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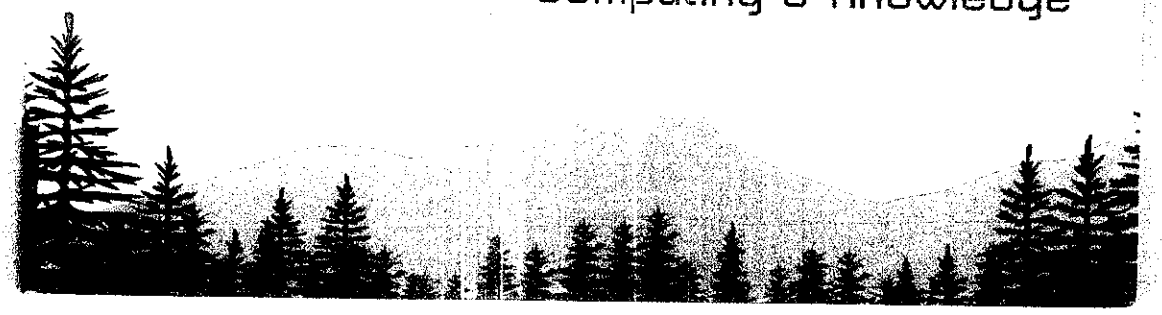

Study of UWB Indoor Localization Using Fingerprinting Technique with Different Number of Antennas

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Abstract— **Wireless sensor networks (WSNs) have been applied in various applications. Each application is developed in order to increase security, increase convenience to life and property. In this work, we have analyzed the application of WSNs to locate with fingerprinting technique on the standard of IEEE802.15.4a (Ultra wideband (UWB)) in terms of the number of antennas required when using line of sight (LOS) environment. The experiment was done by using a vector network analyzer (VNA) with biconical antennas. The frequency transfer function of the channel was measured at various locations. As a result, the use of delay time parameter of the UWB standard gave the best result. It was able to use only one antenna pair to identify areas accurately. Moreover, it saved time for doing the database, reduced size of the database and reduced some cost because the number of antennas was decreased.**

Keywords—indoor localization; UWB; fingerprinting technique; LOS environment

I. INTRODUCTION

Nowadays, wireless sensor networks (WSNs) have been applied in various applications in order to increase the safety of life and property, and the assist on the facilitation. One of the applications, WSNs have been used to track people or objects in indoor localization [1]-[4].

Ultra wideband (UWB) technology is one technology that has more interesting. The UWB technology is robustness to environment and It does not interfere with other technologies. Therefore, it is safety to apply with humans.

In addition, Localization method is an important thing which is considered. Fingerprinting technique is a localization method which has been popular to use in indoor localization. The fingerprinting technique not only applicable to the LOS environment is also available for environments with NLOS. In addition, Fingerprinting technique is also available with two antennas or more than that. Unlike the common technique, it requires multiple antennas.

This research studies the use of the fingerprinting technique with increase of the number of antennas by using UWB technology. This paper consists of 5 sections, There are introduction, UWB localization technique, measurement set up, experimental results and conclusion.

II. UWB LOCALIZATION TECHNIQUE

A. UWB Trasmitted Signal Model

In this research, we used the rectangular passband waveform for the UWB transmitted signal. The equation of rectangular passband waveform in the time domain illustrates in the 1st equation. Then, the equation of spectral density function of the rectangular passband waveform in frequency domain shows in Eq. (2)

$$v_t(t) = \frac{A}{f_B}[f_H \operatorname{sinc}(2f_H t) - f_L \operatorname{sinc}(2f_L t)] \quad (1)$$

$$V_t(f) = \begin{cases} \frac{A}{2f_B} & |f| - f_c| \le \frac{f_B}{2} \\ 0 & |f| - f_c| > \frac{f_B}{2} \end{cases} \quad (2)$$

where A is the maximum amplitude, f_B is the bandwidth, f_C is the center frequency, f_L and f_H are the lowest and highest frequencies, respectively.

The spectral density of UWB received signal is defined by Eq. (3)

$$V_r(f) = V_t(f) \cdot H_c(f) \quad (3)$$

where $H_c(f)$ is the frequency transfer function obtained by using a vector network analyzer (VNA).

After that, the received signal in the time domain, Eq. (4), can be calculated by using inverse Fourier transform.

$$v_r(t) = \int_{-\infty}^{\infty} V_r(f) e^{j2\pi ft} df. \quad (4)$$

B. UWB Radio Propagation Parameters

The received power illustrates in Eq. (5) which is calculated from the received signal in the time domain.

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เรื่อง ให้อาจารย์ไปราชการ

ด้วยมหาวิทยาลัยแม่โจ้ จะจัดการประชุมสัมมนา The 20th International Computer Science And Engineering Conference " Smart Ubiquitous Computing And Knowledge" ระหว่างวันที่ ๑๔-๑๗ ธันวาคม ๒๕๕๙ ณ โรงแรมเชียงใหม่ ออร์คิด จังหวัดเชียงใหม่

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