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tected area. This type of coverage is referred to as barrier coverage, where the sensors form a barrier for the intruders. A given belt region is said to be-barrier covered with a sen-sor network if all crossing paths through the region are - covered1, where a crossing path is any path that crosses the width of the region completely.

Barrier Coverage With Wireless Sensors

If a sensor network guarantees that every penetrating object will be detected by at least k distinct sensors before it crosses the barrier of wireless sensors, we say the network provides k-barrier coverage. In this paper, we develop theoretical foundations for k-barrier coverage.

Barrier coverage with wireless sensors | SpringerLink

We define the notion of k-barrier coverage of a belt region using wireless sensors. We propose efficient algorithms using which one can quickly determine, after deploying the sensors, whether a region is k-barrier covered. Next, we establish the optimal deployment pattern to achieve k-barrier coverage when deploying sensors deterministically. Finally, we consider barrier coverage with high probability when sensors are deployed randomly.

Barrier coverage with wireless sensors | Proceedings of ...
Abstract—Barrier coverage of a wireless sensor network aims at detecting intruders crossing the network. It provides a viable alternative for monitoring boundaries of battlefields, country borders, coastal lines, and perimeters of critical infrastructures.

Barrier Coverage with Airdropped Wireless Sensors - CORE

Barrier coverage is an important issue in many wireless sensor network applications, such as border intrusion detection and environmental safety monitoring.

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tected area. This type of coverage is referred to as barrier coverage, where the sensors form a barrier for the intruders. A given belt region is said to be k-barrier covered with a sen-sor network if all crossing paths through the region are k-covered1, where a crossing path is any path that crosses the width of the region completely.

Barrier coverage with wireless

sensors - ACM Digital Library

For the barrier coverage problem in distributed settings, we give the ?rst dis-tributed local algorithms for fully synchronous unoriented sensors. Our algorithms achieve barrier coverage for a line segment barrier when there are enough sensors tocovertheentirebarrier. Our?rstalgorith misobliviousandterminatesin?(n2)

BARRIER COVERAGE WITH WIRELESS SENSOR NETWORKS

Wireless sensor networks, barrier coverage, network topol-ogy. 1. INTRODUCTION The US-Mexicoborder stretchfor 2000miles(Figure1), much of it barely patrolled and protected only by ditches or barbed wire at best, while every day numerous aliens attempt cross the border illegally. Recently, a senior US

Congressman in-

Barrier Coverage With Wireless Sensors - Memphis

Local Barrier Coverage in Wireless Sensor Networks. Abstract: Global barrier coverage, which requires much fewer sensors than full coverage, is known to be an appropriate model of coverage for movement detection applications such as intrusion detection. However, it has been proved that given a sensor deployment, sensors can not locally determine whether the deployment provides global barrier coverage, making it impossible to develop localized algorithms, thus limiting its use in practice.

Local Barrier Coverage in Wireless Sensor Networks - IEEE ...

Abstract: In this paper, we define a new type of coverage problem named target-barrier coverage problem in wireless sensor networks. A target-barrier is a continuous circular barrier formed around the target. The target-barrier has a d bound constraint that is set depending on applications and needs, where d bound is the minimum distance of the constructed barrier from the target. Target-barrier coverage is very suited for application in defense surveillance, including detection of intrusion ...

The Target-Barrier Coverage Problem in Wireless Sensor ...

Barrier coverage is a critical issue in wireless sensor networks (WSNs) for security applications, which aims to detect intruders attempting to penetrate protected areas. However, it is di cult to achieve desired barrier coverage after initial random deployment of sensors because their locations cannot be controlled or predicted. In

Barrier Coverage in Wireless Sensor Networks

If a sensor network guarantees that every penetrating object will be detected by at least £ distinct sensors before it crosses the barrier of wireless sensors, we say the network provides £-barrier coverage. In this paper, we develop theoretical foundations for £-barrier coverage.

