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A Low-Power Two-Stage Seismic Sensor Scheme for Earthquake Early Warning System

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Abstract : The north-eastern, Himalayan, and Eastern Ghats Belt of India comprise of earthquake-prone, remote, and hilly terrains. Earthquakes have caused enormous damages in these regions in the past. A wireless sensor network based earthquake early warning system (EEWS) is being developed to mitigate the damages caused by earthquakes. It consists of sensor nodes, distributed over the region, that perform majority voting of the output of the seismic sensors in the vicinity, and relay a message to a base station to alert the residents when an earthquake is detected. At the heart of the EEWS is a low-power two-stage seismic sensor that continuously tracks seismic events from incoming three-axis accelerometer signal at the first-stage, and, in the presence of a seismic event, triggers the second-stage P-wave detector that detects the onset of P-wave in an earthquake event. The parameters of the P-wave detector have been optimized for minimizing detection time and maximizing the accuracy of detection.Working of the sensor scheme has been verified with seven earthquakes data retrieved from IRIS. In all test cases, the scheme detected the onset of P-wave accurately. Also, it has been established that the P-wave onset detection time reduces linearly with the sampling rate. It has been verified with test data; the detection time for data sampled at 10Hz was around 2 seconds which reduced to 0.3 second for the data sampled at 100Hz.

Keywords : earthquake early warning system, EEWS, STA/LTA, polarization, wavelet, event detector, P-wave detector
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