International Journal of Innovative Computing, Information and Control
Volume **5**, Number **1**, January **2009**
 ISSN 1349-4198
pp. 119–128

REFORMATION OF PARTICLE FILTERS IN SIMULTANEOUS LOCALIZATION AND MAPPING PROBLEMS

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Received March 2008; revised August 2008

Abstract. *SLAM is a hot topic in robotics community. It uses range sensors and acquires the distances to various directions as the sensor moves and changes its direction, so that it can acquire the environmental landscape and estimate the sensor's position and the angle simultaneously. In this paper, we will explain the detail of FastSLAM by Montemerlo, and propose a modification of the algorithm, where the observed distance measures in one scan are used simultaneously. Numerical example will validate the usefulness of our algorithm.*
Keywords: SLAM, Particle filter, Localization, Mapping, Pushcart

1. **Introduction.** Recently, stochastic models have been widely used in object tracking and robotics (*e.g.* [3],[6]). Among those, simultaneous localization and mapping (SLAM) problem is important in autonomous moving robotics, where acquiring the environmental map and the sensor's trajectory are simultaneously aimed to be achieved. We have been developing a SLAM system on a pushcart, which is equipped with a laser sensor. Our goal is to use a senior car (an electric car for an old person that moves slowly). It is not hard to find any objects that can be detected in one scanned data, since the nature of the data is very suitable for this problem. However, to know the location of the sensor position is a very hard problem, since we have to know its position only from the obtained scanned data without odometry in pushcart case. The importance of SLAM problem can be identified by considering the situation when we got lost our way in a maze. If we bring such equipment to a cave that is not explored sufficiently, it would be of a great help.

The framework of SLAM can be described as follows.

1. Input one cycle of scanned data. The data set is a collection of points with a certain angle interval.
2. The obtained point positions must be rotated and moved by the inverse way of the sensor movement and rotation. However, we lack the knowledge of sensor movement and rotation information.
3. Adjust the observed points to the map that was built by using the past observation points. This new set of data may contribute adding some new part of the map.
4. Repeat Steps 1-3.

There are several strategies for estimating the sensor position and orientation from the observed data, namely, (1) ICP (Iterative closest point)-based method, (2) PF (Particle Filter)-based method [2], and (3) KF (Kalman Filter)-based method [2].

In ICP algorithm, the correspondence between the new data and the reference data set is given by the closest point between two sets. The change of the position and the angle of the sensor can be obtained as a result of point matching. This method is a "passive"