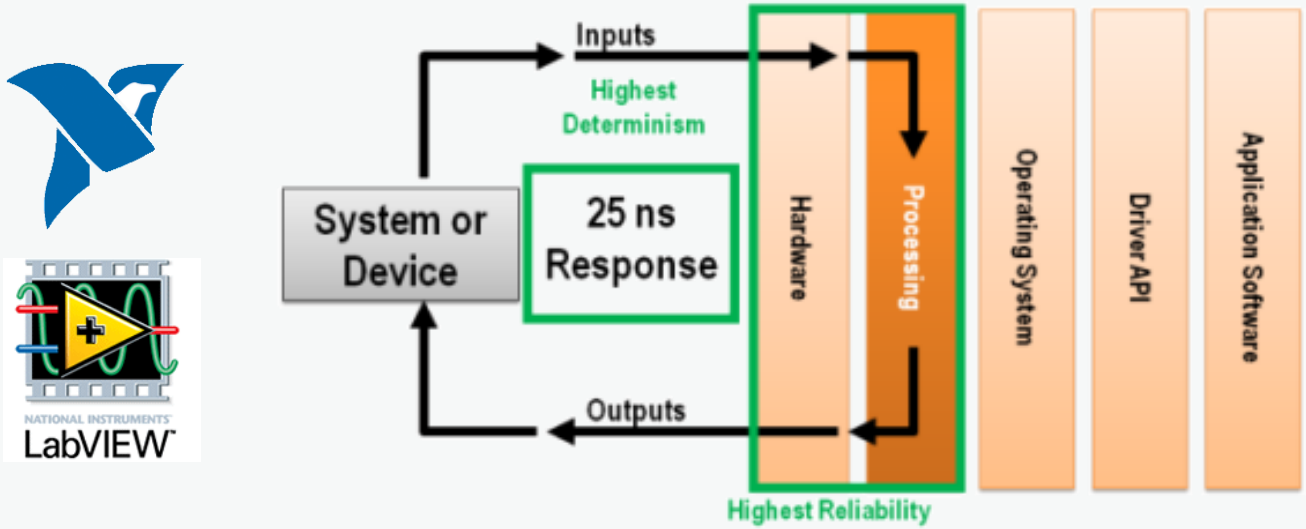
Hardware Design

- Cable design – interface IMU with rate table and DAQ setup
- Mounting board – IMU strapdown
- Rate table leveled with respect to IMU



