Load Stability Alarm

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Overview

- Concept
- Towing Technology
- Consumer
- Testing Protocols
- Results
- Design Improvements
- Marketability
- Conclusion

Concept

- Accelerometer used to monitor load behavior in towing applications
- Active monitoring in 3 planes
- Thresholds are set to ensure load security
- Alarm alerts drive when limits are exceeded to correct driving and prevent accident

Towing Technology

Weight-Carrying Hitches

- Tow vehicle has a **trailer hitch receiver** which has a **draw bar** or **ball mount** attached with a **locking pin**
- Ball mount has actual ball. Size of ball determines weight and type of trailer that can be towed
- Ball from tow vehicle fits in to coupler on trailer
- Weight is placed on tongue/coupler of hitch

Source: http://www.a1toolstore.net/catalog/tri%20ball%20hitch.jpg

Towing Technology cont'd

Weight-Distributing Hitches

- Basic concept is the same as weight-carrying hitches
- Main difference is that weight-distributing hitch distributes the weight pressing down on the tongue to the axles of both the tow vehicle and the trailer.

Source: http://pics.hoobly.com/full/OWS7FWXTWK1UJIQF2N.jpg

Towing Technology cont'd

Fifth Wheel Hitches

- Special connecter in bed of pick-up truck
- Completely different than the previous hitches
- Most of the towing weight is on the rear axle of the towing vehicle

Source: http://images.hayneedle.com/mgen/master:CTM933.jpg

Towing Technology cont'd

- Most trailers have own light and brake system
- Connects to tow vehicle manually or through special connectors in newer vehicles and trailers
- Load is allowed to move independently of steering

Source: http://rv-roadtrips.thefuntimesguide.com/images/blogs/fifth-wheel-trailer-and-pickup-truck-public-domain.gif

Consumer

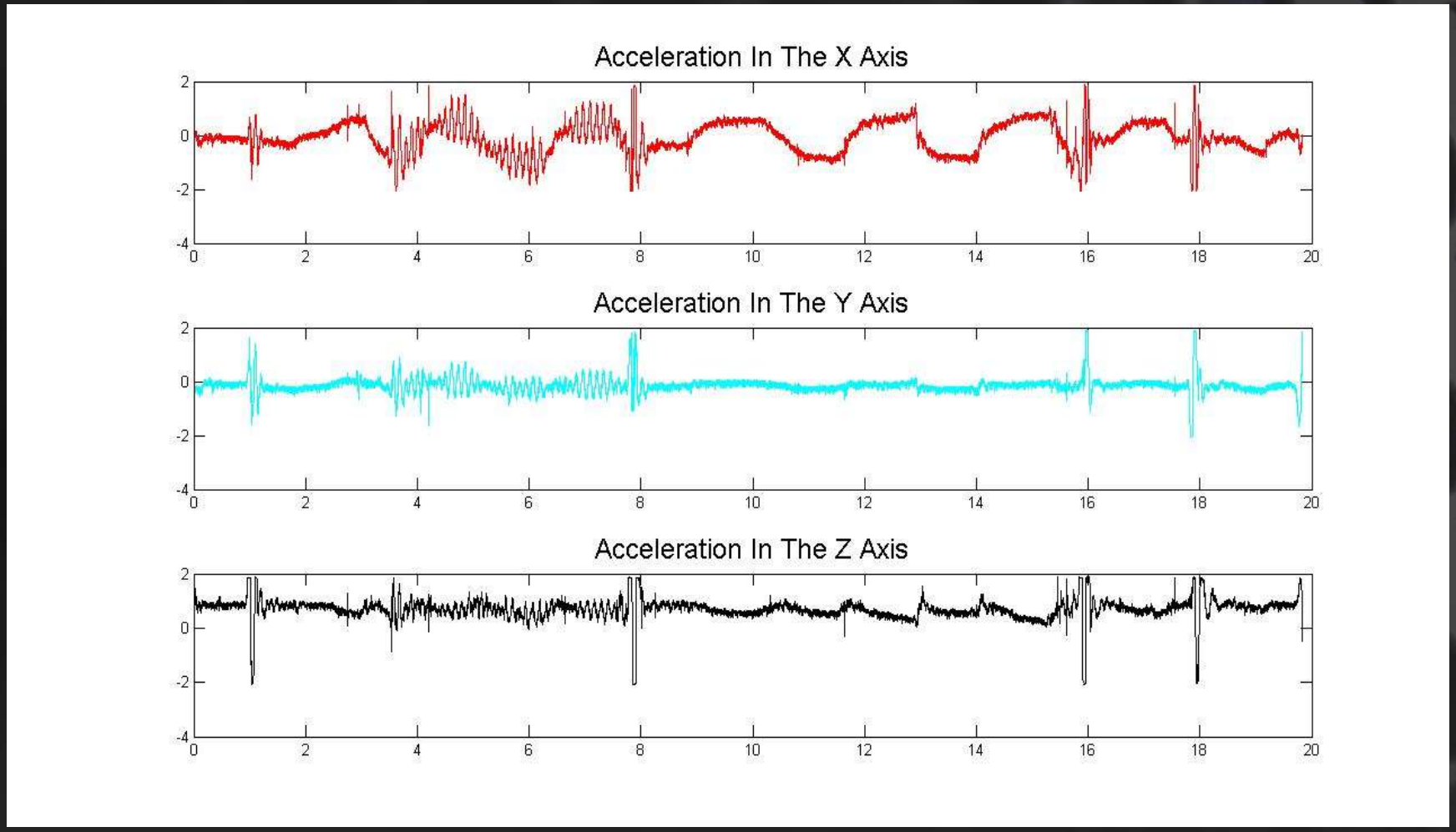
- Ideal consumer is every person who owns any form of a towing package or hitch
- Data on how many Americans tow is not available but based on accident reports numbers are high and market is sizeable