CiteSeerX — Barrier coverage with wireless sensors

Barrier coverage with wireless sensors aims at detecting intruders who attempt to cross a specific area, where wireless sensors are distributed remotely at random. This paper considers limited-power sensors with adjustable ranges deployed along a linear domain to form a barrier to detect intruding incidents.

Problem Specific MOEA/D for Barrier Coverage with Wireless ...

Barrier coverage has been widely used to detect intrusions in wireless sensor networks (WSNs). It can fulfill the monitoring task while extending the lifetime of the network. Though barrier coverage in WSNs has been intensively studied in recent years, previous research failed to consider the problem of intrusion in transversal directions.

Achieving Crossed Strong Barrier Coverage in Wireless ...

Barrier Coverage with Sensors of Limited Mobility Anwar Saipulla Benyuan Liu Guoliang Xing Xinwen Fu Jie Wang Department of Computer Science Department of Computer Science and Engineering University of Massachusetts Lowell Lowell, MA 01854, USA {asaipull, bliu, xinwenfu, wang}@cs.uml.edu Michigan State University East Lansing, MI 48824 glxing@msu.edu ABSTRACT Barrier coverage is a critical ...

Barrier coverage with sensors of limited mobility | 10 ...

However, how to integrate inspection robots into wireless sensor networks is still a great challenge to form an efficient dynamic monitoring network for transmission lines. To address this problem, a dynamic barrier coverage (DBC) method combining inspection robot and wireless sensor network (WSN) is proposed to realize a low-cost, energy ...

Dynamic Barrier Coverage in a Wireless Sensor Network for ...
Barrier coverage is a critical issue in wireless sensor networks (WSNs) for security applications, which however cannot be guaranteed to be formed after initial random deployment of sensors.

Cost-effective barrier coverage formation in heterogeneous ...
Barrier coverage is a critical issue in wireless sensor networks deployed in security applications (e.g., border protection), whose performance strongly depends on the locations of sensor nodes. Existing works on barrier coverage typically assume that

sensor nodes have accurate location information, which is not reasonable or practical for many real sensor networks.

Achieving location error tolerant barrier coverage for ...

The artifice is by getting barrier coverage with wireless sensors iti algorithmik ii as one of the reading material. You can be suitably relieved to gain access to it because it will find the money for more chances and further for well along life. This is not single-handedly about the perfections that we will offer.

We study the problem of barrier coverage with a wireless sensor network. Each sensor is modelled by a point in the plane and a sensing disk or coverage area centered at the sensor's position. The barriers are usually modelled as a set of line segments on the plane. The barrier coverage problem is to add new sensors or move existing sensors on the barriers such that every point on every barrier is within the coverage area of some sensors. Barrier coverage using sensors has important applications, including intruder detection or monitoring the perimeter of a region. Given a set of barriers and a set of sensors initially located at general positions in the plane, we study three problems for relocatable sensors in the centralized setting: the feasibility problem, and the problems of minimizing the maximum or the average relocation distances of sensors (MinMax and MinSum respectively) for barrier coverage. We show that the MinMax problem is strongly NP-complete when sensors have arbitrary ranges and can move to arbitrary positions on the barrier. We also study the case when sensors are restricted to use perpendicular movement to one of the barriers. We show that when the barriers are parallel, both the MinMax and MinSum problems can be solved in polynomial time. In contrast, we show that even the feasibility problem is strongly NP-complete if two perpendicular barriers are to be covered. For the barrier coverage problem in distributed settings, we give the first distributed local algorithms for fully synchronous unoriented sensors. Our algorithms achieve barrier coverage for a line segment barrier when there are enough sensors to cover the entire barrier. Our first algorithm is oblivious and terminates in n2? time, whereas our second one uses two bits of memory at each sensor, and takes n steps, which is asymptotically optimal. However, if the sensors are semi-synchronous, and do not share the same orientation, we show that no algorithm exists that always terminates within finite time. Finally, for sensors that share the same orientation we give an algorithm that terminates within finite time, even if all sensors are fully asynchronous. Finally, we study barrier coverage with multi-round random deployment using stationary sensors. We analyze the probability of barrier coverage with uniformly dispersed sensors as a function of parameters such as length of the barrier, the width of the intruder, the sensing range of sensors, as well as the density of deployed sensors. We propose two specific deployment strategies and analyze the expected number of deployment rounds and deployed sensors for each strategy. We present a cost model for multi-round sensor deployments, and for each deployment strategy we find the optimal density of sensors to be deployed in each round that minimizes the total expected cost. Our results are validated by extensive simulations.