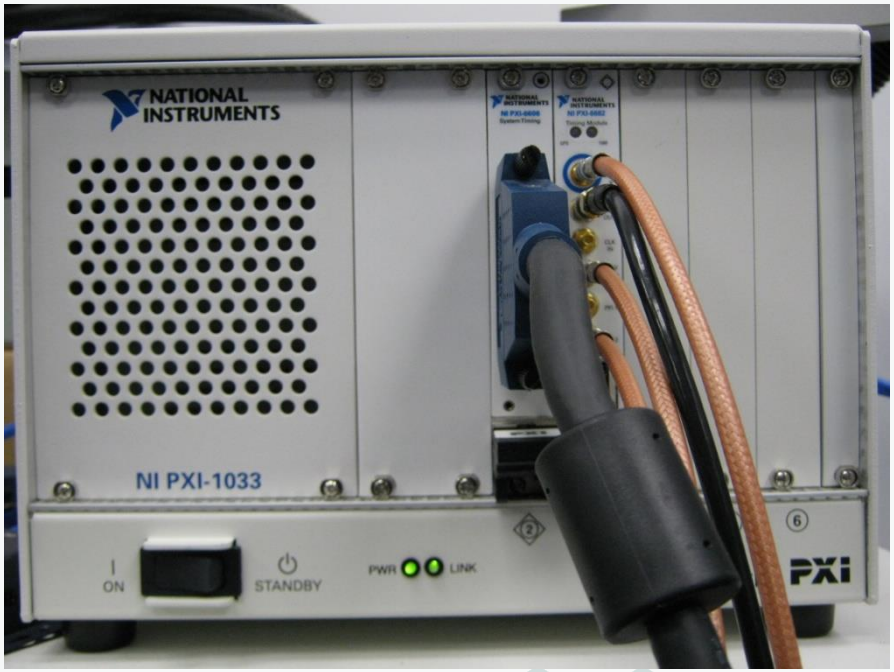
Software Design

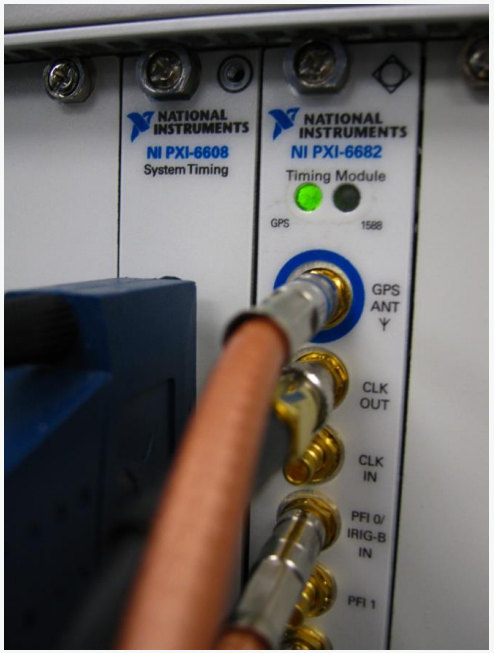
- IMUs communicate with a variety of methods: SPI, RS232, RS485, etc.
- Wholly configurable to each unique IMU interface



System Clock Setup

- Time Setup: Data acquisition triggered by PXI timing module - time stamps and IMU data collection are synced (GPS time)





Data Acquisition

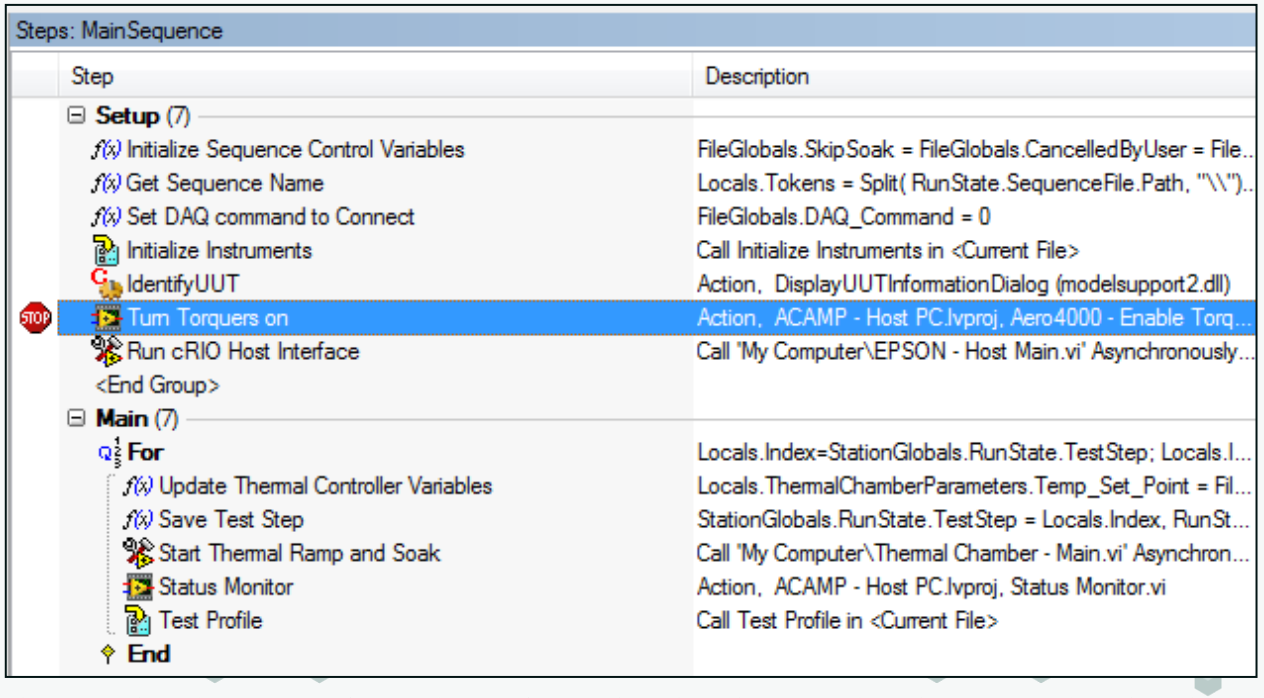
- IMU data logged to DAQ computer by cRIO real time computer

