

## **Seismological Perspectives on Broadband Tilt, Strain, and Rotation Measurement**

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A thorough understanding of the seismic wave field at a point requires the measurement of 3 components of vector displacement and 3 components of rotation. Seismological practice using 3 component seismometers usually assumes that recorded ground motions represent ground displacement. It is very well known, however, that horizontal seismometers are particularly susceptible to tilt, which is a rotation about a horizontal axis. Tilt is a common noise signal for shallow-depth, temporary installations, as in many PASSCAL experiments, where diurnal thermal or water-saturated ground expansion and contraction produces high levels of noise on the horizontal channels. Tilt may also be a direct signal of tectonic interest. Broadband installations on active volcanoes often record large “long-period” pulses that have been interpreted as long-period pressure waves but may also be simple tilts induced in the near-field of intrusive or extrusive loads within the volcano. Thus, a major improvement in broadband seismometry is needed to separate the effects of simple ground displacements from the effects of tilt.

Tilt or rotation, in itself, is also a very interesting observable in wave propagation and should be part of seismic interpretation. Rotation is closely related to strain and both quantities can be used to gain a deeper understand seismic wave propagation. For example, combined use of displacement polarization, rotation, and/or strain at a single observation point yield estimates of wave horizontal phase velocities. Measurement of local strains and tilts could be made by differencing the signals of closely spaced seismometers. Ironically, closely matched instrument responses and tilt insensitivity of individual sensors would be a requirement for accurately estimating rotations and strains with such micro arrays. It would be advantageous to design independent, sensitive rotation meters.