INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
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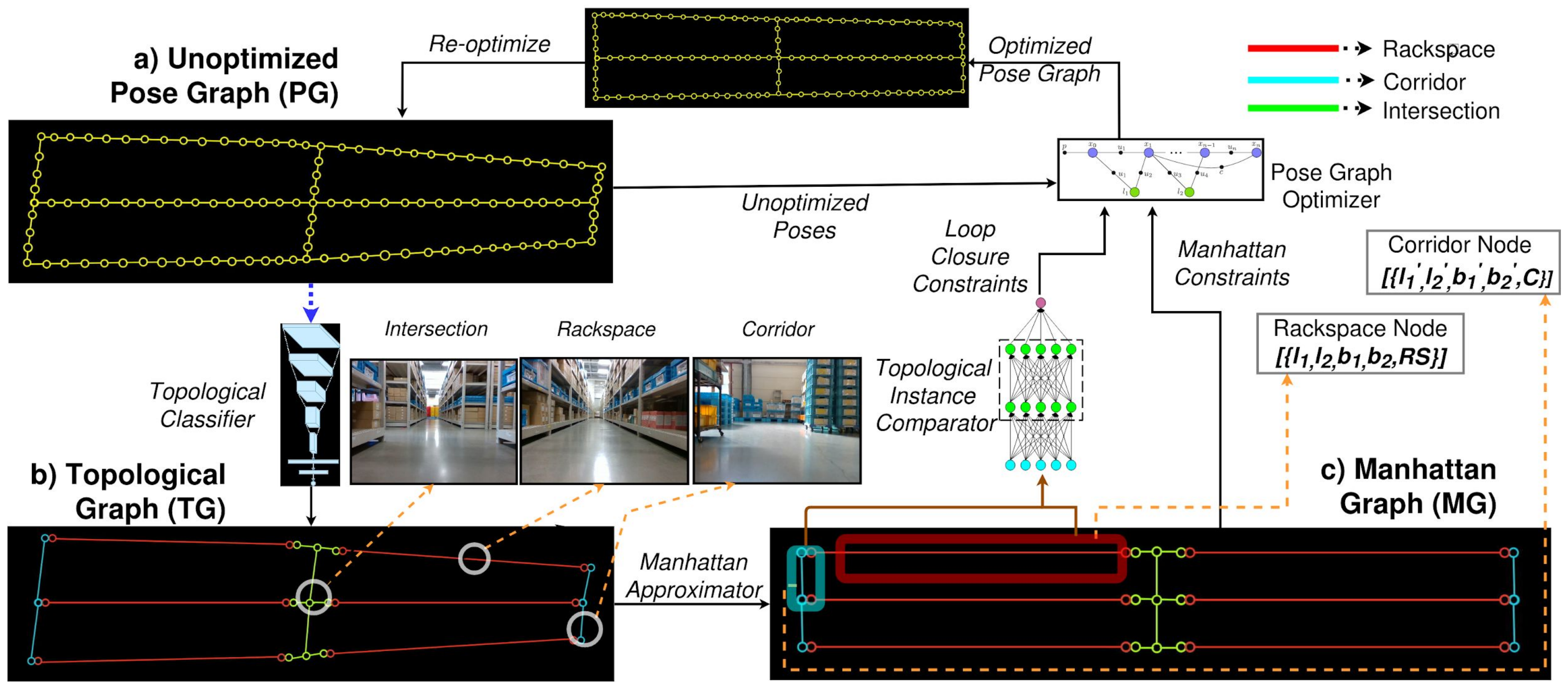
Topological Mapping for Manhattan-like Repetitive Environments

Rapyuta Robotics

ABSTRACTS

We showcase a topological mapping framework for a challenging indoor warehouse setting. At the most abstract level, the warehouse is represented as a Topological Graph where the nodes of the graph represent a particular warehouse topological construct (e.g. rackspace, corridor) and the edges denote the existence of a path between two neighbouring nodes or topologies. At the intermediate level, the map is represented as a Manhattan Graph where the nodes and edges are characterized by Manhattan properties and as a Pose Graph at the lower-most level of detail. The topological constructs are learned via a Deep Convolutional Network while the relational properties between topological instances are learnt via a Siamese-style Neural Network. In the paper, we show that maintaining abstractions such as Topological Graph and Manhattan Graph help in recovering an accurate Pose Graph starting from a highly erroneous and unoptimized Pose Graph. We show how this is achieved by embedding topological and Manhattan relations as well as Manhattan Graph aided loop closure relations as constraints in the backend Pose Graph optimization framework. The recovery of near ground-truth Pose Graph on real-world indoor warehouse scenes vindicate the efficacy of the proposed framework.

