



Motion Analysis Smart Sensor MASS

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Motion Analysis Smart Sensor Overview

- CVII & VISION compliant data collection system
- 3 axis of angular rate and acceleration data
- Calculates passenger absorbed power value
- VISION BLOb format data in histogram and time history.
- Hardware Designed by ACM Systems
- Software Designed by Aberdeen Test Center

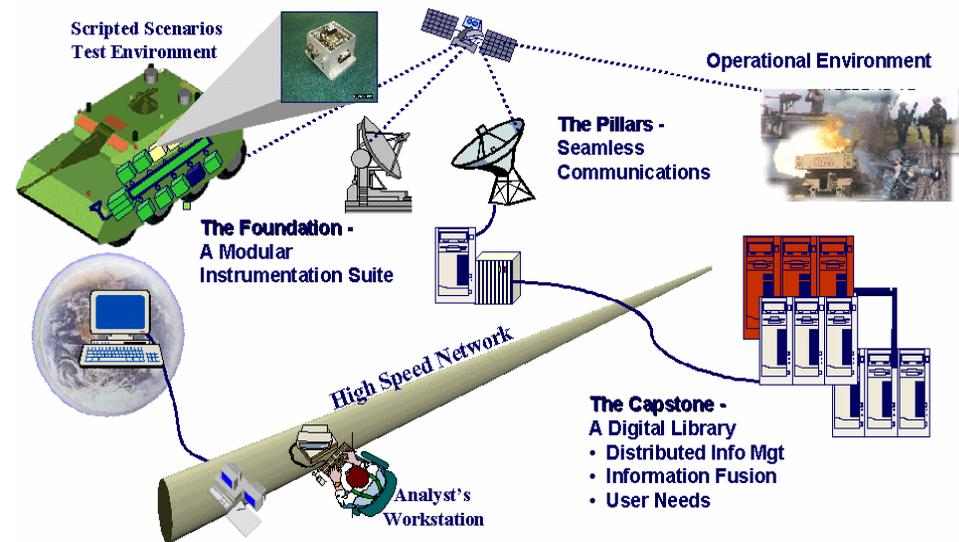
VISION

Versatile Information Systems Integrated On-line

VISION embodies a comprehensive, holistic, top down approach to information collection, management, and ultimate transformation into knowledge.

VISION

- **Modular Instrumentation Suite** – a family of intelligent instruments configured as an on-vehicle Local Area Network
- **Seamless Communications** – wireless Ethernet based on IEEE-802.11 standards
- **Digital Library** – knowledge management web-based system for information fusion



VISION employs a web-centric approach that merges and exploits instrumentation and information management technologies

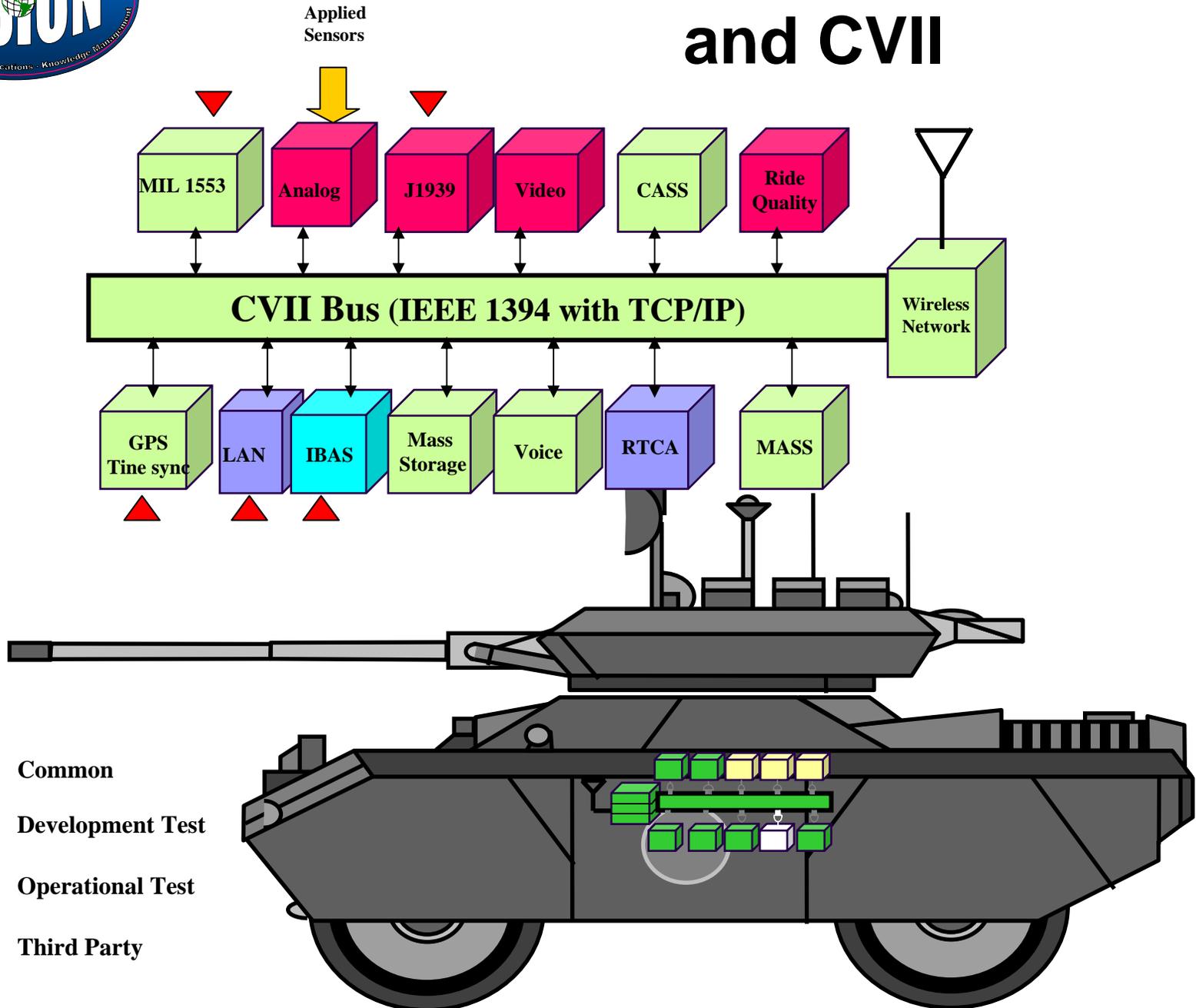
Common Vehicular Instrumentation Initiative (CVII)

