香港浸會大學理學院
HKBU Faculty of Science

# DEPARTMENT OF COMPUTER SCIENCE

## PhD Degree Oral Presentation

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| PhD Candidate: | Ms Qiaolin PU |
| Date | 10 December 2021 (Friday) |
| Time: | 2:00 pm – 4:00 pm (35 mins presentation and 15 mins Q & A) |
| Venue: | Zoom ID: 982 1274 4605<br>(The password and direct link will only be provided to registrants) |
| Registration: | https://bit.ly/sem-zm (Deadline: 6:00 pm, 8 December, 2021) |

***Advances in WiFi Fingerprinting Positioning System: Anchor Optimization, Fingerprint Processing and Theoretic Error Bound Analysis***

## Abstract

With the development of Indoor Location-based Services (ILBSs), there have been increasing demands on high-accuracy indoor positioning systems. Recently, WiFi fingerprinting positioning system has been widely studied due to the pervasive infrastructures. However, it still faces some challenges, such as the anchor optimization problem, processing of raw fingerprints, and the assessment of theoretical location accuracy, etc. Therefore, in this thesis, we study these mentioned challenges to improve the location accuracy, system efficiency and robustness.

First, we conduct an Access Point (AP) deployment optimization based on the projection-induced knowledge in user aimed fingerprinting positioning system. An objective function is constructed aiming at decreasing big error cases and then we solve it from the projection perspective rather than search algorithms. Second, we propose a joint compressive sensing (CS) kernel optimization and outlier detection scheme in rogue AP aimed fingerprinting positioning system. The scheme consists of three steps: i) coarse localization: a novel Object Weighting Affinity Propagation (OWAP) clustering method is proposed to group the offline fingerprints; ii) CS kernel optimization: the minimum number of required monitors is deduced, and an Equiangular Tight Frame (ETF) based monitors selection scheme is presented; and iii) joint fine rogue AP positioning and outlier detection: a formulation of an improved CS based sparse recovery model is proposed. Third, for raw fingerprints with high dimensionality, we present a feature extraction algorithm using a manifold learning called T-distributed Stochastic Neighbor Embedding (TSNE) which extracts these non-linear fingerprint features and reduces the dimensionality of fingerprint database simultaneously. During the procedure, an intrinsic dimensionality estimation method is proposed to obtain the best dimensionality in advance. Lastly, we construct a novel derivation model involving the grid size to analyze the location error bound from the perspectives of the signal measurement and positioning algorithm. From the former perspective, the error bound is analyzed under two cases: specific and non-specific signal distributions. From the latter perspective, we analyze the error bound of the widely used KNN algorithm, based on which a novel adaptive KNN algorithm is designed, and it has improved the location accuracy by about 20%.

***** ALL INTERESTED ARE WELCOME *****