

MECHATRONICS BOOK SERIES SYSTEM DESIGN AND SIGNAL PROCESSING VOLUME 1

Editors

**Asan G. A. Muthalif
Amir Akramin Shafie
Siti Fauziah Toha
Iskandar Al-Thani Mahmood**



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CHAPTER 6

Auto Landmarks Generation for SLAM Algorithm

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6.1 Introduction

An autonomous robot must know its pose in order to move to the next step. A non-autonomous robot merely executes the planned path that has already been programmed. An early method of determining the robot current position is using dead reckoning (DR) approach. In DR, current position is estimated by adding to the last position an amount equal to the change in distance traveled. The change is calculated based on the speed, time, and direction of movement. The problem with this method is that measurement errors tend to be cumulative and with time the calculated position will be far from the actual position. Errors are introduced among others by sensors, encoders, and slippage of the wheels while moving. The errors must be corrected, and this lead to a new algorithm.

Simultaneous Localization and Mapping (SLAM), also sometimes called Concurrent Localization and Mapping (CLAM), is a two part process in which a robot builds a map of its environment and use the map to determine its pose. Early SLAM algorithm makes use of Kalman Filter to estimate the next position. Due to non-linearities introduced by for instance sensor errors and wheel slippage the Extended Kalman Filter (EKF) was used.

SLAM makes it possible for a moving robot starting from an unknown location without previous knowledge of the environment to build a map using its on-board sensors while using the same map to compute its location [1]. SLAM allows a robot to move autonomously in an environment without prior programming of its path. It is a well-known and well-researched problem but its applications in real life is still plagued with many challenges. The acronym SLAM was presented in 1995 at International Symposium on Robotics Research. Durrant-Whyte and Bailey have produced a two-part tutorial paper on SLAM that covers the topic comprehensively including the history of its development [2].

6.2 SLAM Challenges

The idea in SLAM is to eventually create the map of the environment and to enable robots to navigate their way. The challenges in dynamic environment where other objects moves in relation to the robot is bigger than in static environment. As the robot moves in an environment it continuously creates and updates the map of the environment it is in. This map can be extracted and used for specific purposes. The ability to move autonomously also enables such robots to navigate itself and functions as service robots.

There are a number of challenges associated with SLAM. Thrun listed and enumerated five challenges [3]:

1. measurement noise,
2. dimensionality of the area being mapped,
3. correspondence or data association,
4. temporal variation,