CVII is a cooperative effort between the Aberdeen Test Center (ATC) and the Operational Test Command (OTC). CVII is defining the communication infrastructure for modular instrumentation used by the U.S. Army for test and training exercises. The specification includes hardware, protocol / services, and application level interface specifications that are based on a common object model.

CVII provides a basis for development of diverse modules which are configurable to the instrumentation requirements of the system under test without the expense of an entirely new instrumentation suite.



VISION Instrumentation and CVII



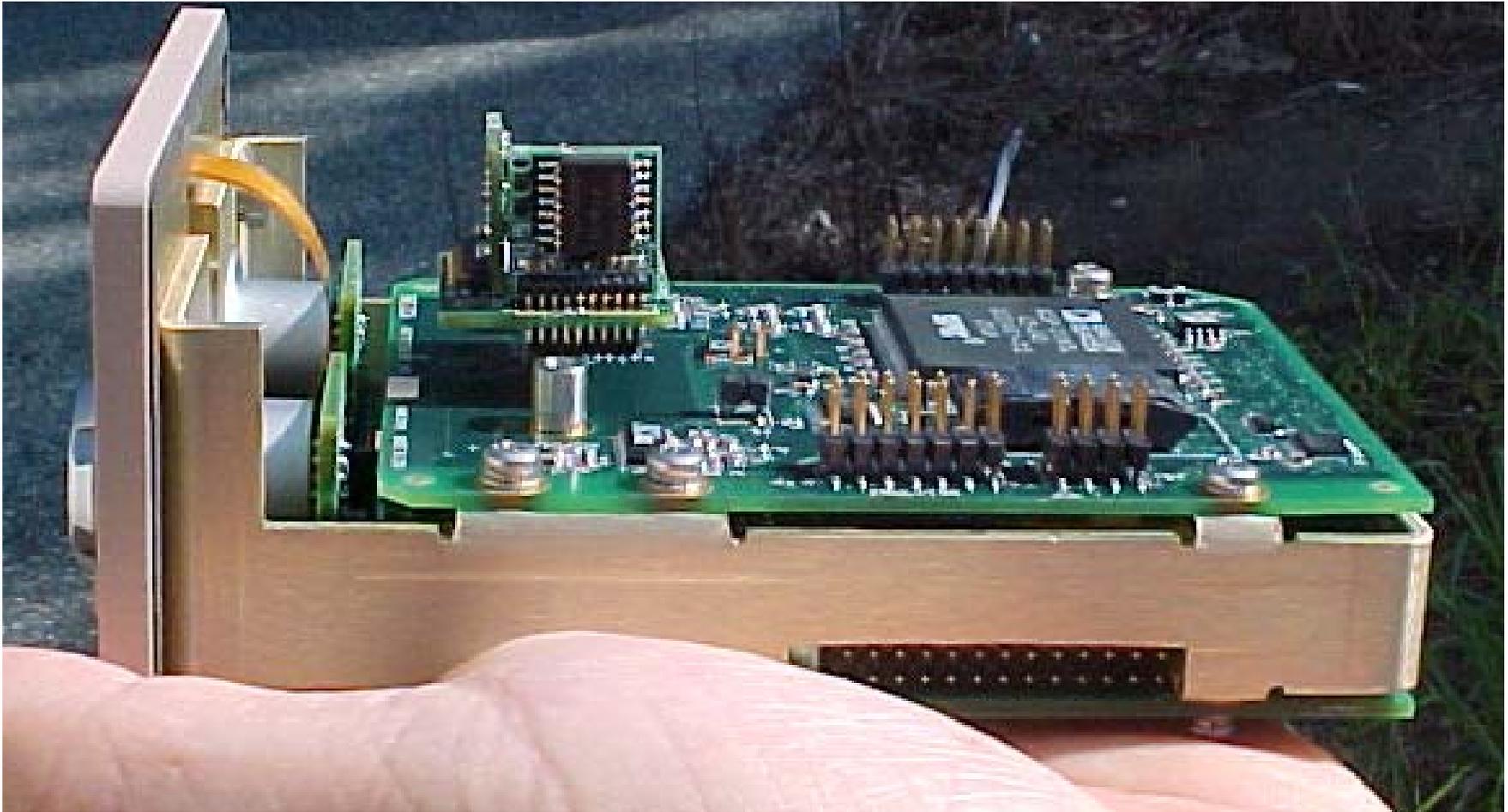


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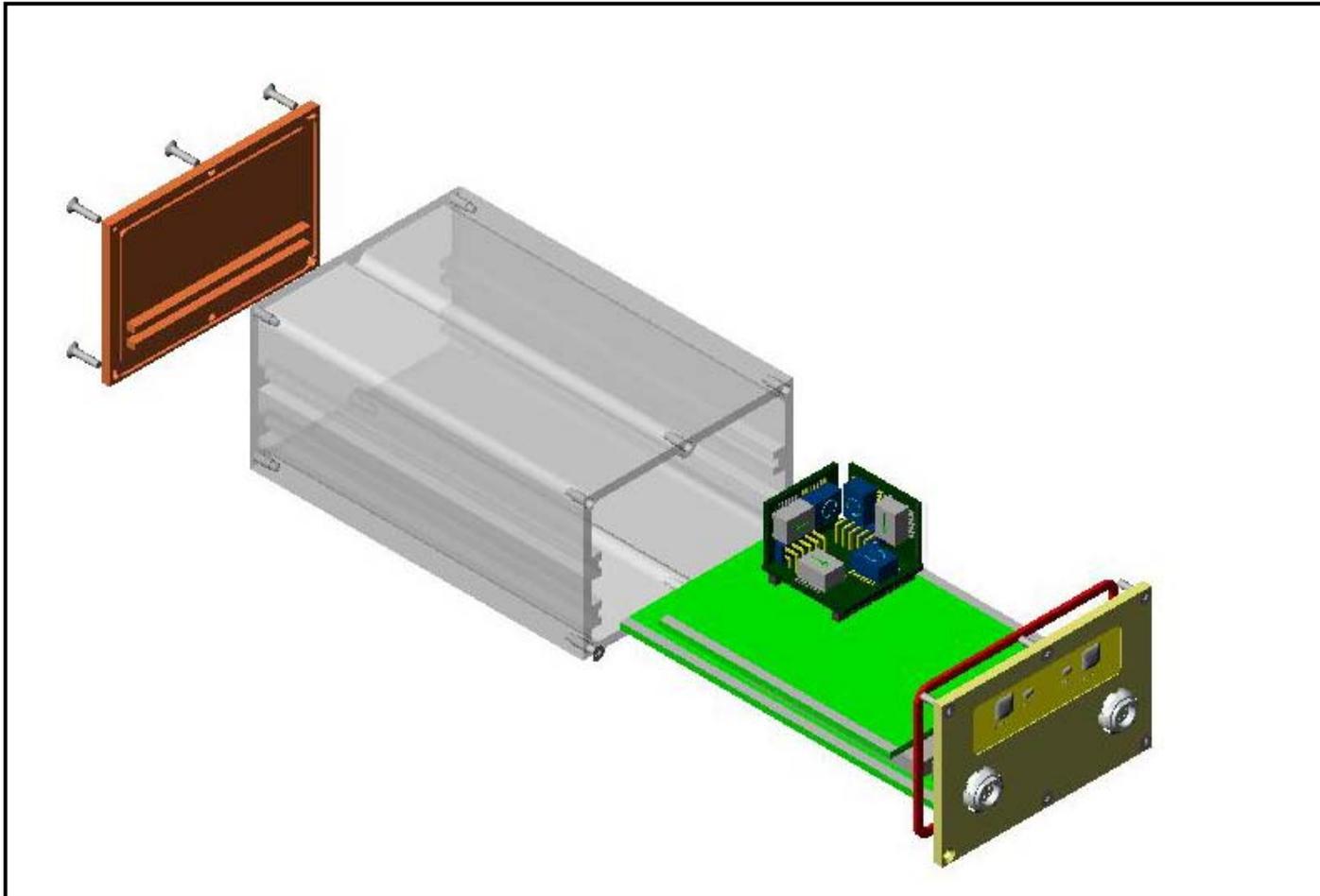