Testing Protocol

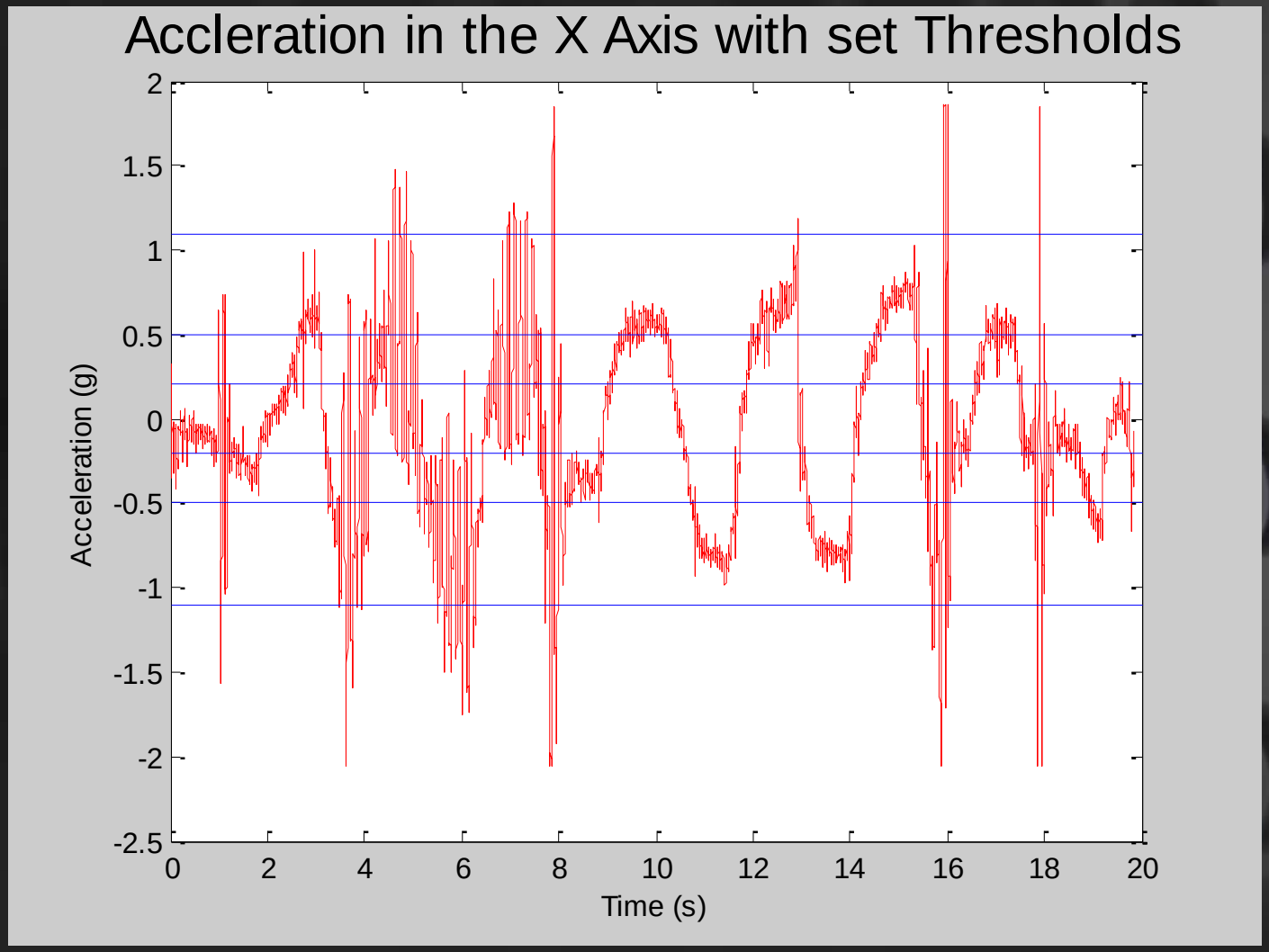
- Accelerometer placed on the floor of the trailer and secured with tape
- Collect data the entire time load is being towed
- Perform different driver maneuvers (90 degree turns, drive over potholes, simulate sudden stops and veering) to determine how load will behave
- Analyze load movement in 3 planes

