Master Thesis

Chair for Theoretical Information Technology | RWTH AACHEN UNIVERSITY

Fast Training and Fingerprint Construction in Indoor Localization Solutions: A Deep Learning Perspective

Research Area
Indoor Localization, Deep Learning

Keywords
Deep neural networks, denoising auto-encoders, fingerprinting indoor localization

Description
Precise location of people, equipments, and materials, both indoor and outdoor, is an essential information for future networks as an enabler of context aware services, location aware and pervasive computing, ambient intelligence, and location based services. A variety of localization solutions have been studied and proposed by researchers over the years. Fingerprinting algorithms are particularly attractive because they rely on available wireless infrastructures and do not require costly set-up of a new infrastructure. In these algorithms, a database is constructed by gathering fingerprints of different locations. A pattern matching algorithm identifies the location by finding the most similar fingerprints in the database to the reported fingerprint from an unknown location. However these algorithms come with two main drawbacks. In most cases, a measured feature for fingerprinting, the RSSI value in the case of this thesis, is directly used as fingerprint without additional process. This leads possibly to inefficient redundant training databases. The first goal of this thesis is to find useful abstractions of measured RSSI values to construct fingerprints using deep architectures. The unsupervised nature of this phase makes it possible to use the unlabeled measurements to better train the autoencoders. Therefore, in the training phase, RSSI values are gathered not only from points of the training grid but also from users in the area. These additional measurements are used to train autoencoders by optimizing their parameters and find fingerprints for indoor localization. Another drawback is the costly training phase. The second goal of this work is therefore to reduce the training phase cost by taking fewer measurements and interpolating between them using deep architectures.

Goal
The goal of this thesis is to employ deep architectures for two main purposes. First useful abstractions of measured RSSI values are extracted to construct fingerprints. The performance of fingerprinting indoor localization solutions is evaluated using the new fingerprint construction. Second deep architectures are used to construct the training database of indoor localization algorithms from far fewer training grid points. The respective deep neural network is trained using other available databases from buildings of similar structure. It is investigated whether this approach can reduce the training phase while achieving acceptable performances.

Requirements
- Strong background in optimization
- Python programming

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