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Combination of High Rate, Real-time GNSS and Accelerometer Observations – Preliminary Results Using a Shake Table and Historic Earthquake Events.

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One of the fundamental requirements of an Earthquake Early Warning (EEW) system (and other mission critical applications) is to quickly detect and process the information from the strong motion event, i.e. event detection and location, magnitude estimation, and the peak ground motion estimation at the defined targeted site, thus allowing the civil protection authorities to provide pre-programmed emergency response actions: Slow down or stop rapid transit trains and high-speed trains; shutoff of gas pipelines and chemical facilities; stop elevators at the nearest floor; send alarms to hospitals, schools and other civil institutions.

An important question associated with the EEW system is: can we measure displacements in real time with sufficient accuracy? Scientific GNSS networks are moving towards a model of real-time data acquisition, storage integrity, and real-time position and displacement calculations. This new paradigm allows the integration of real-time, high-rate GNSS displacement information with acceleration and velocity data to create very high-rate displacement records. The mating of these two instruments allows the creation of a new, very high-rate (200 Hz) displacement observable that has the full-scale displacement characteristics of GNSS and high-precision dynamic motions of seismic technologies. It is envisioned that these new observables can be used for earthquake early warning studies and other mission critical applications, such as volcano monitoring, building, bridge and dam monitoring systems.

REF TEK a Division of Trimble has developed the integrated GNSS/Accelerograph system, model 160-09SG, which consists of REF TEK's fourth generation electronics, a 147-01 high-resolution ANSS Class A accelerometer, and Trimble GNSS receiver and antenna capable of real time, on board Precise Point Positioning (PPP) techniques with satellite clock and orbit corrections delivered to the receiver directly via L-band satellite communications.

The test we conducted with the 160-09SG Recorder is focused on the characteristics of GNSS and seismic sensors in high dynamic environments, including historic earthquakes replicated on a shake table, over a range of displacements and frequencies. The main goals of the field tests are to explore the optimum integration of these sensors from a filtering perspective including simple harmonic impulses over varying frequencies and amplitudes and under the dynamic conditions of various earthquake scenarios.