



Ascendant
Engineering Solutions

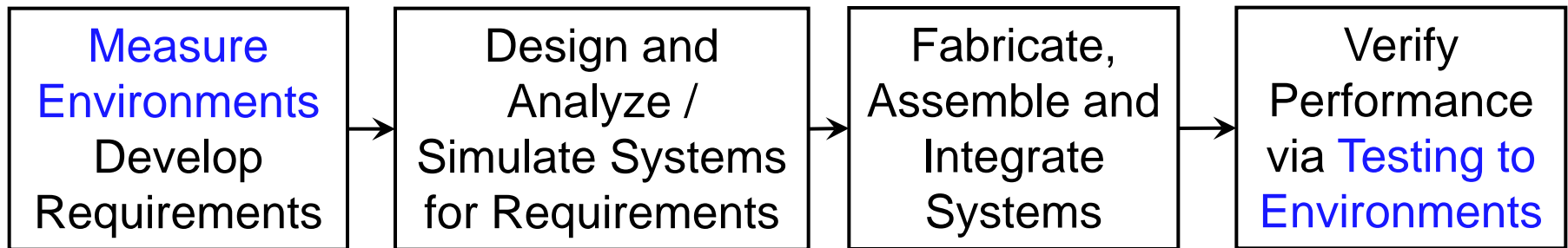
Measuring Vehicle Environments and Testing Their Small
Stabilized Payloads – A Simple, Affordable Approach

National Defense Industrial Association
50th Annual Targets, UAVs & Range Operations Symposium & Exhibition
“The Future of Testing and Training”

Session III: Current Developments
4 October 2012

The Future of Testing and Training

- Major stages of the Product Development Cycle



- AES presentation covers the front-end vehicle **environmental measurement** of small unmanned systems; and..
- The end-game system **testing** of unmanned system stabilized platforms or other motion-sensitive equipment

Market Background



Explosive Growth of Unmanned Systems

- One of the few areas of defense budget actually increasing
- Rapid proliferation of new vehicles, especially smaller, lower cost systems

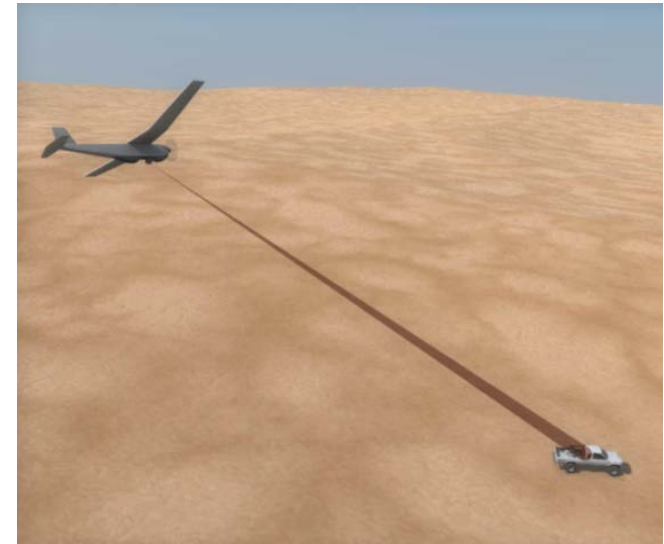
Most, if not all carry sensor systems, many of which are in stabilized gimbal

- Meet target recognition and identification ranges
- Work with integrated target trackers, laser designators for ordnance delivery or for guidance in weaponized UAVs

