

Wireless Networks

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Wireless Localization Techniques

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Preface

Location service is a prerequisite for numerous IoT applications. While most modern mobile devices are equipped with global navigation satellite system (GNSS) receivers, the satellite system-based location service could be unavailable in certain circumstances, for example, in indoor spaces and “urban canyon” areas, where the satellite signals could be blocked by walls and buildings. It is, therefore, necessary to perform localization with other technical means, which are supposed to meet the following needs: (1) universality—can use commercial off-the-shelf (COTS) devices for localization without hardware modification; (2) effectiveness—can provide services with certain accuracy and reliability; (3) deployability—can be easily deployed with existing infrastructure and limited investments.

Wireless localization can be a very appropriate candidate solution, which estimates a wireless terminal’s location by analyzing features of wireless communication signals, such as Wi-Fi, LTE, and BLE. This technique has been attracting interest from both academia and industry since the past decades; however, most of the research work has been conducted empirically, that is, observing experimental results and phenomena, then coming up with a new idea, and then verifying the new idea with experiments again. A systematic theoretical study has been long pending. Answers to some fundamental issues of the wireless localization technique are still unknown.

In this book, we provide systematic theoretical studies and design approaches for wireless localization systems, which tentatively answer the following fundamental questions:

- (1) How good the wireless localization system could possibly achieve?
- (2) How the system could scale up with the number of users to be served?
- (3) How to make key design decisions in implementing the system?
- (4) How to mitigate human efforts in deploying the wireless localization system?

Such theoretical insights could help researchers and engineers understand the essence of wireless localization methodology and develop practical systems.

We hope this book can help in advancing research and the practice of wireless localization. This book is primarily intended for anyone who wants to learn wireless

localization technology. It is an ideal guidebook for students or beginners who are the first to walk into this area, as well as professionals, engineers, and researchers working in related fields.

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Introduction

Wireless localization is a technique used to estimate a wireless terminal's location by utilizing characteristics of wireless communication signals, such as Wi-Fi, LTE, and BLE. This technique has been attracting interest from both academia and industry since the past decades; however, most of the research work has been conducted using the methodology of “empirical study.” A systematic theoretical study on the topic has been long pending. In this book, we present a systematic theoretical study of the wireless localization technique. Guided by theoretical results, we will provide design approaches for improving performance of the localization system and making its deployment more convenient.

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