UNIVERSITI TEKNOLOGI MARA

DEVELOPMENT OF WIRELESS TRI-AXIAL FLUXGATE MAGNETOMETER FOR GEOMAGNETIC MONITORING

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ABSTRACT

Conventional observatory grade magnetometer for geomagnetic monitoring purpose offers high end sensing performance in terms of sensitivity, reliability and stability. The robustness comes with bulky part-by-part system contributing to large physical dimensions and high cost. Hence, these become the limiting factors of magnetometer array expansion. Serial cable contributes to extra load (up to 4.5 kg for 70 m long) and effort for installation. Meanwhile, facilities such as on-grid power supply and underground concrete slab for sensor placement are required to ensure that the conventional magnetometer is enable to operate in ideal setup. Since extra requirement is needed to operate the conventional magnetometer, extra manpower and authorities' bureaucracy must be considered. Additionally, the cost for a complete unit of a magnetometer reached 100000 USD (RM 390250). A mobile wireless tri-axial fluxgate magnetometer known as Wireless Fluxgate Magnetometer (Wireless FGM) was developed as an alternative to overcome the issues stated. Furthermore, this development aims towards a low cost instrumentation. The digitization processes were performed using an Atmel ATmega2560 16-bit frequency counter. The fluxgate sensors data were transferred via IEEE 802.11 WLAN module to data acquisition (DAQ) unit at 1-Hz sampling rate. The DAQ unit received and retrieved the information by accessing each sensor data, converting them into HDZ coordination system followed by storing in the DAQ storage and displayed the HDZ data along with time stamp on the DAQ display unit. A benchmarking test was performed by comparing the developed Wireless FGM and established Magnetic Data Acquisition System (MAGDAS) Mag-9 from 27 April 2016 to 28 April 2016 at Langkawi National Observatory where these two units were separated by 400 metres from each other. The measurement was done for 48-hours to observe the diurnal variation of geomagnetic field. Horizontal (H), vertical component (Z) and field intensity (F) components showed variation pattern consistency with the existing observatory, whereas declination (D) component graph pattern was seen strongly affected by local activities. From the benchmarking test, the wireless FGM demonstrated the average reading difference with H-component, D-component, Z-component and F-component equal to 0.95%, 0.0022°, 111%, and 1.06%, respectively. In terms of development cost, the Wireless FGM development cost consumes approximately USD 500 (RM 1951.25) within one year development.

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TABLE OF CONTENTS