The Quake-Catcher Network: A Volunteer Computing Seismic Network

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The Quake-Catcher Network (QCN) is a low-cost seismic network that utilizes volunteer computing techniques and low-cost MEMS accelerometers. Volunteer computing provides a mechanism to expand seismic observations with minimal infrastructure costs, while promoting community participation in science. Micro-Electro-Mechanical Systems (MEMS) triaxial accelerometers can be attached to a desktop computer via USB and are internal to many laptops. Preliminary shake table tests show the MEMS accelerometers can record high-quality seismic data with instrument response similar to research-grade strong-motion sensors. QCN began distributing sensors and software to K-12 schools and the general public in April 2008 and has grown to roughly 2000 stations worldwide. We also recently deployed QCN sensors as part of a Rapid Aftershock Mobilization Program (RAMP) following the 2010 M8.8 Maule, Chile and M7.2 Darfield, New Zealand earthquakes. Volunteers are recruited through media reports, web-based sensor request forms, as well as social networking sites.

We utilize client-side triggering algorithms to determine when significant ground shaking occurs and this metadata is sent to the main QCN server. On average, trigger metadata are received at the server within 5-7 seconds from the observation of a trigger; the larger data latencies are correlated with greater server-station distances. Once a set of triggers are detected, we determine if the triggers correlate to others in the network using spatial and temporal clustering of incoming trigger information. If a minimum number of triggers are detected then a QCN-event is declared and an initial earthquake location and magnitude is estimated. Initial analysis suggests that the estimated locations and magnitudes are similar to that reported in regional and global catalogs. With a dense network of stations, events can be detected as soon as 7 seconds after the earthquake origin by the QCN network.

As the network expands, it will become increasingly important to provide volunteers access to the data they collect, both to encourage continued participation in the network and to improve community engagement in scientific discourse related to seismic hazard. We are currently working on providing access to raw seismic data and images of seismograms in formats accessible to the general public through existing seismic data archives (e.g. IRIS, SCSN) and/or through the QCN project website. While encouraging community participation in seismic data collection, we can extend the capabilities of existing seismic networks to rapidly detect and characterize strong motion events. In addition, the dense waveform observations may provide high-resolution ground shaking information to improve source imaging and seismic risk assessment.