2008 TAIWAN INTERNATIONAL SCIENCE FAIR

CATEGORY : Engineering

PROJECT : Construction of a Mechanical Prototype of a Microtremor Recorder

AWARDS : Engineering Second Award

SCHOOL : Philippine Science High School Main Campus

FINALISTS : Marvin Paolo G. Ambrosio

COUNTRY : Philippines

Taiwan International Science Fair 2008

ABSTRACT

CATEGORY: Engineering
TITLE: Construction of a Mechanical Prototype of a Microtremor Recorder
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COUNTRY: Philippines

Ambient vibration, the movement of the ground caused by transient objects such as the wind, sounds and human activities, is one major site effect evaluation method presently used. The respective predominant frequencies of a site and the structures above it obtained using this method serve as reference to the renovation and/or construction of structures. Predominant frequencies of the landmass and the structures above it should be non-identical to avoid prolonged shaking with the occurrence of an extensive movement of the ground as dictated by resonance effect. Since electronic ambient vibration or microtremor recorders, specifically their sensors, are expensive and inaccessible, a mechanical prototype of such device was designed and constructed. The proposed design of the mechanical ambient vibration recorder (mAVR) was mainly based on the IRIS Seismograph which makes use of the principle of electromagnetic induction. The relationship between ground motion and the movement of the prototype lever, which is a direct proportion, was the concept highlighted by the prototype's mechanism. After the design of the mAVR prototype was finalized, its assembly, which consisted of the calibration of the solenoid and the inertial mass, was performed. The calibration of the solenoid was based on the voltage output of its solenoid based on the number of turns while the inertial mass was determined based on the equilibrium level of the prototype lever. Having proven the mAVR's capacity to function by simulating stimulus, the testing of its accuracy was done with two setups: recording of (1) natural and (2) induced ambient vibration. This tested the prototype's accuracy

relative to values obtained using the commercial recorder. The natural ambient vibration of a control site was simultaneously obtained using the mechanical prototype and the commercial recorder, which were situated next to each other during the actual recording. Moreover, both sensors were used to record a control stimulus for a constant amount of time. The data obtained from these subparts were processed using WinWaveShot which quantified and presented ambient vibration as waves. The deviations of the maximum and minimum amplitudes, mode and median values of these waves, as graphed by DADiSP2002, was performed to verify the accuracy or reliability of the prototype. These graphs were converted to their DFT graphs and histograms, with accompanying converted wave properties which characterized the predominant frequency. Based from the results, the recordings obtained from the mAVR are proportional from the ones obtained from the eAVR. Therefore, the mechanical prototype is capable of recording the predominant frequency of a site. The prototype, when improved, is a potential alternative to commercial sensors since it is able to record actual movements and its scale is proportional to the scale of the eAVR. Since the prototype was constructed and can be reproduced from readily available and inexpensive materials, ambient vibration analysis can be used more commonly by architects and engineers for construction purposes. To verify the reliability of the values obtained using the prototype, the ambient vibration of other sites must be recorded and compared to those using the eAVR.

評語

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