

# **A low frequency seismic triboelectric energy nano-generator used in slow and higher ground motion**

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## **Abstract-**

Today sees a need for low-cost detectors able to measure slow ground motion in a broad range of low frequencies. In this sense, the use of triboelectric nanogenerators (TENGs) has been recently suggested, motivated by their low cost and simple design. In this work the use of a a TENG for low-frequency detection is explored. This system is based on low-cost polydimethylsiloxane (PDMS)/polyvinyl acetate (PVA) self-power triboelectric energy nanogenerator modified single wall carbon nanohorns (SWCNHs). Minimum traction and compression forces of 35 N at minimum velocities of 10 mm/min for elongations up to 4 mm could be detected, without any limit regarding the duration of the excitation signals generated. Relative motion of this system and its parts related to the ground was studied and allowed determining its displacement, velocity and acceleration by following the force damped oscillation model. The effect of electrical induction when inertial mass was either moving to or away from the TENG could be detected, even before contact. A high agreement of the TENG signals generated for frequencies lower than 5 Hz with the external excitation frequency was achieved, corroborating the goodness of the SLOW-SEISTENG when measuring low frequency signals. Lastly, an application as a remote alarm sensor operating with LoRA and Wi-Fi protocols was designed meaning that SLOW-SEISTENG could work as an Early Detection Alarm System (EDAS).

**Index Terms-** triboelectric energy generators; seismic devices; early detection alarm systems; LoRA; slow ground motion; SLOW-SEISTENG

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