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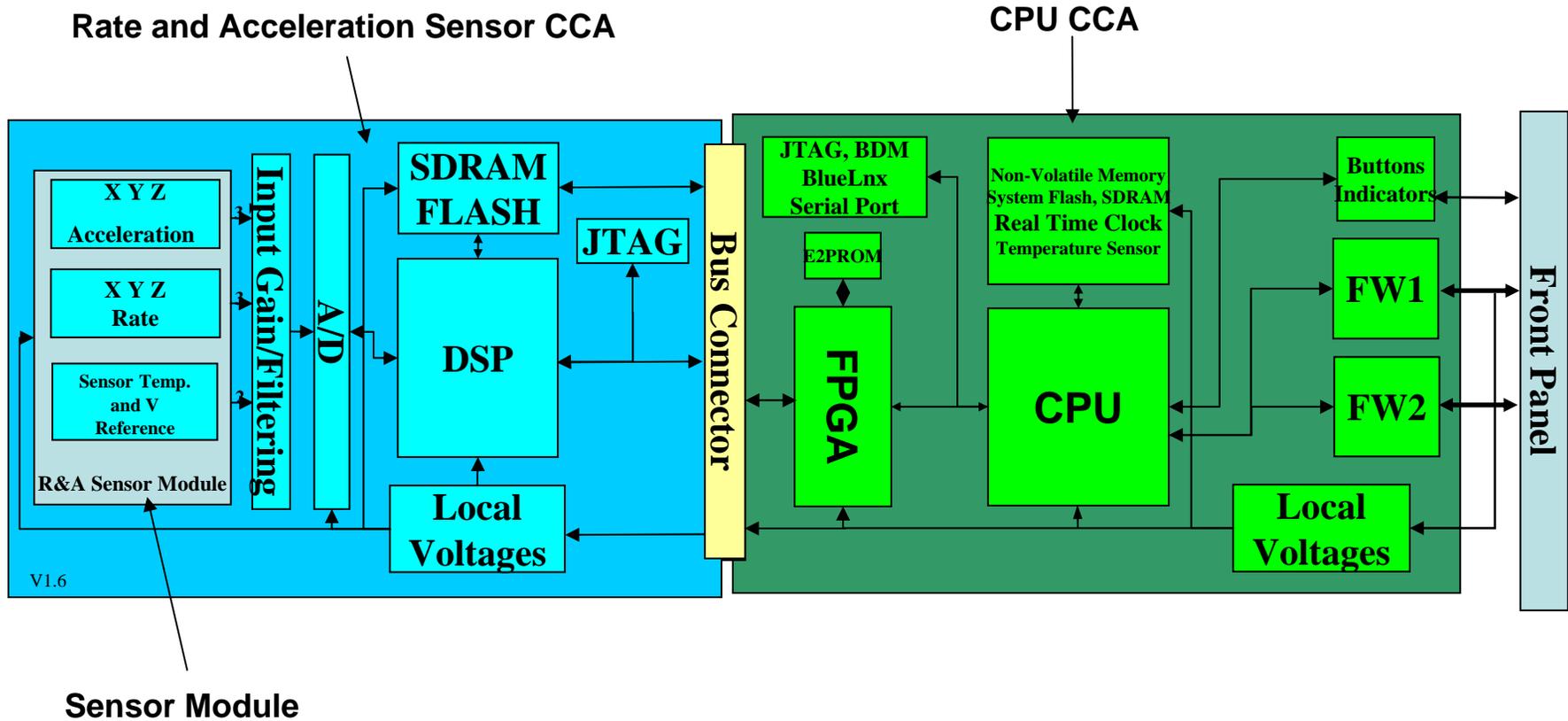




Motion Analysis Smart Sensor



MASS Design Overview – System Diagram





Sensor System Overview

- **Sensor Pod**

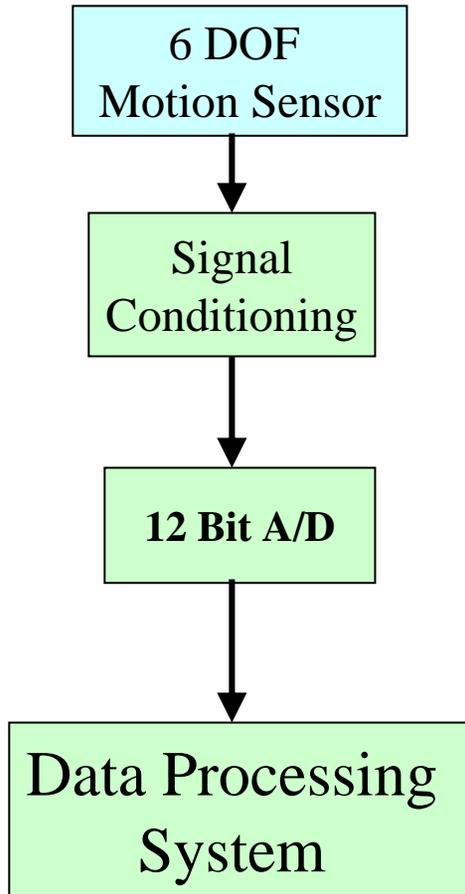
- Three Axis Rate Sensing

- Analog Devices ADXRS150
 - 1000 sps per channel (3000 sps aggregate)
 - Maximum Rate $\pm 60^\circ/\text{s}$
 - Accuracy $\pm 1^\circ/\text{s}$

- Three Axis Acceleration Sensing

- Analog Devices ADXL150/250 (g)
 - 1000 sps per channel (3000 sps aggregate)
 - Accuracy ± 0.05 g
 - Maximum Acceleration ± 25 g

