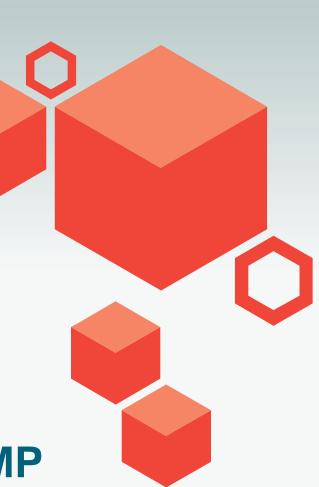


ACAMP Inertial Test & Characterization







ACAMP INERTIAL DEVELOPMENT

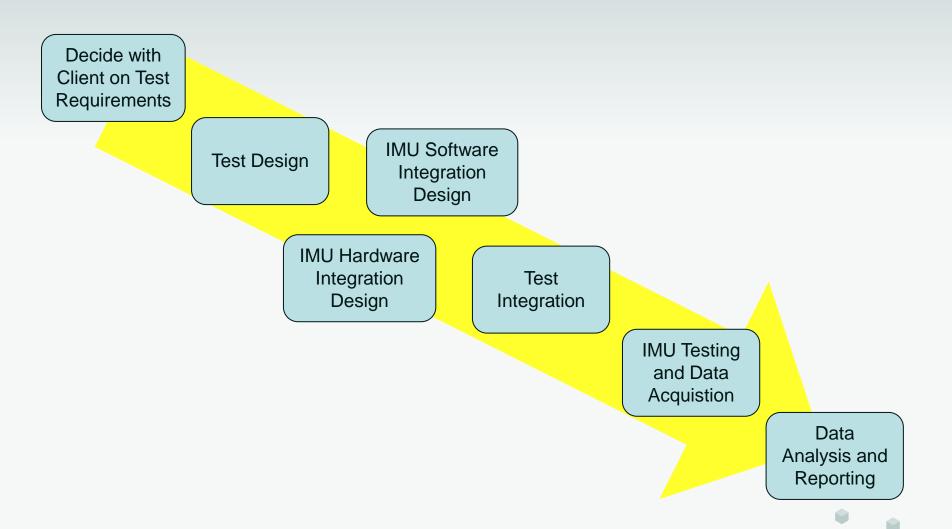
Presentation Agenda

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





acamp Rate Table Testing Process



acamp 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

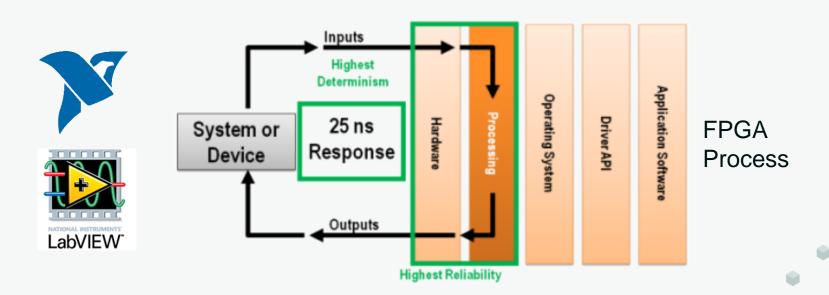


- Cable design –
 interface IMU with
 rate table and DAQ
 setup
- Mounting board –IMU strapdown
- Rate table leveled with respect to IMU



acamp Software Design

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



acamp System Clock Setup

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







IMU data logged to DAQ computer by cRIO real time computer







AEROSMITH

Rate table position data logged simultaneously



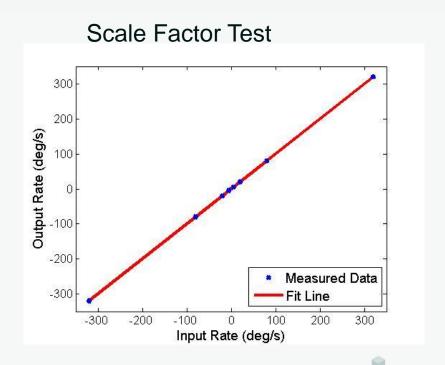
- NI TestStand integrates and synchronizes entire testing process
- Test parameters are easily configurable
- Tests can be modified quickly and easily if