DoD Unmanned Aircraft Systems (As of 1 JULY 2011)					
General Groupings	Depiction	Name	(Vehicles/GCS)	Capability/Mission	Command Level
Group 3 • < 1320 lbs • < FL180 • < 250 knots		•USA MQ-5 Hunter	•45/21	•ISR/RSTA/BDA	•Corps, Div, Brig
		•USA/USMC/SOCOM RQ-7 Shadow	•368/265	•ISR/RSTA/BDA	•Brigade Combat Team
		•USN/USMC STUAS	•0/0	•Demonstration	•Small Unit
Group 2 • 21-55 lbs • < 3500 AGL • < 250 knots		•USN/SOCOM/USMC RQ-21A ScanEagle	•122/13	•ISR/RSTA/FORCE PROT	•Small Unit/Ship
Group 1 • 0-20 lbs • < 1200 AGL • < 100 knots		•USA / USN / USMC / SOCOM RQ-11 Raven	•5628/3752	•ISR/RSTA	•Small Unit
		•USMC/ SOCOM Wasp	•540/270	•ISR/RSTA	•Small Unit
		•SOCOM SUAS AECV Puma	•372/124	•ISR/RSTA	•Small Unit
		•USA gMAV / USN T-Hawk	•270/135	•ISR/RSTA/EOD	•Small Unit

AES Background

- AES is a design services company in Austin, Texas helping companies bring a wide variety of commercial and military products to market
- AES recently completed three small stabilized gimbal designs
- We are currently working on a 4th new stabilized gimbal for AFRL through SBIR AF112-097
 - “Develop stabilized gimbal with precision laser (designator) pointing capability for small hand launched UAVs, and mid-sized tube launched UAVs. “
- AES discovered that there was virtually no environmental data for these small vehicles and no relatively inexpensive test equipment for simulating multiple axes of angular motion to evaluate stabilization performance



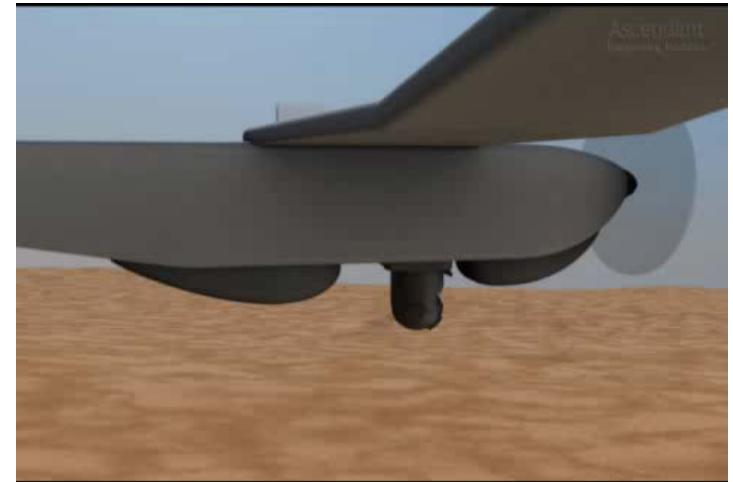
**Small UAV Gimbal Laser
Designating Target**

Introduction / Description of Problem

- Paramount to the design and analysis of these stabilized imaging systems (or any sensitive subsystems / components) is an understanding of the vehicle motion / vibration environment

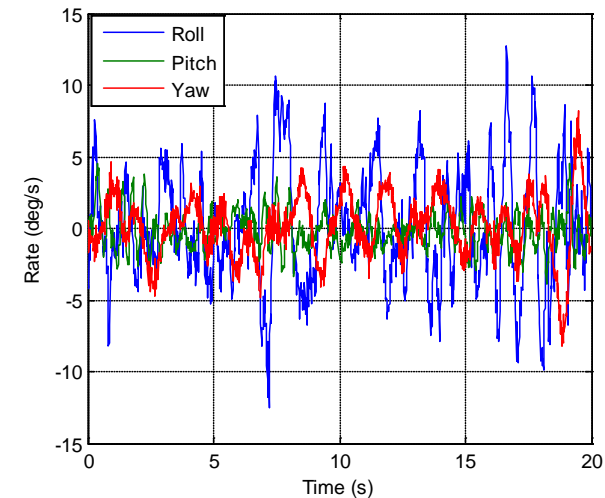
- Angular motions that the gimbal is required to reject
- Vibration that can adversely affect performance via structural response, gyro noise due to g-sensitivity, other electronics / sensors sensitive to vibration

- Unlike larger, more costly manned vehicle programs, structured efforts to instrument and gather motion / vibration data on smaller unmanned vehicles is rare



Engagement Simulation Animation

**Typical Small
UAV Roll, Pitch,
Yaw Rates**



Traditional Measurement and Test

- Vehicles typically instrumented by large company internal test group or external testing labs