Source: Paul Moldovan

Results (Raw Data)



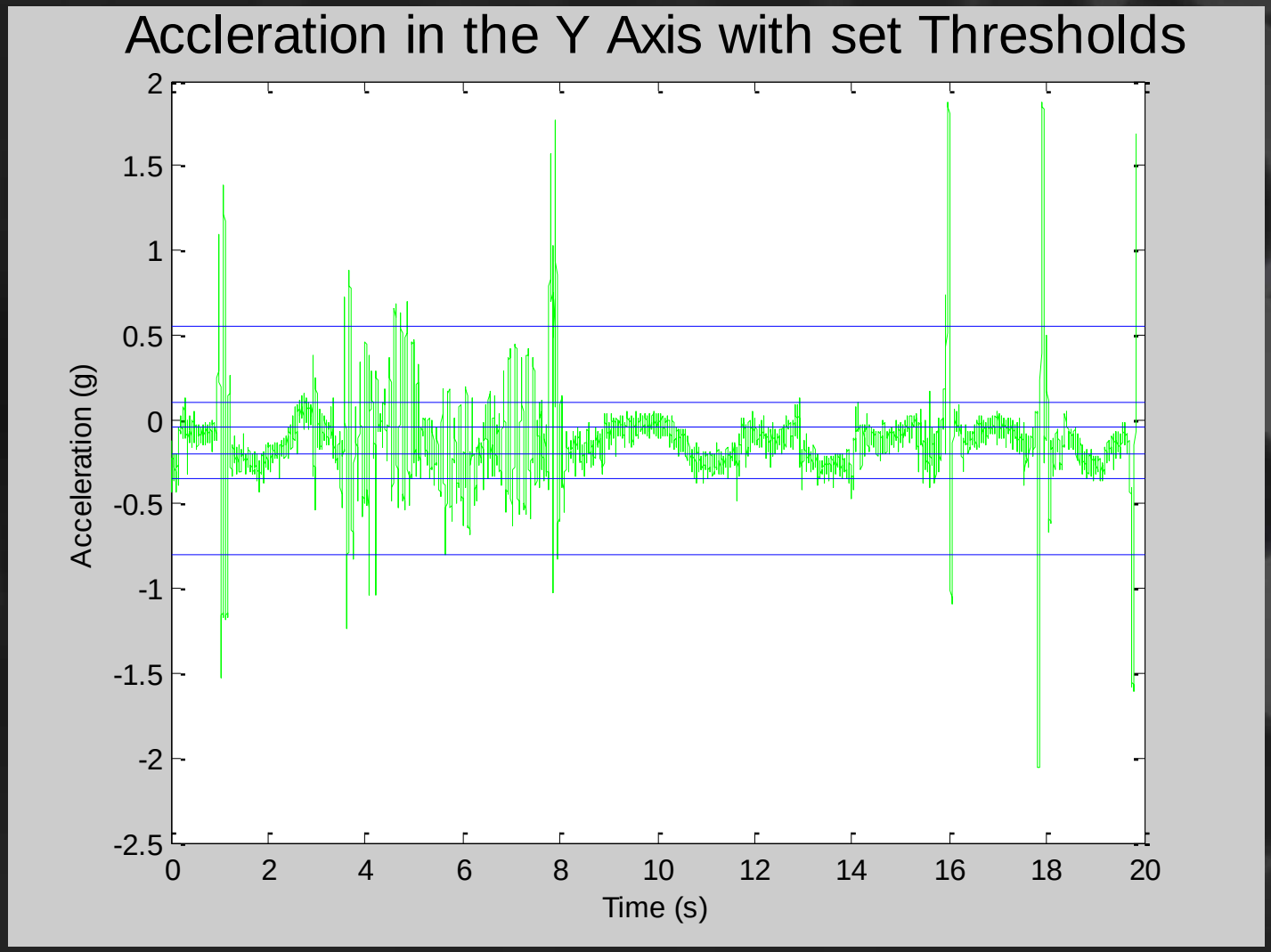
Results cont'd



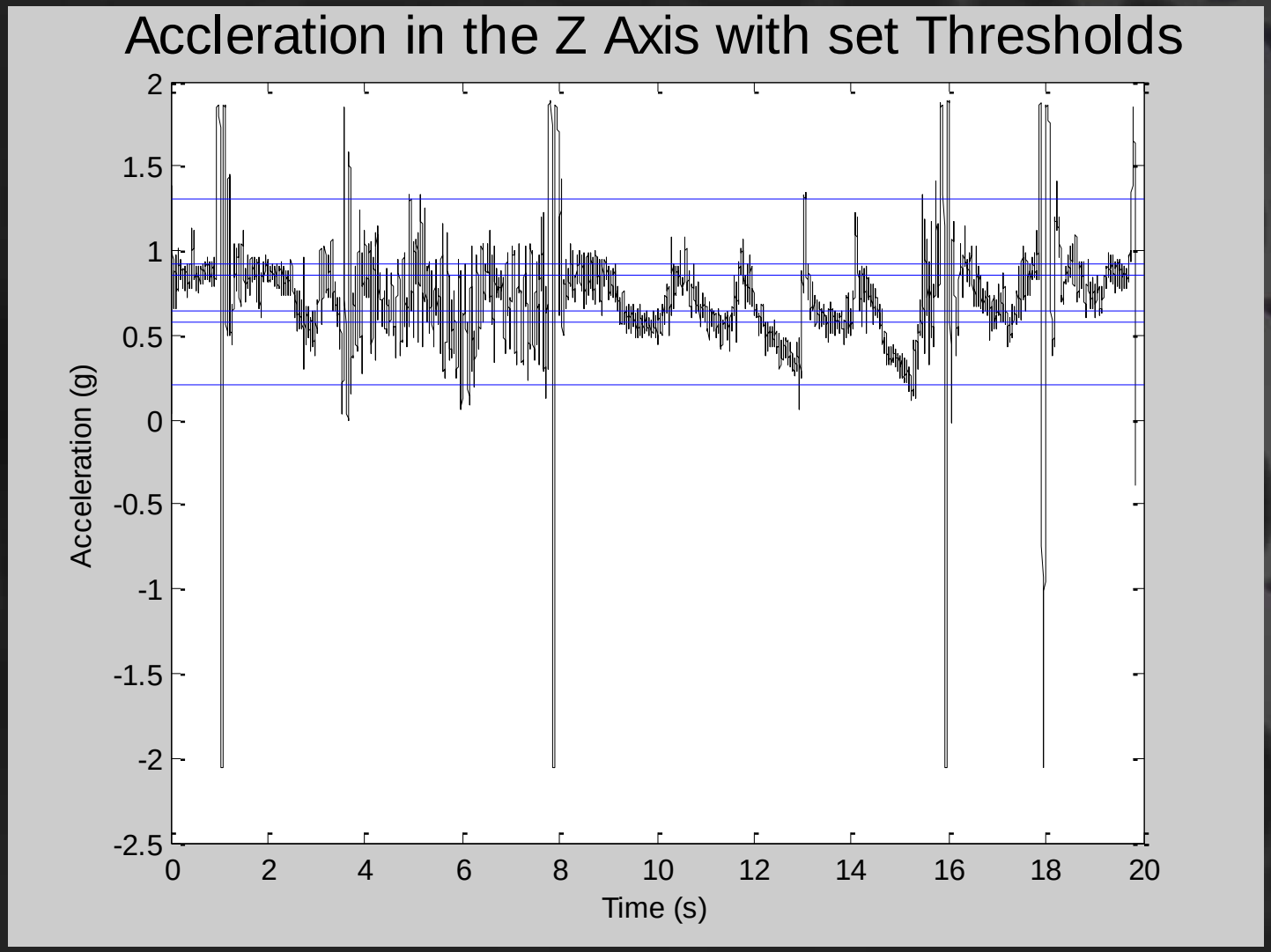
Results cont'd

- Large spikes represent trailer going over potholes and road irregularities
- Up and down movement in graph due to swerving. Indicates considerable movement in the trailer
- Raw data filtered using a moving average filter
- Example thresholds set

