

Preface

With the popularity of wireless networks, location-based service (LBS) has quickly entered people's daily life. In practice, LBS has a large range of applications and often manifests in various forms in different types of networks. For example, E-911 in the USA, or corresponding E-112 in Europe, offers timely and accurate assistance to the emergency callers by locating them through mobile communication networks or global positioning system (GPS). Location information also plays a major role in modern asset management. Some companies, in particular hospitals, have deployed the WiFi-based solutions for real-time equipment locating and tracking, in order to increase equipment utilization and reduce overpurchasing costs. In addition, sensor network, a typical type of wireless ad hoc networks, has shown its great prospects of environmental monitoring, industrial sensing and diagnosis, battlefield surveillance, context-aware computing, and more. Autonomous localization of sensor nodes is essential since location makes the sensory data geographically meaningful. In all, many applications and services of wireless networks directly or indirectly rely on location information.

This book aims to provide a comprehensive and in-depth view of location-awareness technology in today's popular wireless networks. However, the obvious diversity of networks, from short-range bluetooth to long-range telecommunication network, makes it very challenging to organize materials. Although general principles exist, the implementation differs from network to network and application to application.

When composing the text, we have been thinking a lot what materials to include and how to organize them. Our thoughts come to the following two decisions. First, from the perspective of application, the book focuses on wireless ad hoc and sensor networks, in which the overwhelming majority of localization techniques are involved. Indeed, the techniques discussed in the book are quite versatile. Other types of networks, such as WLAN and 3G mobile network, are also mentioned. Second, to make it better understood, the book is basically organized around three step-by-step themes: location, localization, and localizability. Location-based applications are close to daily life and accordingly presented at the beginning.

Afterward, as the major part of the book, localization approaches are discussed in-depth. Other advanced topics, such as localizability and location privacy, are studied at last.

Book Organization

To begin with, the background of LBS and localization for wireless networks is presented in Chap. 1. Localization relies on the knowledge of physical world, in particular, the geometric relationship of network nodes. Chapter 2 discusses some popular ranging methods, including radio signal strength (RSS), time of arrival (ToA), time difference of arrival (TDoA), and hop counts. According to the physical measurements, one-hop positioning, as well as the related mathematical techniques of location computation, is presented in Chap. 3. Chapters 4 and 5 discuss the range-based and range-free localization approaches, respectively. Chapter 6 studies a key factor, error control, which determines the success of a localization approach in practice. Typically, location errors come from two sources: ranging noises and algorithm design, both of which are explained in detail. Chapter 7 presents the localization approaches for mobile networks, in which network nodes physically move and their locations change continuously. As we know, different approaches have different capabilities in terms of the number of nodes whose locations can be determined by a particular approach. Chapter 8 studies the issue of localizability that characterizes such capability in theory. With the development of LBS, location privacy is becoming crucial, which is discussed in Chap. 9.

The book discusses many up-to-date localization algorithms in considerable depth, yet makes their design and analysis accessible to all levels of readers. We emphasize the basic concepts and designs while keep the completeness. Each chapter presents a related topic and is independent of each other. When finishing the first two chapters, readers can select the remaining ones by their own interests. Each chapter ends with a summary or a comparative study, which provides a big picture and facilitates understanding.

Anticipated Audience

The book can serve as a guide book for the technicians and practitioners in the industry of real-time location systems (RTLS) and wireless networks. They can expect to obtain a comprehensive understanding of the field through reading the book, in order to compare and select localization solutions fulfilling various application requirements. Abundant references of the book open up a broader domain for advanced study. In addition, the book is tailored toward a textbook for college researchers and graduate students. For a one-semester graduate course, the main part includes three chapters (Chaps. 3–5) about one-hop positioning and multi-hop

network localization. Chapter 6 can be used as a follow-on topic. When there is time, three independent chapters (Chaps. 7–9) can be added to course materials with freedom of choice. The book includes the state-of-the-art research results in many technical journals and conferences during its preparation. Readers can track trends and hot topics in the field.

Last but not least, the book purposefully accommodates the different backgrounds and career objectives of its reader. Specifically, it does not require a background of location-awareness technology. But as a technical book, we hope the readers have a basic knowledge of computer algorithms and networks.

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