needed

Step		Description
Setup	(7)	
f(x) Initi	alize Sequence Control Variables	FileGlobals.SkipSoak = FileGlobals.CancelledByUser = File.
f(x) Get	Sequence Name	Locals.Tokens = Split(RunState.SequenceFile.Path, "\\").
f(x) Set DAQ command to Connect		FileGlobals.DAQ_Command = 0
🔀 Initi	alize Instruments	Call Initialize Instruments in <current file=""></current>
🔚 lde	ntifyUUT	Action, DisplayUUTInformationDialog (modelsupport2.dll)
📭 Tur	n Torquers on	Action, ACAMP - Host PC.lvproj, Aero4000 - Enable Torq
% Ru	n cRIO Host Interface	Call 'My Computer\EPSON - Host Main.vi' Asynchronously.
<end (<="" td=""><td>Group></td><td></td></end>	Group>	
■ Main	(7)	
Q g Fo	r	Locals.Index=StationGlobals.RunState.TestStep; Locals.I
f(x)	Update Thermal Controller Variables	Locals.ThermalChamberParameters.Temp_Set_Point = Fil
f(x)	Save Test Step	StationGlobals.RunState.TestStep = Locals.Index, RunSt
98	Start Thermal Ramp and Soak	Call 'My Computer\Themal Chamber - Main.vi' Asynchron
12	Status Monitor	Action, ACAMP - Host PC.lvproj, Status Monitor.vi
<u></u>	Test Profile	Call Test Profile in <current file=""></current>
∳ En	d	



- 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

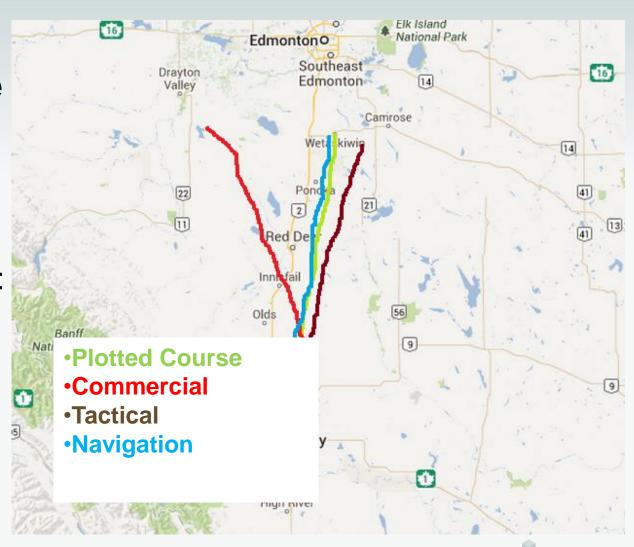
Rate Table Testing: Specific Inertial Testing Available





acamp 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



ACAMPRate Table Testing at ACAMP

Gyroscope Parameters

- Scale Factor
- Scale Factor Errors
 - \bullet Error (1 σ)
 - 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

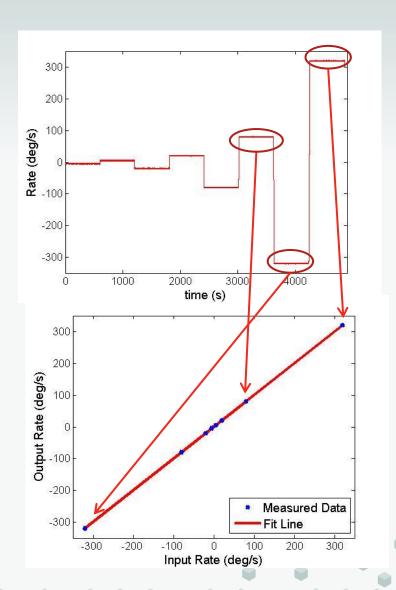


IMU Specs Available

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

Test Procedure

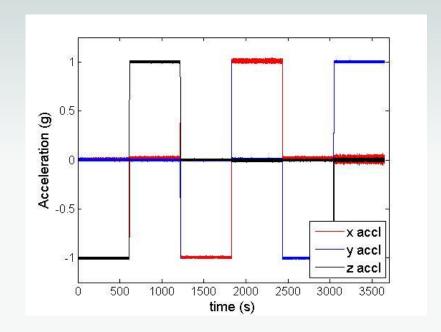
 Spin rate table at varying rates, in several orientations



acamp 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

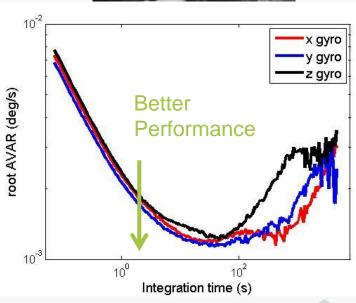
IMU Specs Available

- 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







acamp 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