Several aerospace companies are designing quiet supersonic business jets for service over the United States. NASA Dryden Flight Research Center. This project aims to evaluate the effects of sonic booms on EQW sensors.

Resistant Earthquake Warning Systems (EQW) is a collaborative effort between Seismic Warning Systems, Inc. and NASA Dryden Flight Research Center. The project aims to evaluate the effects of sonic booms on EQW sensors.

Microphones recorded the acoustic wave above ground near the sensor. The sensors were deployed at the Consolidated Services Facility at Edwards AFB. One accelerometer was located on the ground floor near an exterior wall, and another was placed approximately 15 meters outside the building.

We deployed two Reftek 131A low-noise strong-motion accelerometers recording to a Reftek 130 datalogger. We set this distance to 10 km as a reference to determine if an EQW system based on peak displacement algorithms can be spoofed by a sonic boom under realistic conditions. We find that sonic booms approaching 1 psf overpressure can generate ground velocities comparable to a M 3 at 10 km.

The accelerometers exhibit variation of sensitivity with temperature. Between sortie 1 and sortie 2 on the second day, the outside temperature increased from the mid-70s to mid-90s resulting in a factor of 2 reduction in the observed peak ground velocity. Accelerometer will produce a significantly aliased record. Thus the observed peak ground velocity is strongly dependent on the sampling rate, and increases as the sampling rate is reduced. This can be seen in the difference between the magnitude vs. Δp relations from day 1 and day 2.

Sonic booms are broad-band noise signals with much higher frequencies than earthquake. The dominant peak ground velocity is strongly dependent on the sampling rate, and increases as the sampling rate is reduced. This can be seen in the difference between the magnitude vs. Δp relations from day 1 and day 2.

The sonic boom from Edwards AFB was recorded with microphones placed in two locations near the Consolidated Services Facility. One microphone was placed inside the building, and another was placed inside the building. The displacement is integrated from velocity and inverted to overlay with the microphone record. The initial portion of the record was not used due to noise.

The sonic booms from space shuttle re-entry are readily detectable on modern seismometers [Kanamori et al., 2002]. The figure shows a record of a sonic boom from an F-18 at Edwards AFB. The blue trace is a microphone in the free field, and the green trace is the vertical displacement from nearby CISN station EDW2.

We integrate the accelerometer record to velocity and take the ratio from Wurman et al. [2007] for magnitude as a function of peak P-wave velocity.

Because flight Mach number on STS-1 orbiter (17.0) exceeds, according to our threshold, 10 psf, we look at these STS-1 orbiter (17.0) exceeding Mach number on STS-1 orbiter (17.0). The sonic booms from space shuttle re-entry are readily detectable on modern seismometers [Kanamori et al., 2002].

The time delay between the boom onset at the two sensors is used to calculate the sound wave traveled at 300 m/s, rather than a seismic wave. This discriminant requires two sensors and breaks down if the boom is normally incident to the array.

The sonic booms (microphones) are detected by seismic waves, though care must be taken not to erroneously exclude actual earthquakes. The enhanced high-frequency component of the sonic boom can be critical in this determination.

Because of the enhanced high-frequency component, sonic booms may be distinguishable from earthquakes by use of seismic methods such as joint traveltime and amplitude analysis [Allen and Kanamori, 2004 and 2007]. In comparison with amplitude analysis, the joint traveltime analysis is less sensitive to noise.

In May 2011 we will deploy 4 accelerometers in an array of 4 accelerometers at Cuddeback dry lake during the Superboom Caustic Analysis and Measurement Program to test the response of high-amplitude (600 Pa) sonic booms. We will also fly three dedicated sonic boom flights, during which we will test specific sonic boom verification techniques on a building.

References
Allen and Kanamori, 2004 and 2007
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