- Rate table position data logged simultaneously

IDEAL AEROSMITH

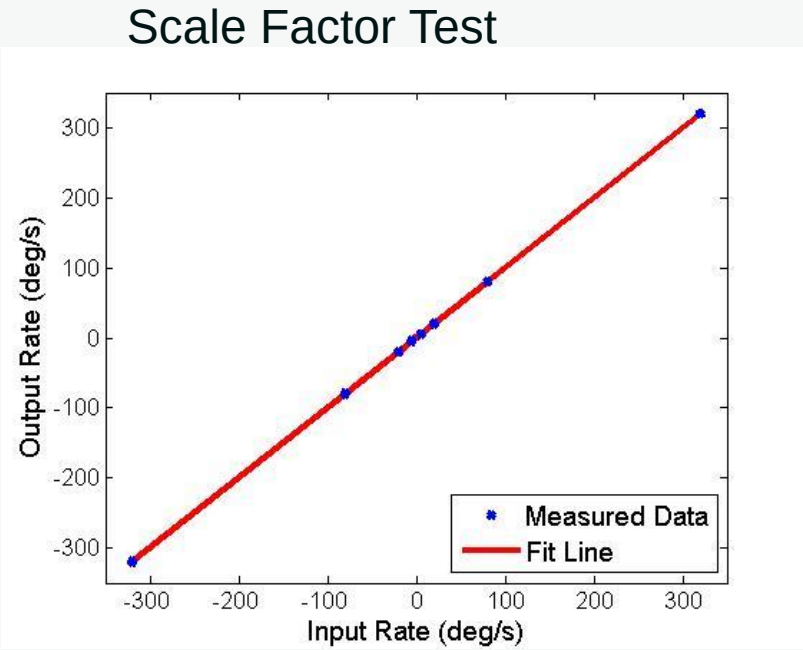
Test Synchronization

- NI TestStand integrates and synchronizes entire testing process
- Test parameters are easily configurable
- Tests can be modified quickly and easily if needed



Data Analysis

- ACAMP can process raw data to provide client with relevant ‘datasheet’ parameters
  - Scale Factor and scale factor errors
  - Bias and bias repeatability
  - Allan Variance with ARW/VRW and bias stability