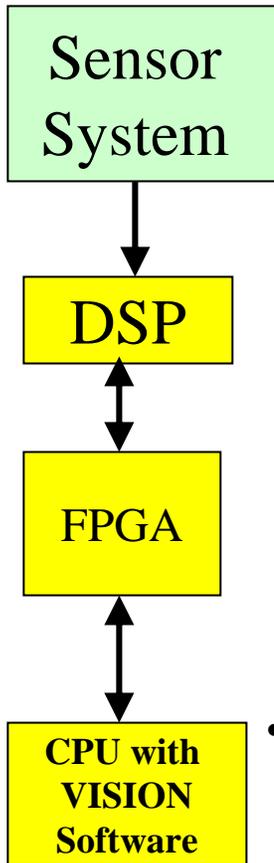
- Sensors are assembled in their proper orientation in a plastic housing





Data Processing System Overview

• CPU Architecture



– Motorola Coldfire CPU operating at 60Mhz,

- μ CLinux embedded operating system
- Running ADMAS Model based data collection software
- Processor is programmable to run up to 140 Mhz

– Analog Devices Digital Signal Processor (DSP)

- ADSP-21065 SHARK DSP
- Provides capabilities for real time data processing and statistical analysis

– Xilinx Spartan Field Programmable Gate Array (FPGA).

- Provides logic and interfaces to connect DSP to CPU

• Control/Status

– VISION Compliant ADMAS Model Based Software

- Designed with a UML design process
- Implemented with Rational Rose RealTime
- Responds to CVII compliant XML messages as well as ADMAS binary commands

– Status and statistics via IEEE 1394 (Fire Wire)

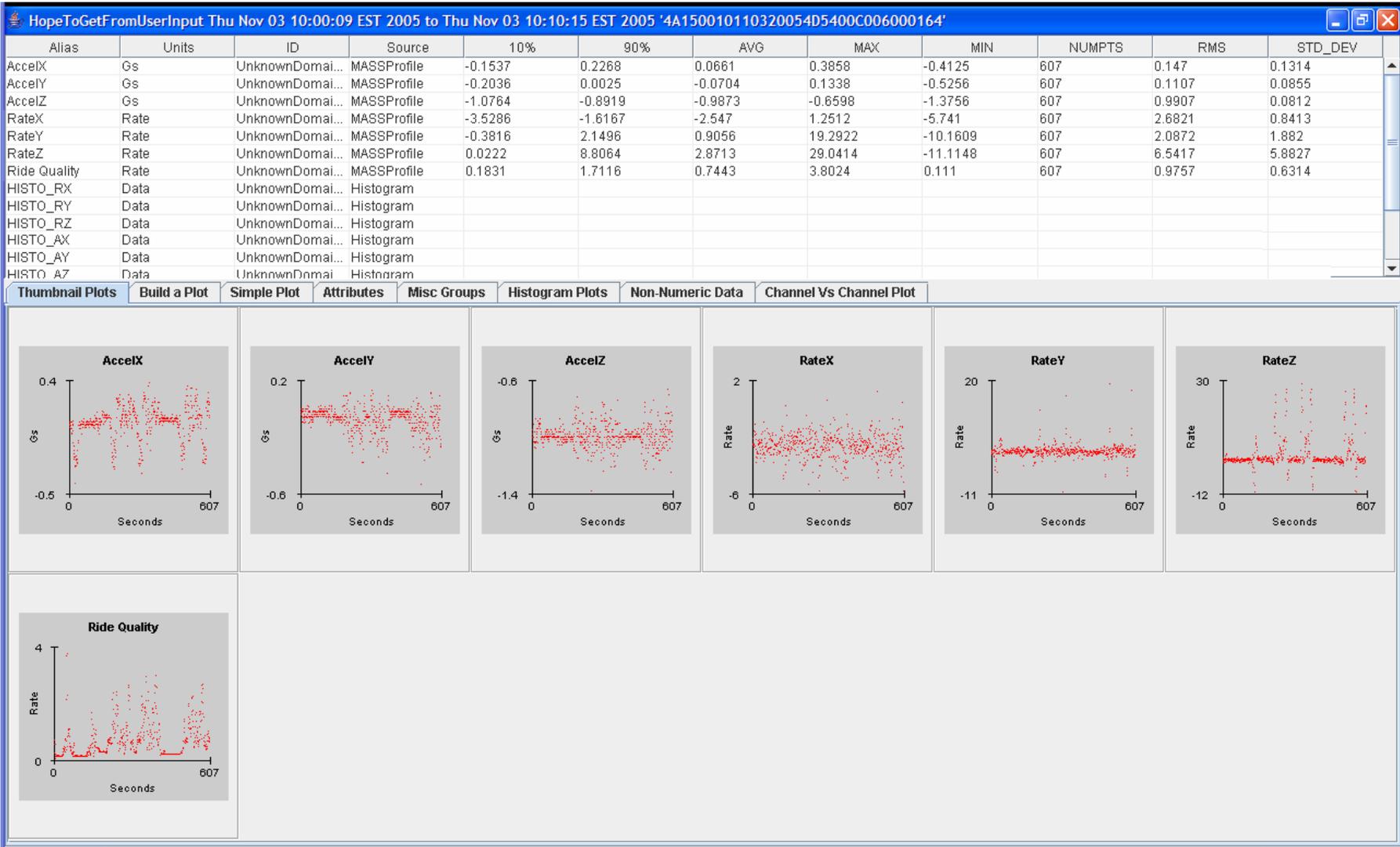
DSP application: Absorbed Power

- Calculation of the rate at which a human body absorbs power due to vibration of a vehicle.
- Created by the integration of weighted power spectral density functions of each axis of acceleration which are averaged together as scalars to form a power value
- This value can be used as a measure of human tolerance to vibration for military vehicles in rough terrain.
- Based on SAE Practices and DTC Test operating procedures.