This book will serve as a reference, presenting state-of-the-art research on theoretical aspects of optimal sensor coverage problems. Readers will find it a useful tool for furthering developments on theory and applications of optimal coverage;

much of the content can serve as material for advanced topics courses at the graduate level. The book is well versed with the hottest research topics such as Lifetime of Coverage, Weighted Sensor Cover, k-Coverage, Heterogeneous Sensors, Barrier, Sweep and Partial Coverage, Mobile Sensors, Camera Sensors and Energy-Harvesting Sensors, and more. Topics are introduced in a natural order from simple covers to connected covers, to the lifetime problem. Later, the book begins revisiting earlier problems ranging from the introduction of weights to coverage by k sensors and partial coverage, and from sensor heterogeneity to novel problems such as the barrier coverage problem. The book ends with coverage of mobile sensors, camera sensors, energy-harvesting sensors, underwater sensors, and crowdsensing.

Barrier coverage is a critical issue in wireless sensor networks (WSNs) for security applications, which aims to detect intruders attempting to penetrate protected areas. However, it is difficult to achieve desired barrier coverage after initial random deployment of sensors because their locations cannot be controlled or predicted. In this dissertation, we explore how to leverage the mobility capacity of mobile sensors to improve the quality of barrier coverage. We first study the 1-barrier coverage formation problem in heterogeneous sensor networks and explore how to efficiently use different types of mobile sensors to form a barrier with pre-deployed different types of stationary sensors. We introduce a novel directional barrier graph model and prove that the minimum cost of mobile sensors required to form a barrier with stationary sensors is the length of the shortest path from the source node to the destination node on the graph. In addition, we formulate the problem of minimizing the cost of moving mobile sensors to fill in the gaps on the shortest path as a minimum cost bipartite assignment problem and solve it in polynomial time using the Hungarian algorithm. We further study the k-barrier coverage formation problem in sensor networks. We introduce a novel weighted barrier graph model and prove that determining the minimum number of mobile sensors required to form k-barrier coverage is related with but not equal to finding k vertex-disjoint paths with the minimum total length on the

WBG. With this observation, we propose an optimal algorithm and a faster greedy algorithm to find the minimum number of mobile sensors required to form k-barrier coverage. Finally, we study the barrier coverage formation problem when sensors have location errors. We derive the minimum number of mobile sensors needed to fill in a gap with a guarantee when location errors exist and propose a progressive method for mobile sensor deployment. Furthermore, we propose a fault tolerant weighted barrier graph to find the minimum number of mobile sensors needed to form barrier coverage with a guarantee. Both analytical and experimental studies demonstrated the effectiveness of our proposed algorithms.

Abstract: Wireless sensor networks (WSN) promise to revolutionize the way we monitor our surroundings by enhancing our senses. Prototype systems are already being demonstrated. Several fundamental research issues, however, remain unaddressed. Sensing events being the main task of a WSN, appropriately addressing the issue of coverage is critical. In this dissertation, we make a two fold contribution on establishing a strong foundation for the issue of coverage. First, we argue that a single concept of coverage such as k-full coverage (where every point in the deployment region needs to be within the monitoring range of at least k sensors) does not fit all applications. We propose a new concept of