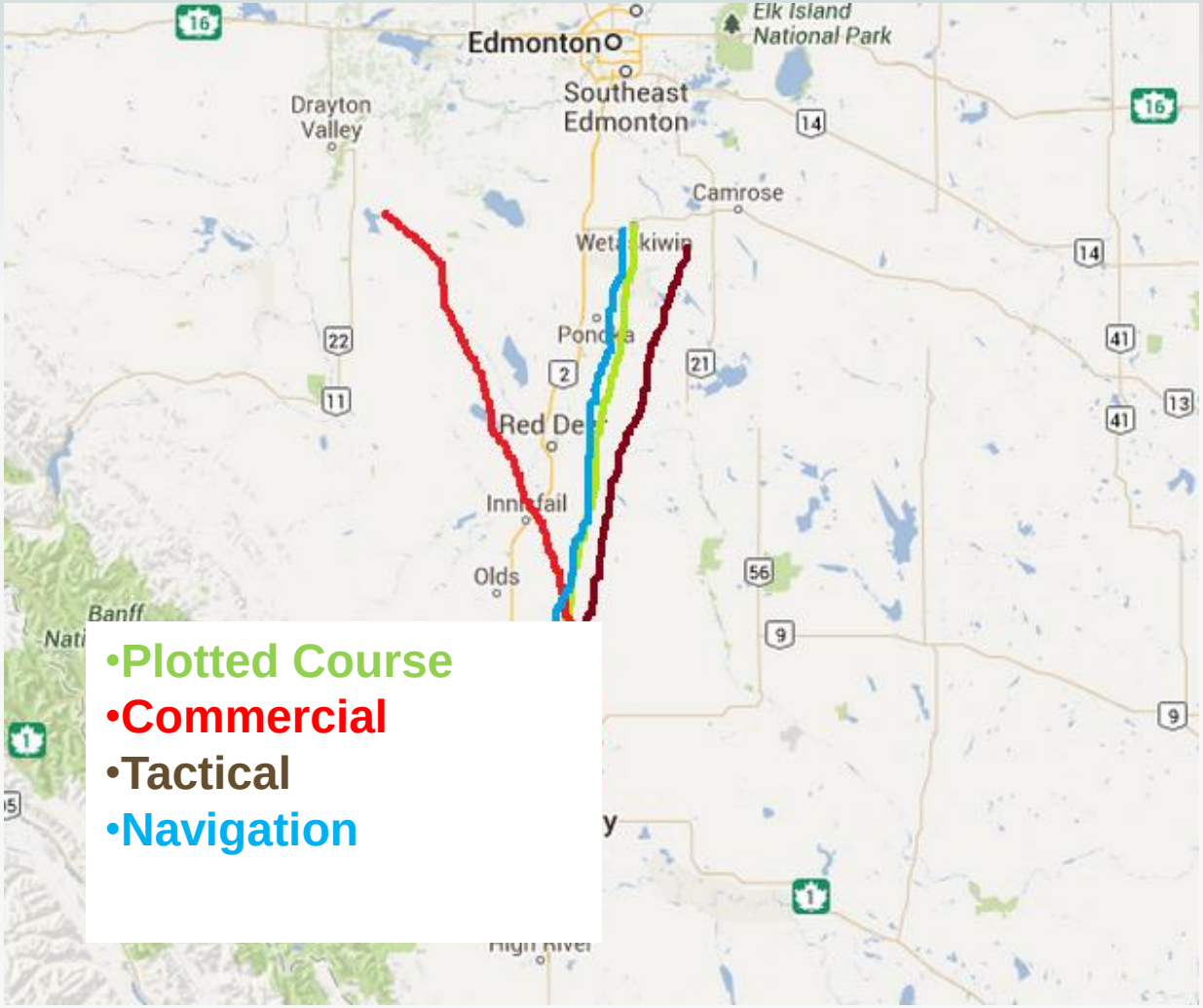


ACAMP INERTIAL DEVELOPMENT

Rate Table Testing: Specific Inertial Testing Available

Reason for specific tests

- **Goal is to get where you are trying to go**
- Why can't you get there?
  - Various Errors:
    - Noise errors
    - Scale Factor Errors
    - Bias errors



Rate Table Testing at ACAMP

Gyroscope Parameters

- Scale Factor
- Scale Factor Errors
  - Error (1σ)
  - Non-linearity
  - Asymmetry
- Scale Factor Repeatability
- Axis Misalignment
- *g*-Sensitivity
- Absolute Bias
- Bias Repeatability
- In-Run Bias Instability
- Angular Random Walk
- Temperature Dependence
- Latency Testing

Accelerometer Parameters

- Scale Factor
- Scale Factor Error (1σ)
- Scale Factor Repeatability
- Axis Misalignment
- Absolute Bias
- Bias Repeatability
- In-Run Bias Instability
- Velocity Random Walk
- Temperature Dependence
- Latency Testing