DSP application: Histograms

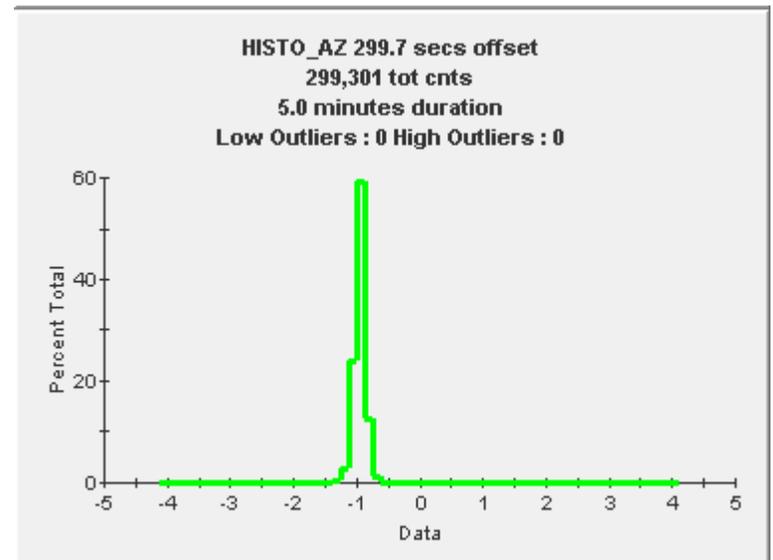
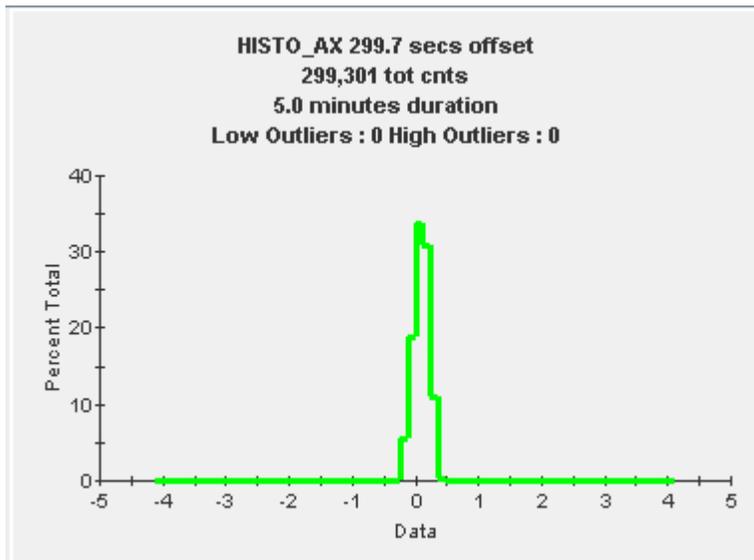
- The DSP is capable of creating Histograms of rate and acceleration data at rates of 1KHz
- This allows the CPU to use processing cycles on data storage, and command and control applications.
- Histograms parameters such as number of bins, bin sizes, min and max ranges and histogram period are configurable by the user by use of a TEMPL configuration file

