

INTERMITTENT MEASUREMENT ANALYSIS
FOR MOBILE ROBOT APPLICATION

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UNIVERSITI MALAYSIA PAHANG

INTERMITTENT MEASUREMENT ANALYSIS FOR MOBILE ROBOT
APPLICATION

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ED12029

This thesis is submitted as partial fulfilment of the requirements for the award of the
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FINAL YEAR PROJECT REPORT

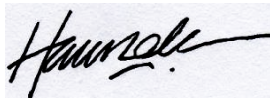
Faculty of Electrical & Electronics Engineering

Universiti Malaysia Pahang

2016

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of the Bachelor Degree of Electrical Engineering (Hons.) (Electronics).

Signature : 


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Date : 16th Disember 2016

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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ABSTRACT

This research is about the investigating of the condition during intermittent measurement when Extended Kalman Filter (EKF) is applied for Simultaneous Localization and Mapping (SLAM) problem of mobile robot during measuring and estimating its environment while updating its location consistently. This problem is being analyzed because to reduce the mobile robot uncertainties or covariance state during it is working also to prevent data loosing that to be updated to the monitor. There are two purposes of this research. Firstly is to determine the performance of Extended Kalman Filter based Simultaneous Localization and Mapping (SLAM) and secondly is to determine the condition during intermittent measurement when Extended Kalman Filter (EKF) is applied for Simultaneous Localization and Mapping (SLAM) problem. Simultaneous Localization and Mapping (SLAM) method is used in achieving the objective; to determine the condition of statistical bound during intermittent measurement. A few technical approaches such as Extended Kalman Filter (EKF), H infinity Filter, Unscented Kalman Filter (UKF) and Particle Filter are used for estimation purposes. EKF is the most recommended method for SLAM solution. This is because the filter offers simple algorithm to follow and has lower computational cost compared to others.

ABSTRAK

Kajian ini akan menyiasat keadaan semasa pengukuran tergendala apabila Pelanjut Penapis Kalman (EKF) digunakan untuk masalah Penempatan dan Pemetaan Serentak (SLAM) robot mudah alih semasa mengukur dan menganggar persekitarannya semasa mengemas kini kedudukannya secara konsisten. Masalah ini sedang dikaji untuk mengurangkan ketidakmenentuan atau keadaan kovarians robot tersebut semasa ia sedang berfungsi juga untuk mengelak kehilangan informasi untuk dikemaskini kepada pengawal. Kajian ini mempunyai dua tujuan. Tujuan pertama ialah untuk menentukan prestasi apabila Pelanjut Penapis Kalman (EKF) berdasarkan Penempatan dan Pemetaan Serentak (SLAM) dan tujuan kedua ialah untuk menentukan keadaan kovarians ketika pengukuran tergendala apabila Pelanjut Penapis Kalman (EKF) digunakan untuk masalah Penempatan dan Pemetaan Serentak (SLAM). Kaedah Penempatan dan Pemetaan Serentak (SLAM) digunakan untuk mencapai objektif tersebut; untuk menentukan keadaan statistik julat ketika pengukuran tergendala. Beberapa pendekatan teknikal seperti Pelanjut Penapis Kalman (EKF), Penapis H Infiniti, Penapis Tidak berbau Kalman (UKF), Penapis Zarah telah digunakan untuk tujuan pengukuran. Teknik Pelanjut Penapis Kalman (EKF) adalah paling disyorkan bagi penyelesaian masalah Penempatan dan Pemetaan Serentak (SLAM). Hal ini adalah kerana teknik ini menawarkan algorithm yang mudah dan kos pengiraan yang lebih rendah berbanding yang lain.

CHAPTER 1

INTRODUCTION AND GENERAL INFORMATIONS

1.1 BACKGROUND

This chapter is discussed about the project background which includes the project scope, applications of the project, the problem statement and objectives of the project. The development of mobile robot is attracting nowadays. It has been used more and being too varies in completing tasks so that human can have an easier and better life. The basic and significant part of mobile robot is the motion and movement made by the robot itself. It must know the information about the environment surrounding and where to move. An accurate measurement achieved for localization could be considered as a successful navigation in large-scale environment without the information given at first.

A mobile robot is quite popular since it is mostly used in investigate on navigation and examination. A robot is exploring an unknown or static environment and could do observations of nearby features. Some applications were applied in a real world are in the hazardous or disaster place. It is included for indoor, underwater, underground and space. The maps of robot environment and its estimated position over time were contributed by the combination of input controls and sensors reading.

Therefore, this research attempts to design a mobile robot with a sensor to detect the environment then updates its location. However, one of the problems is about intermittent signal from sensor when mobile robot attempts to observe surroundings and consistently updates its location. If the robot fails to get data measurement from the

sensor then probability of losing information is high. This matter brings ineffectiveness of mobile robot application.

Mobile robot specifications and operation should be understood before doing the research about the system in it. The type of mobile robot, type and number of sensor used, way of movement and other physical specifications must be recognized so that it is easier for engineer to design a better system for it to operate. In this project, normal mobile robot with four wheels, 2 sensors for front and rear, sensor at tyres also move in all directions will be assumed.

In making the mobile robot be a good observer, designer should use a better system or method to estimate the environment and give accurate estimation for it to update its location. For this project, the method to be use is extended Kalman filter (EKF) for non-linear system. EKF method is chosen because of its function which is to linearize the non-linear system subjected to Gaussian noise. This research will be carried out with two different conditions; normal and intermittent condition.



Figure 1.1: Mobile robot

1.2 PROBLEM STATEMENT

This project is about the investigating of the condition during intermittent measurement when Extended Kalman Filter (EKF) is applied for Simultaneous Localization and Mapping (SLAM) problem. This model will be simulated in MATLAB software for analysis purposes.

1.3 OBJECTIVE OF PROJECT

The main objectives of this project:

- i. To determine the performance of Extended Kalman Filter based Simultaneous Localization and Mapping (SLAM).
- ii. To determine the condition during intermittent measurement when Extended Kalman Filter (EKF) is applied for Simultaneous Localization and Mapping (SLAM) problem.

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