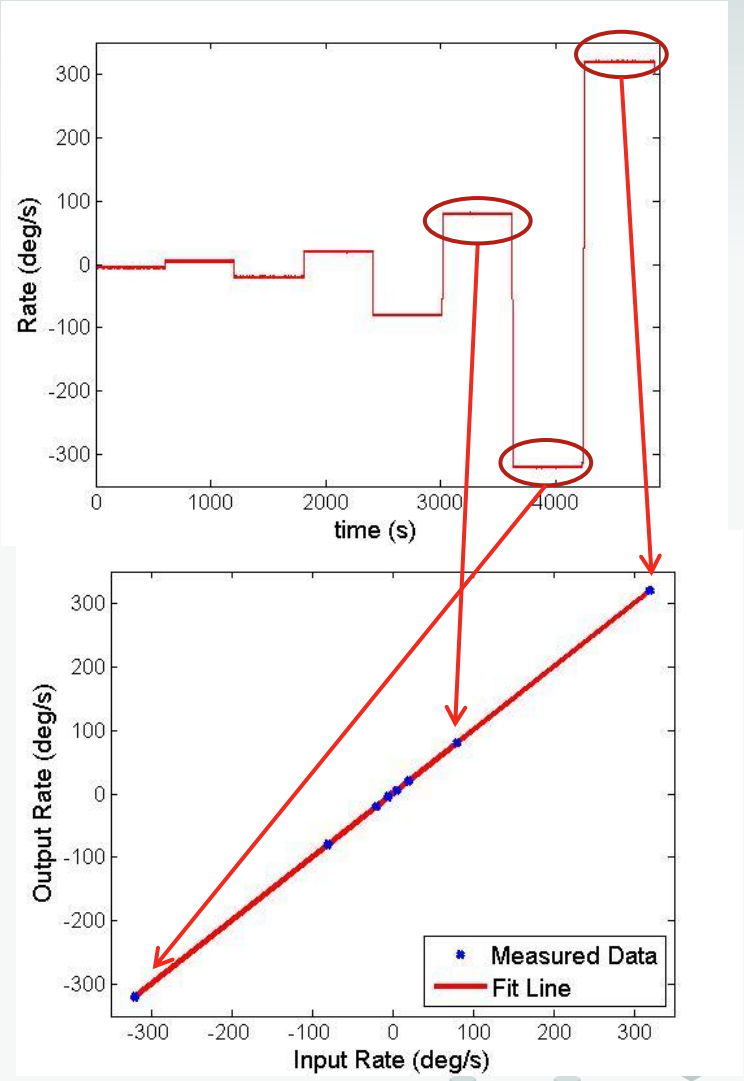
Rate Testing

IMU Specs Available

- Gyroscope Specs
  - Scale Factor
  - Scale Factor Errors
  - Scale Factor Repeatability
  - Axis Misalignment

Test Procedure

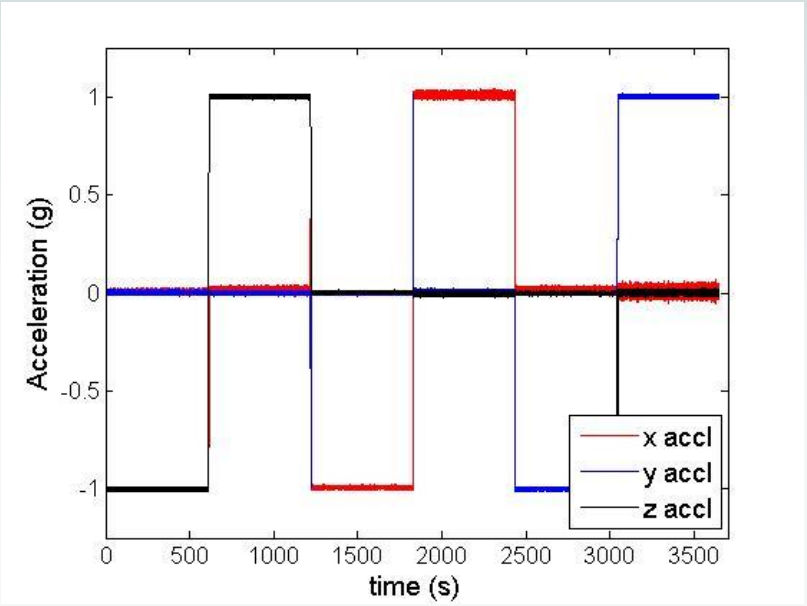
- Spin rate table at varying rates, in several orientations