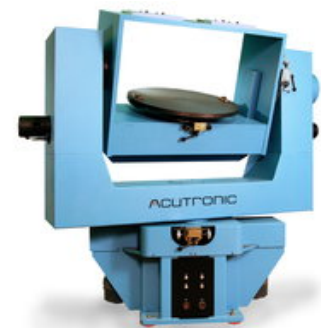
- Equipment usually not small or lightweight
- Generally uses vehicle power and infrastructure
- Process time consuming involving a number of test engineers to gather and reduce data

- For testing stabilized gimbals, multi-axis rate tables exist, but they:

- Are expensive >\$100k
- Have long procurement lead times
- Require significant facilities infrastructure

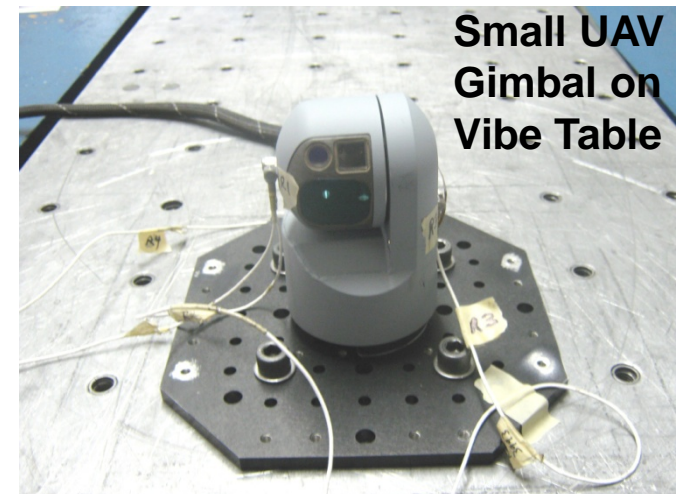
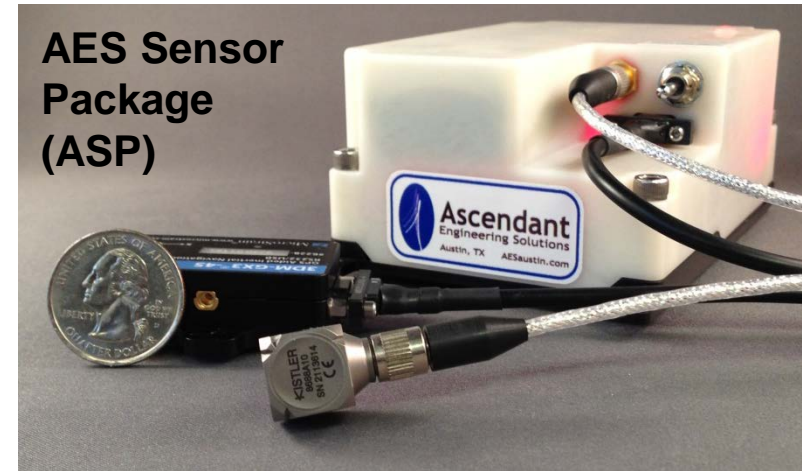


**COTS
Rate
Tables**



AES Sensor Package (ASP)

- Self-contained
- 2" X 3" X 5" and <math><3/4</math> lb package
- Six hour (battery) recording capability
- 6DOF Angular & Trans. - DC to 100 Hz
- GPS for location / altitude
- Magnetometer for heading
- Gyro Rates, Attitude/Heading (Roll, Pitch, Yaw)
- Small accelerometer - 10G, 2 to 1 kHz, 3 axes
- All data time-stamped
- Engineering data parsing and data reduction



AES Sensor Package (ASP) Simple Data Collection Process

- Easy and affordable method to gather environmental data on any vehicle platform
 - Mount sensors and package in vehicle and turn it on
 - Vehicle executes mission / operation
 - Remove equipment and reduce data
- Ability to easily piggyback on other tests