Data Example

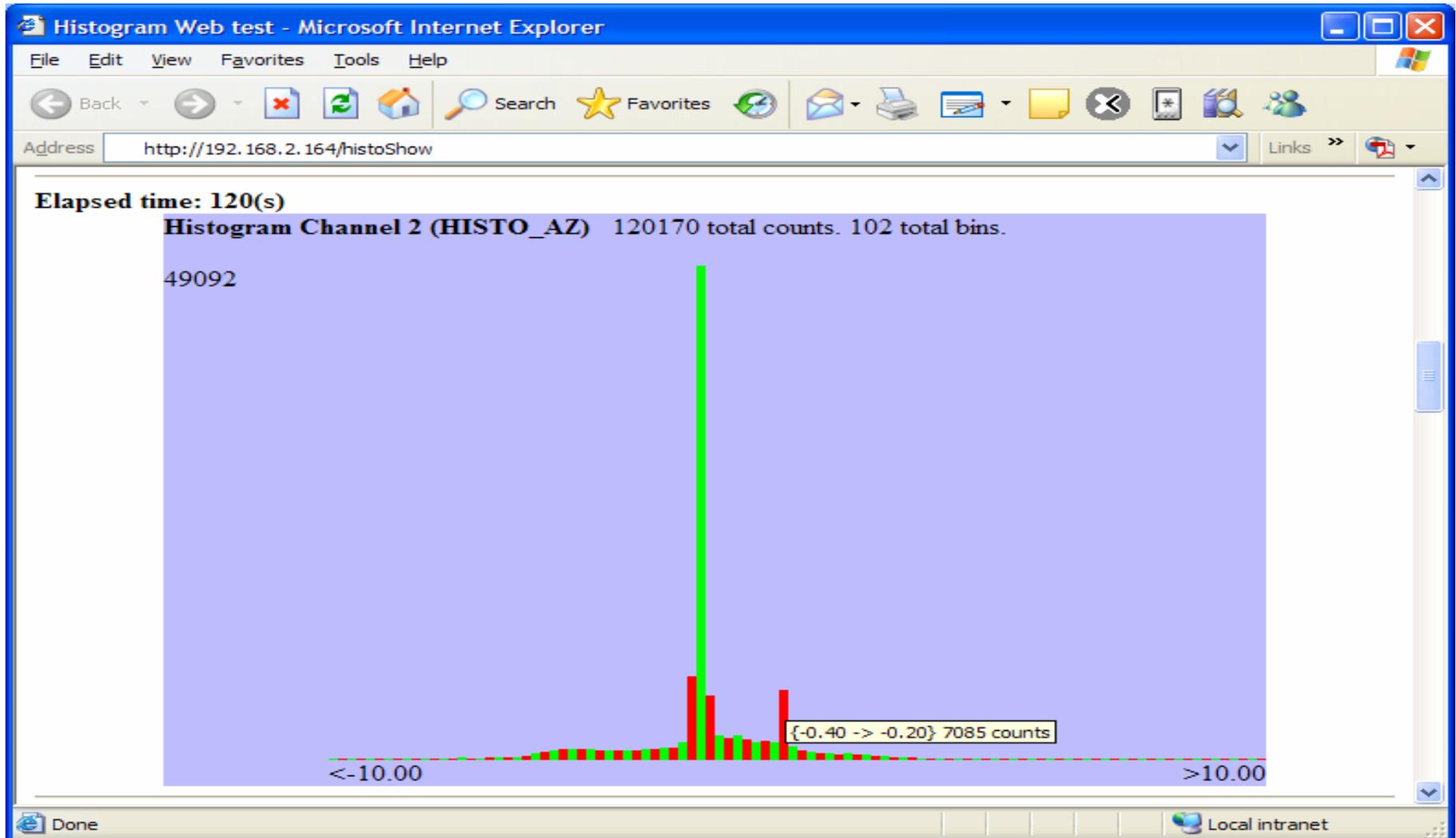


Data Example

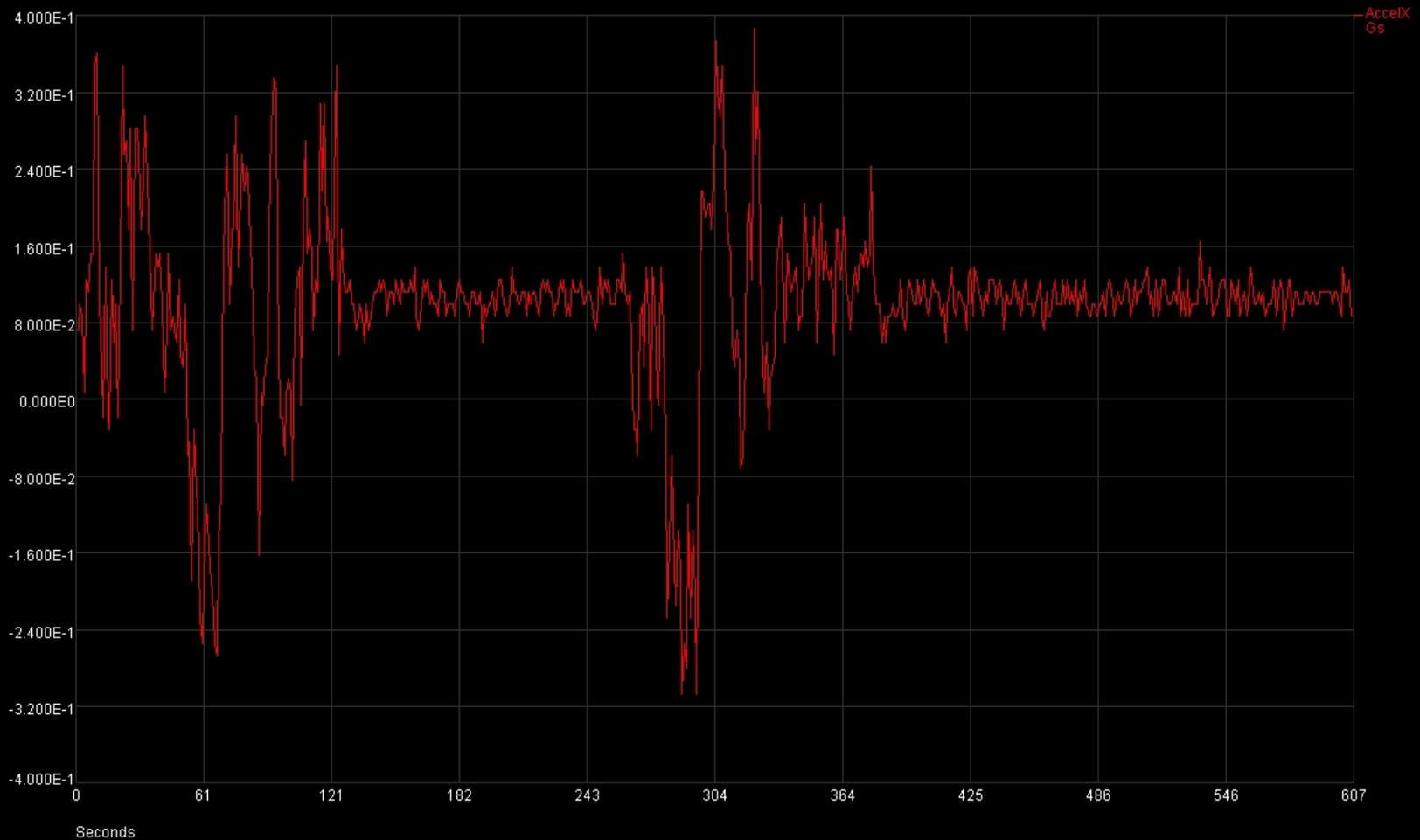
- Histograms