Results cont'd



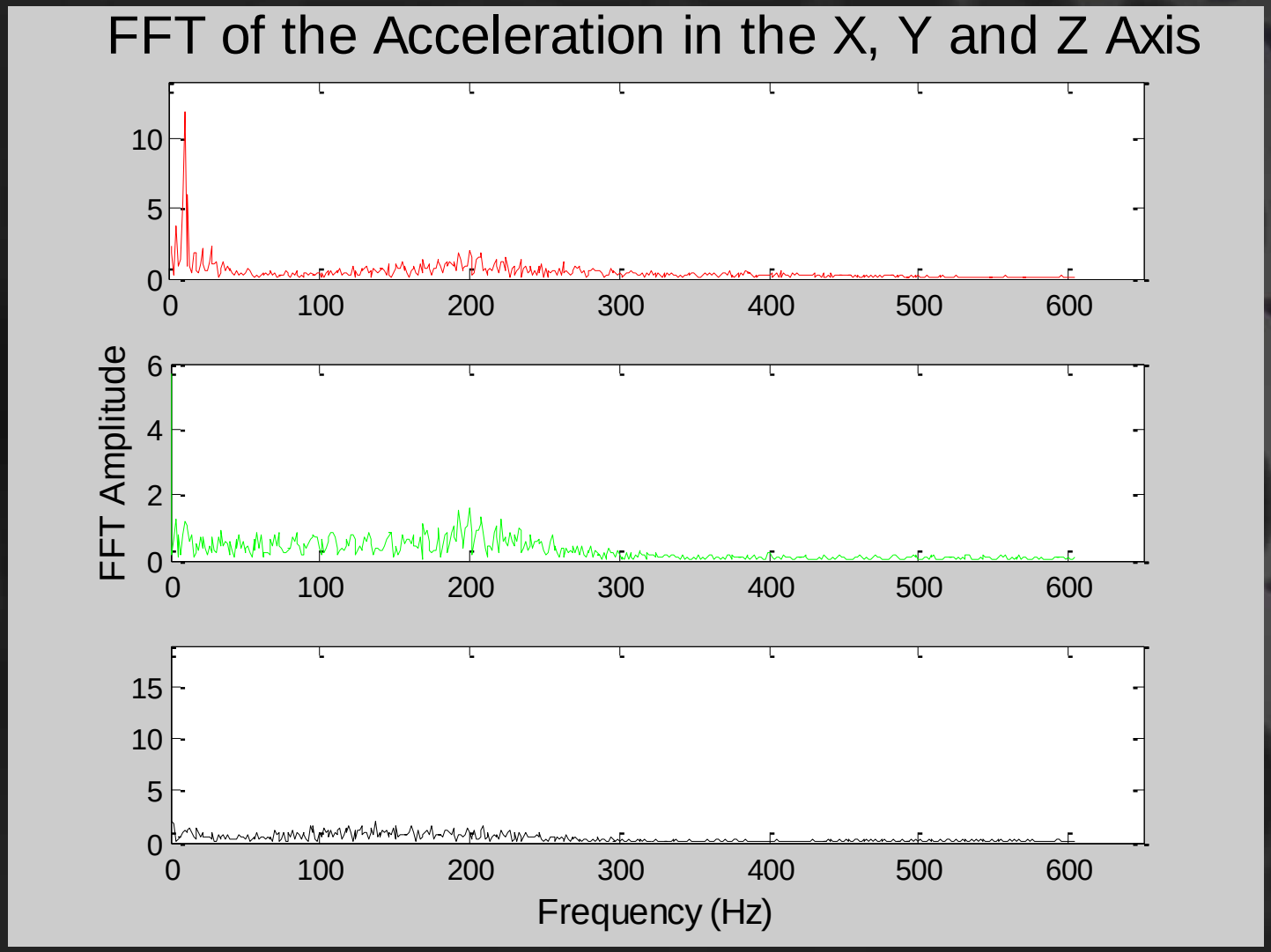
Results cont'd



Results cont'd

- Large spikes seen in the X-axis are echoed in both the Y and the Z-axis
- Up and down movement which was present in X-axis is also seen here. This suggests all motion translates to all planes
- Example thresholds set

Results cont'd



Results cont'd

- FFT not needed because looking at forces on the load which are caused by road conditions as well as driving behaviors
- Not concerned with the frequency of the movement.

Design Improvements

- Trials done in a empty trailer, to see true effectiveness sensor must be placed in a loaded trailer
- Center of gravity must be taken in to account for taller loads
- More trials must be done in order to determine whether sensor must be calibrated for each type of hitch or if only one design needs to be manufactured

Marketability

- Sensor will be sold for non-commercial towing applications
- Commercial trucks (big rigs) already have load monitoring capabilities
- Sold to prevent accidents which result in millions of dollars worth of damage
- Sensor needed because of the independent movement of trailer

Source: http://i.usatoday.net/news/_photos/2007/09/04/mexican-trucks.jpg

Marketability cont'd

- In 2004 there were more than 65,000 crashes involving non-commercial towing vehicles
- This resulted in 422 deaths, 27,232 injuries and 46,737 instances where only property damage occurred

Source: http://images.bimedia.net/images/081028wreck_wide.jpg

Source: Towing Troubles: Danger on America's Road

