Descriptive statistical calibration method of triaxial digital accelerometer adxl345 as earthquakes sensor

ABSTRACT

Seismic monitoring networks are the crucial elements in strong motion seismology for effective risk reduction. Low scale lateral variation of high intensity ground movement caused by earthquakes will be detected more effectively with densely located networks. However, the limitations of developing such project are rooted in expensive costs associated with the construction and installation in addition to bulky size of the conventional seismic observation system. Recently, micro-electromechanical system (MEMS) has being recognized in the applications of seismological and earthquake engineering due to the high precision obtained in these micron size semiconductor instruments and cheaper alternative for traditional seismic detector. ADXL345 is a type of digital triaxial MEMS accelerometer that is ideal for measurement of low-frequency vibrations and static accelerations of gravity, which makes it suitable for ground motion detection. Thus, this study aims at calibrating ADXL345 sensor that is required as sensing component in an affordable earthquake monitoring system with the Earthquake Benchmarking System (Penanda Aras Gempa Bumi, PAG) available in the inventory of Department of Mineral and Geoscience Malaysia, Sabah. Soil vibrations in EW (east-west or x-axis), NS (north-south or y-axis), and UD (up-down or z-axis) directions during random forces hit on the surface are recorded by both accelerometers. Acceleration magnitudes recorded by PAG and ADXL345 are extracted and data exploration is performed. Predominantly, ADXL345 measurements in horizontal and vertical ground movements are on a higher scale than the reference device. Subsequently, evaluation by using descriptive statistical analysis is chosen to produce numerical equations for data correction operations. İmplementation of the mathematical functions in ADXL345 for observing land movements in EW, NS, and UD directions resulted in decreasing the range values of output readings. Higher approximation of magnitudes of ground motion with the PAG system is achieved.