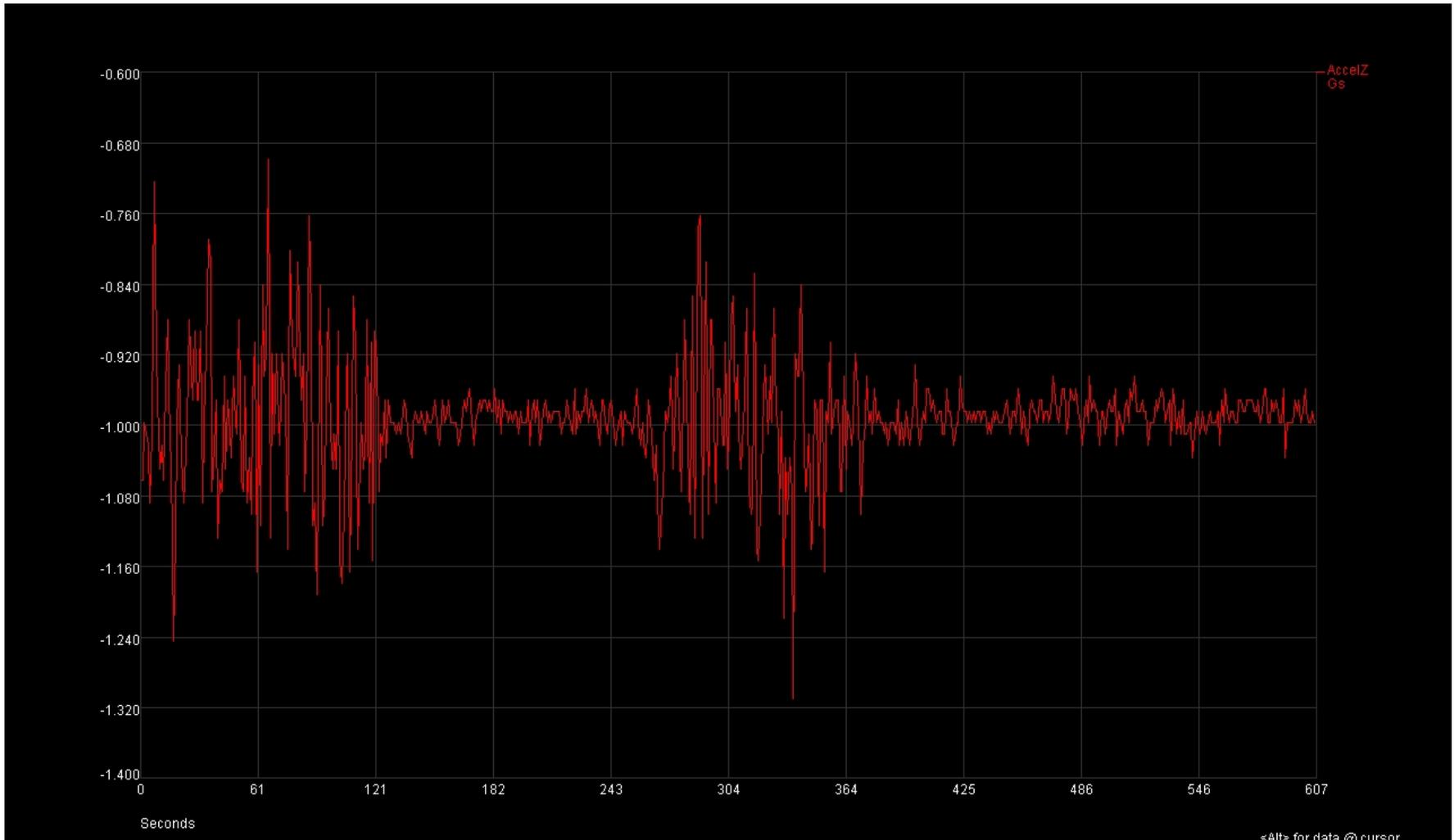
Real Time Web Histograms



X - Acceleration



Z - Acceleration



Z - Rate



Ride Quality