6-Position Testing

IMU Specs Available

- Gyroscope Specs
  - *g*-Sensitivity
  - Absolute Bias
  - Bias Repeatability
- Accelerometer Specs
  - Scale Factor
  - Scale Factor Error (1σ)
  - Scale Factor Repeatability
  - Axis Misalignment
  - Absolute Bias
  - Bias Repeatability



Test Procedure

- Collect static data in 6 orthogonal positions with net-0 external bias

Allan Variance Testing

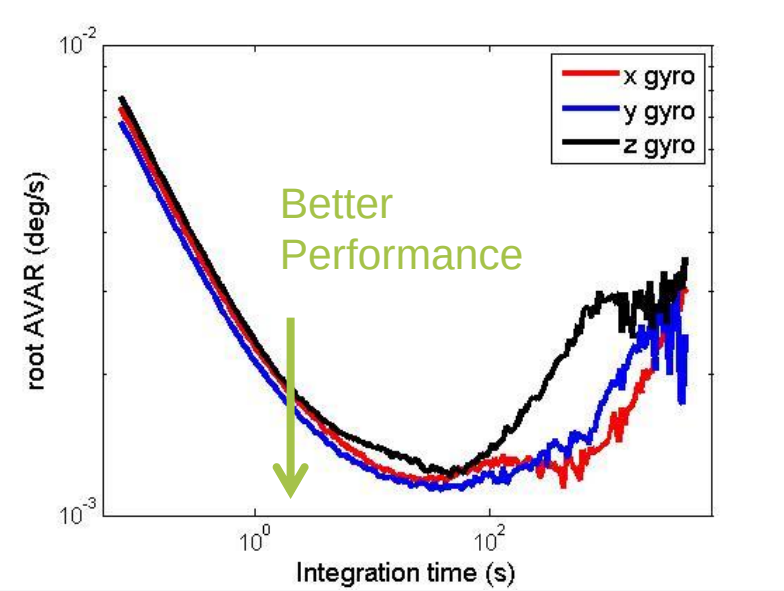
no motion, intrinsic noise measurement

IMU Specs Available

- Gyroscope Specs
  - In-Run Bias Instability
  - Angular Random Walk (ARW)
- Accelerometer Specs
  - In-Run Bias Instability
  - Velocity Random Walk (VRW)

Test Procedure

- Leave device on stable surface and collect data for long durations of time



ADIS16375 Data Comparison

Characteristic	ACAMP Measurement	Manufacturer Data Sheet
Absolute Bias (Gyro)	0.2 °/s	1 °/s (1σ)
Absolute Bias (Accel)	9.1 mg	16 mg (1σ)
In-Run Bias Stability (Gyro)	11.4 °/hr (1σ)	12 °/hr (1σ)
In-Run Bias Stability (Accel)	0.13 mg (1σ)	0.13 mg (1σ)
Angular Random Walk	1.74 °/√hr	1.0 °/√hr
Velocity Random Walk	0.090 m/s/√hr	0.076 m/s/√hr
Scale Factor (Gyro)	0.013105 °/s/LSB	0.01311 °/s/LSB
Scale Factor Error (Gyro)	330 ppm	< 250 ppm
Scale Factor (Accel)	0.81992 mg/LSB	0.8192 mg/LSB
Scale Factor Error (Accel)	320 ppm	< 1000 ppm
g-Sensitivity (Gyro)	0.002 °/s/g	0.013 °/s/g