6.1 Introduction to mapping

In the previous chapter we studied different methods for localizing a robot equipped with a sensor able to take measurements to a number of landmarks with known positions, that is, the map m of the environment was given before hand. Now we will review a number of techniques addressing the opposite problem: to build a map m of the environment given a set of known robot poses x and sensor measurements z, that is:

$$p(m|z, x)$$

Notice that:

- x is not a random variable here, but a know vector (3×1 in 2D).
- since the robot pose x is given, it is not necessary to consider the motion command u!
- z is a sample from a distribution with mean $h(x, m)$.

There exist different types of maps, being the most used ones:

Landmarks based maps

Fig.1 - Landmarks based map of an office environment. In this case Landmarks are QR codes placed next to doors.

Occupancy grid maps

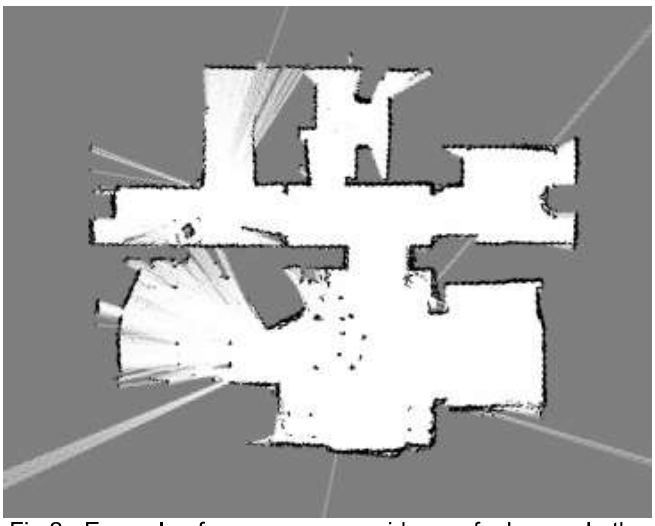

Fig.2 - Example of an occupancy gridmap of a house. In the image, white pixels represent traversable space, black pixels stand for obstacles, and gray ones are unknown space.

Topological maps

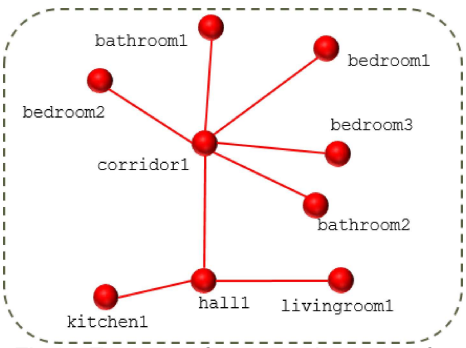

Fig.3 - Example of a topological map of a house where nodes represent rooms and edges link connected rooms.

Semantic maps

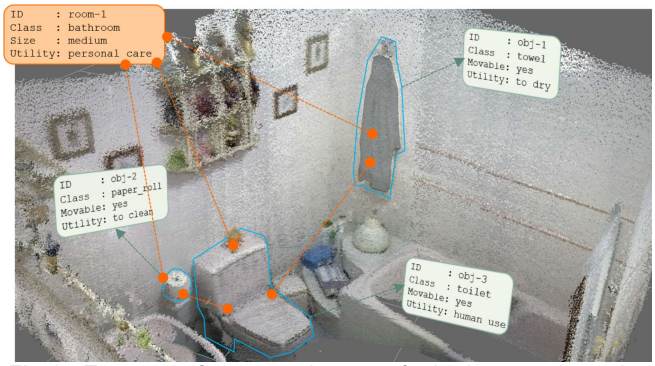

Fig.4 - Example of a semantic map of a bathroom where the objects within it are linked with meta-information about their category, size, utility, mobility, etc.

Notice that both Landmarks based maps and occupancy grid maps are **geometric maps**. In

OPTIONAL

Surf the internet looking for more general information about robot mapping. You can include additional definition, examples, images, videos,... anything you find interesting!

Topological Mapping in Visual SLAM

Topological mapping focuses on the connectivity and relationships between areas rather than detailed geometric information. In Visual SLAM, it utilizes camera data to create a map based on key locations and connections. Topological maps are often graph-based, with nodes representing significant locations and edges denoting connections. Keyframes, selected frames capturing essential information, are crucial in this representation.

It recognizes when the robot revisits a location, ensuring consistency in the map and visual features are used for loop closure detection. However, detecting loop closures accurately can be challenging.

It identifies previously visited locations based on visual features and associates current visual input with the existing topological map. It focuses on the semantic relationships between locations.

Youtube video: https://www.youtube.com/watch?v=UokjxSLTcd0&ab_channel=aslteam (https://www.youtube.com/watch?v=UokjxSLTcd0&ab_channel=aslteam)

Paper:

- https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5152501 (https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5152501)
- https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8460641 (https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8460641)

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