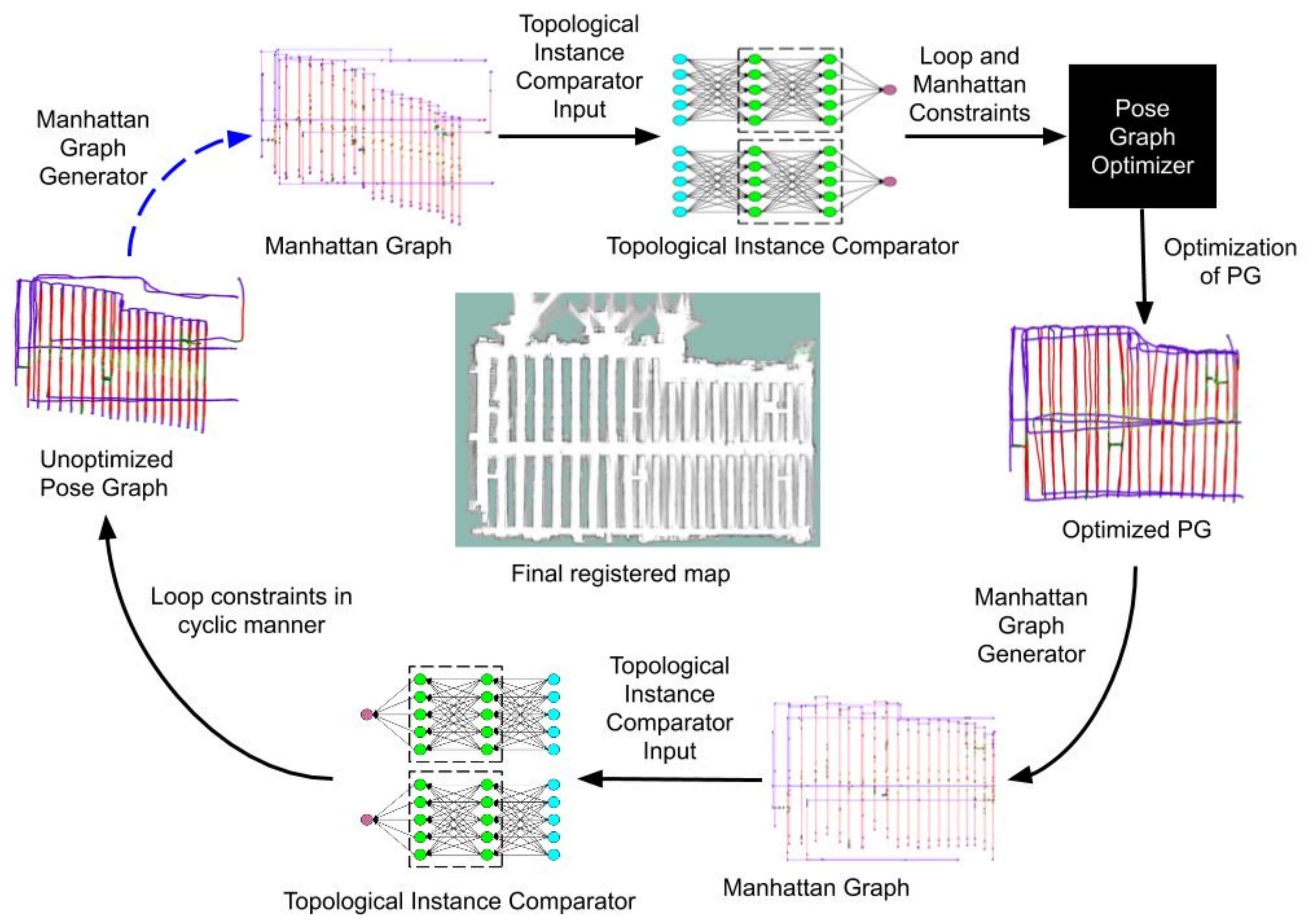


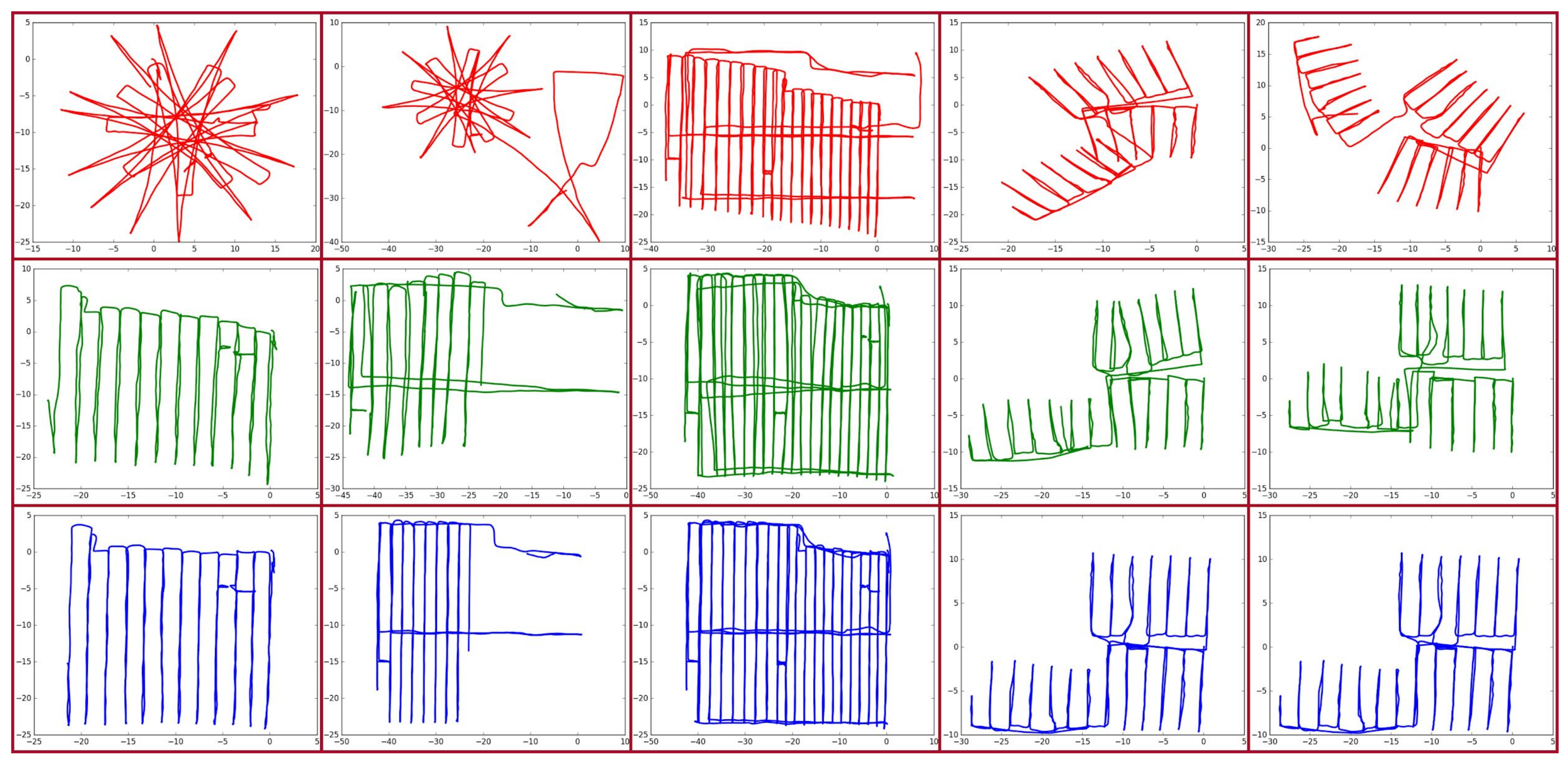
METHOD

1. A deep convolutional network capable of learning warehouse topologies.
2. A Siamese Neural Network based relational classifier which resolves topological element ambiguity and helps achieve an accurate pose graph purely based on Topological relations.
3. We showcase a backend SLAM framework that integrates loop closure relations from an intermediate level Manhattan Graph to the lowest level Pose Graph and elevate a disoriented unoptimized map to a structured optimized map which closely resembles the floor plan of the warehouse. Apart from the loop closure relations, the SLAM integrates other Manhattan relations to the pose graph. Ablation studies show the utility of both loop and Manhattan constraints as well as the superior performance of an incremental topological SLAM over a full batch topological SLAM.

OBJECTIVE

1. Developing a topological mapping framework for a challenging indoor warehouse setting.
2. Recovering near ground-truth trajectories starting from highly erroneous trajectories.





Authors: Sai Shubodh Puligilla , Udit Singh Parihar, Satyajit Tourani, Tushar Vaidya. Research Center Name: Robotics Research Center