

Type [SA/MA] (Theoretical, Practical)

Graph-based Modeling of Construction Logistics: Literature Review and Framework Development

Background

Construction sites are characterized by complex, evolving relationships between various entities such as cranes, storage areas, and transport routes. While traditional simulation models capture these dynamics, they lack the ability to generalize across different projects. Graph Neural Networks (GNNs) have emerged as a powerful tool for learning from relational data. To leverage GNNs for construction logistics, we first need a robust framework that translates physical site layouts and material flows into a standardized graph-based format.

Objective

The goal of this thesis is to bridge the gap between construction logistics domain knowledge and Graph Machine Learning. You will investigate existing GNN approaches and develop a Python-based framework to represent dynamic construction sites.

Your tasks will include:

Systematic Literature Review:

Identify and analyze current research on GNNs in the context of logistics, supply chain management, and facility layout planning, with a specific focus on construction-related challenges.

Data Schema Design:

Develop a comprehensive use-case data model that maps construction entities (e.g., cranes, storage areas, access points) and their spatio-temporal relationships (material flows, distances, dependencies) into graph structures.

Framework Development (PyG):

Implement a modular data framework using PyTorch Geometric (PyG). This includes the creation of data loaders and the definition of node, edge, and global features tailored to construction logistics scenarios.

Conceptual Evaluation:

Create a set of synthetic "toy-problem" graphs to demonstrate and validate the framework's ability to capture changing conditions and dependencies across different construction layouts.

Profile

- Interest in Logistics, Machine Learning, Deep Learning, and Graph Theory.
- Solid programming skills in Python.
- Background in Engineering, Computer Science, or a related field.
- Practical experience with Deep Learning frameworks (e.g., PyTorch, TensorFlow) is a significant advantage.
- High degree of independence, reliability, and structured working style.
- Good German and/or English skills.

Start Immediately

If you are interested, please send your application including your CV and academic transcript [via email](#).

Kontakt Yuan-Jen Huang, M.Sc.

Raum: MW 0501 Tel.: +49 (89) 289 – 15931

E-Mail: yuan-jen.huang@tum.de