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Acoustic emissions preceding the stress drops in locally sheared granular materials

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For better understanding the mechanisms of rapid landsliding events, both the initial and long runout motion in which granular masses flow with extremely low friction is essential. Many studies had been performed to understand such kind of the unusual physical feature. However, the progressive maturation of these catastrophic landslides is still lack of enough scientific evidence. Importantly, acoustic emission (AE) technique provides the opportunity to study the grain-scale shear deformation of granular assemblies, and can be used to directly investigate the physical processes and failure mechanisms. Herewith, we employed a high frequency range of AE sensor to capture the elastic waves due to the abrupt perturbations of internal forces and release of strain energy, and the dependence of particle size and shear velocity on the AE characteristics has also been examined. We found that the dynamical drops of shear resistance and the amplitude of AE waveforms were larger with increase of the particle size. We also analyzed the relationship between AE rates (per second) and shear velocity, which indicated that the AE rates would increase with increase of the shear velocity. Ultimately, we examined the frequency contents and occurrence time of AE waveforms, and we found that the ultrasonic precursors occurred prior to the dynamic failures among granular materials.

Keywords: acoustic emission, stress drop, granular materials, particle size, shear velocity, rapid landslides