UNIVERSITI TEKNOLOGI MARA

EFFECT OF RADIO FREQUENCY INTERFERENCE (RFI) ON THE GLOBAL POSITIONING SYSTEM (GPS) SIGNALS

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Thesis submitted in fulfillment
of the requirements for the degree of
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I certify that a Panel of Examiners has met on 2nd December 2014 to conduct the final examination of Ahmad Norhisyam Bin Hj. Idris on his Master of Science thesis entitled "Effect of Radio Frequency Interference (RFI) on Global Positioning System (GPS) Signals" in accordance with UniversitiTeknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Radio frequency interference (RFI) can be a detrimental effect on the positioning, navigation, and timing (PNT) elements of the Global Positioning System (GPS). This can range from a degradation of performance to a loss of tracking signals due to a weak GPS power levels. In this study, the concern is on two major RFI scenarios; intentional RFI where someone intended to jam the GPS signals, and unintentional RFI of other systems using the same, near, or out of GPS frequency bands. For intentional RFI, several tests were conducted in static relative positioning method between long and short baselines via single and dual frequency receivers within three (3) hours. All data were processed via kinematic post-processing at one (1) second interval and their trends or patterns of 3D position residuals, GDOPs, and ambiguity resolution were reviewed and analyzed in order to investigate their positional accuracy and precision degradations towards different levels of noise interference power. A laboratory environment using GPS simulator in semi-anechoic chamber was utilized instead of field evaluations which are usually infected with various GPS error parameters. For unintentional RFI, several tests were conducted in the vicinity of satellite broadcasting dish and power lines for detecting any positional precision and accuracy degradations using similar steps like intentional RFI test but limited to field evaluations at short baseline via dual frequency receiver only. Findings were showed that the intentional RFI degrade the received GPS signals with the effect at the threshold of until hundred meters, and at the highest power level (i.e., -80dBm) the GPS receiver can lose signal lock. It was shown that the short baseline (10km) produces better results than long baseline (30km) whenever an observation was corrupted with RFI. The dual frequency GPS receiver is seen to resist the effect of RFI better than single frequency receiver through the differencing method between L1 and L2 frequencies. It was also shown the feasibility of laboratory test for controlling various error parameters as opposed to field environment. Meanwhile, results on unintentional RFI were showed the disturbance of GPS signals when operating too close with RFI sources below than five (5) meter. Based on the findings, GPS users, especially land surveyors, GPS suppliers, geomatic students, and local researchers should be aware of the effect of RFI on the positional accuracy and precision specifically on the survey-grade GPS receivers.

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