19. Indoor localization in IoT networks based on Graph Neural Networks

Company -		ISEP supervisors Wafa Njima and Masood Jan
Domain(s) ☒ Computer Science ☒ Signal, Image, Data ☒ Telecom & Networks ☐ Electronics	Pre-requisites ▪ Knowledge of Machine Learning ▪ Python or TensorFlow ▪ Basics of signal propagation	Number of students 1 – 2

General presentation / Technological context

- Indoor localization systems are increasingly integral to various Internet of Things (IoT) applications. The demand for increased accuracy and reliability in such systems continues to grow, driving innovation and expanding the potential for seamless indoor navigation and advanced location-based services.
- In response to this growing demand, machine learning (ML) has emerged as a powerful tool for processing the heterogeneous and high-dimensional data generated for localization
- While neural network (NN)-based approaches offer high accuracy, their training often requires large datasets and significant computational resources.
- Graph Neural Networks (GNNs) have emerged as a specialized class of neural networks designed to address problems related to graph interpretations, such as geometric correlation scenarios, further expanding the toolkit available for enhancing indoor localization systems.
- The goal of this project is to propose a novel GNN architecture to effectively capture spatial relationships between WiFi access points used for localization and underlying data patterns leading to superior performance.

Specifications / Tasks

- Built a state of the art of indoor localization basics and different signal propagation parameters used for localization.
- Formulate the localization problem as a regression problem solved using GNNs given a specific signal parameter.
- Implement the proposed method using python and compare it with DNN-based localization method in terms of localization accuracy and computational complexity using the public database UJIIndoorLoc.

Work organization / Expected deliverables

- Weekly meetings
- End of project: Written report, commented code, demonstration and final presentation

References

[1] Ibrahim, Mai, Marwan Torki, and Mustafa ElNainay. "CNN based Indoor Localization using RSS Time-Series." *2018 IEEE symposium on computers and communications (ISCC)*. IEEE, 2018.

[2] Torres-Sospedra, Joaquín, et al. "UJIIndoorLoc: A New Multi-Building and Multi-Floor Database for WLAN Fingerprint-based Indoor Localization Problems." *2014 international conference on indoor positioning and indoor navigation (IPIN)*. IEEE, 2014.