Comments on :

Handbook of robotics - chapter 36 - World Modeling

Virgile Daugé*

University of Lorraine
virgile.dauge@inria.fr

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Abstract

The way to represent the world is very influent in scanning and modeling results. This book chapter is listing different existing solutions.

I. Models for Indoors and structured environements

i. Occupancy grids

The space is divaded into cells, each cell have is own probability of being an obstacle. Mainly 2D grid of obstacle probability. Can be used in 3D. Used a lot for Slam. High memory requirements (directly depending on the resolution of the grid). Strongly sensor dependant (difficult to use with sonar for example cause is measurment area is quite large).

ii. Line maps

Extracting lines from the environement, mainly by mean squares estimation. Require less memory. Scale better with the size of the environement. More acurate (not discretisation's resolution dependant). Not a closed-form solution.

iii. Topological Maps

The environement is represented by a graph-like structure, in witch nodes are locally distinguishables places. A way to use it is to compute a voronoi graph, showing paths free from obstacles. Not really suited for mapping but can be usefull for navigation.

iv. Landmark-Based Maps

Lighter than grid map, used in FASTSLAM

II. Natural environements

i. Elevation Grids

Using 2D grid of cells, where each cell contains an elevation. Good for representing unconsistent terrain. Bad for multi-level environemments. The cell size (and grid resolution) can be adaptative according to the distance to the robot for exemple). It's easy to use with Lidar (each point returned by the lidar can be a cell delimiter)

ii. 3D grids and points sets/point clouds

3D dense occupancy grids cost a lot of memory.

Point cloud consist of storing each points returned by a sensor according to the same reference pose. Point clouds are more extensibles

*A thank you or further information

and scalable. However, the amount of data can be quite huge in prolongated scans.

iii. Meshes

Representation surfaces with a set of polygones. Compact representation, and there is a lot of available mesh simplification algorythms. However, the extraction of surfaces can be really difficult in complex environements. Difficult to represent vegetation with continuous surfaces. Good for human visualisation.

iv. Cost maps

Representing the space by the estimated cost of passing through. Common way for rovers is to compute the angle of the slope. Not really relevant for drones.

v. Semantic Attributes

Learning to recognize landmarks. Can be viewed as classifictation problem. Simple discrimination between obstacles and free region for navigation. Difficult to pick good resolution for classification, as it is strongly dependant to the type of the environement.

III. Dynamic Environements

Dynamic object filtering by using feature-based tracking algorithm.

IV. Discussion