Marketability cont'd

- One in five trailer owners experienced a safety incident ranging from fishtailing to loss of cargo
- 27% of accidents result in injury and 72% result in property damage only
- 71% of owners admitted to not knowing proper towing procedures
- 75% of owners attributed their knowledge to past experience with trailers, or trial and error

Source: Towing Troubles: Danger on America's Road

Marketability cont'd

Marketing Point 1

- Sensor will be sold to increase safety of non commercial towing applications
- In recent years accidents have been on the rise
- A load stability alarm will help reverse this trend
- Allow for advance notice to perform corrective driving maneuvers to prevent accidents

Marketing Point 2

- Zero owner calibration required
- Easy to install
- Offer lower insurance rates to owners who use approved sensors

Marketability cont'd

- Sensor would be sold as part of towing lighting/brake kit
- Completely enclosed system that plugs in directly to towing vehicle
- Certain trailers will have sensor built in to body

Source: http://cache1.realtruck.com/images/products/1363/200x200_18148_a.jpg

Conclusion

- More testing needs to be done in order to determine proper placement of sensor on trailer
- Data shows that trailer experiences tremendous force that can lead to load shifting or tipping
- Market exists and could be government mandated or use can be influenced by monetary compensation
- Sold to prevent deaths and accidents
- Would not be bought by consumers if sold as a standalone product

Questions?