



A and B are metric maps, C is topological

Some SLAMs use hybrid metric and topological, but none use only topological

The conversion from a topological to a metric map is not always trivial, and for this reason, recent monocular SLAM systems employ hybrid maps, which are locally metric and globally topological.

3 main solutions to generate/expand a map:

1. Two-view triangulation, which recognizes a point and uses 3D vectors to triangulate its position from camera angles. Actually uses more than 2 views, and triangulates by minimizing the sum of re-projection errors over multiple vectors

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1. Filter depth estimation, which assumes the first landmark is along a 1D ray, and applies a uniform distribution filter, then uses other angles to update depth
2. Topological map, using data association between keyframes to connect them as nodes. They are less computation-intensive, and connects keyframes as nodes with data association to link them based on amount of data association. Co-visibility graphs contain all links, and essential graphs only contain the 2 strongest links for each node as borders

Problems:

Topological maps cannot be used standalone, as they are essentially just connected keyframes.

Two-view triangulation can only be effective when there is significant movement to triangulate between, meaning there are problems when most camera motion is rotational and scenes aren’t re-observed

Filter-based triangulation comes into processing issues when dealing with very far objects that do not change significantly from different angles. They are identified as outliers when the depth map does not change from the flat one, and brought in to the metric map when depth has been measured. However, it requires complexity to determine the probabilities that landmarks are too far to be recognized or can be brought in.

Dense and semi-dense maps require more data handling in 3D, but can actually show detail as opposed to sparse, which only shows features.