1) Install



Sensors

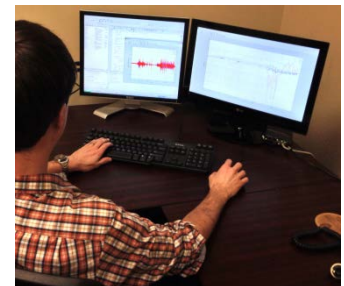


Data Logger

2) Measure



3) Reduce Data

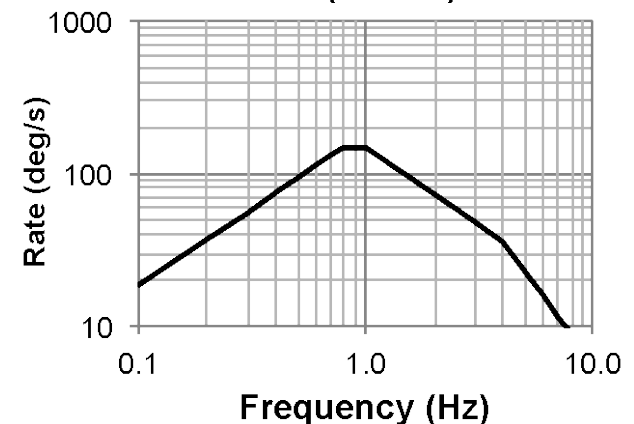


AES 3DOF Motion Simulator (A3MS)

- Simulates motion of unmanned vehicles
 - aerial, ground and marine vehicles
 - Small UAV, HMMWV, and patrol boat data used to establish max motion ranges
- Simulates simultaneous 3DOF motion
 - Measured time history, or
 - Spectrum / frequency-based
- UUT capacity – up to 20 lb, 10” tall, 7” dia
- Range of Motion
 - Position: $\pm 30^\circ$
 - Rate: $\pm 150^\circ /s$
 - Accel: $\pm 1000^\circ /s^2$
- Portable – under 25 lbs, 110V AC power
- 3DOF real-time (e.g. joystick) control in development



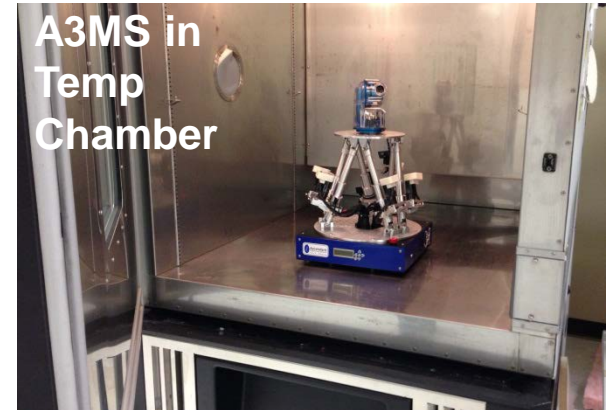
**AES 3DOF Motion Simulator
(3 Axes)**



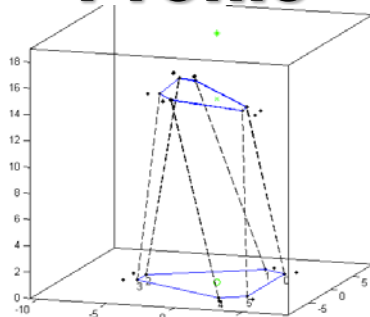
AES 3DOF Simulator (A3MS)

Simple Testing Process

- Excellent engineering testing tool
- Quickly evaluate stabilized platforms or other angular motion-sensitive sensors / systems
- Portability allows testing in labs and outdoor ranges - on towers / platforms to view / track targets and evaluate stabilization performance
- Operational over Mil-Spec temperature range -40° C to $+65^{\circ}$ C – can be used in environmental chamber
- Lab testing with imaging collimators



4) Generate Profile



5) Install UUT



6) Simulate



Measurement / Test Example

Helicopter UAV measurement and motion environment simulation



Future Opportunities / AES Contact Information



1) Install → 2) Measure → 3) Reduce Data

4) Generate Profile → 5) Install UUT → 6) Simulate



AES is currently delivering initial prototype units to beta customers. We are interested in discussing further sales, service or customization opportunities to meet your needs.

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