

Ambiguities in Simultaneous Localization and Mapping (SLAM)

Simultaneous Localization and Mapping (SLAM) is one of the cornerstones of robotics research. Any mobile robot which is to operate in a previously unknown area requires a method for estimating both a model of its new surrounding and its own location within it. The major source of errors in SLAM is faulty data association. Specifically, two types of errors were identified:

- a) Errors in identifying common data in two consecutive sensor observations (local ambiguity) and
- b) errors identifying common data in temporally distant sensor observations (global ambiguity).

These two errors are fundamentally different as the first is often caused by limited common data or symmetries in observation pairs, while the second is usually caused by perceptual aliasing and is relevant to loop detection.

The talk presents several examples of local and global ambiguities as they occur in real-world SLAM problems, a principled graph-based approach to address these ambiguities with multimodal and hyperedge constraints called the Generalized Graph SLAM framework, and the Prefilter method to solve SLAM problems formulated in this framework.