coverage called k-barrier coverage that is appropriate for intrusion detection applications. A WSN provides k-barrier coverage} if it guarantees that every penetrating object is detected by at least k sensors before crossing the barrier of sensors. Second, we address five foundational problems for the issue of k-barrier coverage: optimal deployment pattern, critical conditions, coverage status determination, coverage restoration, and optimal sleep wakeup. The problem of optimal deployment pattern is to determine a pattern of deployment that uses the minimum number of sensors. The problem of critical conditions is to derive conditions that can be used to determine the minimum number of sensors to deploy in probabilistic deployments. The problem of coverage status determination is to determine whether a deployed WSN provides a desired quality of monitoring. The problem of coverage restoration is to determine the minimum number of sensors to deploy, and their locations, such that a desired quality of monitoring can be restored in a deployed WSN. The problem of optimal sleep wakeup is to produce a sleeping schedule for sensors that maximizes the network lifetime. We comprehensively solve four of the five foundational problems. For the problem of critical conditions, we derive the conditions for a weaker notion of k-barrier coverage, called weak k-barrier coverage. In addition, we derive critical conditions for the case of k-full coverage.

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have fun mastering key concepts from anywhere. The convenient format is perfect for the car, waiting rooms, restaurants, and more. Plus, with dozens of colorful, game-based activities covering the alphabet, numbers, colors, shapes, and more, kids will be engaged and interested in learning. And they'll love the colorful sticker sheet!

The advances in sensor design have decreased the size, weight, and cost of sensors by orders of magnitude, yet with the increase of higher spatial and temporal re- lution and accuracy. With the fast progress of sensors design and communications technique, sensor networks have also been quickly evolving in both research and practical domains in the last decade. More and more sensor networks have been - ployed in real-world to gather information for our daily life. Applications of sensor networks can be found in battle?eld surveillance, environmental monitoring, b- logical detection, smart spaces, industrial diagnostics, etc. Although the technique of sensor networks has a very promising future, many challenges are still deserving lots of research efforts for its successful applications. Thisbookisdevotedtocoveragecontrol,oneofthemostfundamentalandimportant research issues in sensor networks. The aim of the book is to provide tutorial-like and up-to-date reference resources on various coverage control problems in sensor networks, a hot topic that has been intensively researched in recent years.

Due to some unique characteristics of sensor networks such as energy constraint and - hoc topology, the coverage problems in sensor networks have many new scenarios and features that entitle them an important research issue in recent years. I have done my best to include in the book the most recent advances, techniques, protocols, results, and ?ndings in this ?eld.

During the last one and a half decades, wireless sensor networks have witnessed significant growth and tremendous development in both academia and industry. A large number of researchers, including computer scientists and engineers, have been interested in solving challenging problems that span all the layers of the protocol stack of sensor networking systems. Several venues, such as journals, conferences, and workshops, have been launched to cover innovative research and practice in this promising and rapidly advancing field. Because of these trends, I thought it would be beneficial to provide our sensor networks community with a comprehensive reference on as much of the findings as possible on a variety of topics in wireless sensor networks. As this area of research is in continuous progress, it does not seem to be a reasonable solution to keep delaying the publication of such reference any more. This book relates to the second volume and focuses on the advanced topics and applications of wireless sensor networks. Our rationale is that the second volume has all application-specific and non-conventional sensor networks, emerging techniques and advanced topics that are not as matured as what is covered in the first volume. Thus, the second volume deals with three-dimensional, underground, underwater, body-mounted, and societal networks. Following Donald E. Knuth's above-quoted elegant strategy to focus on several important fields (The Art of Computer Programming: Fundamental Algorithms, 1997), all the book chapters in this volume include up-to-date research work spanning various topics, such as stochastic modeling, barrier and spatiotemporal coverage, tracking, estimation, counting, coverage and localization in three-dimensional sensor networks, topology control and routing in three-dimensional sensor networks, underground and underwater sensor networks, multimedia and body sensor networks, and social sensing. Most of these major topics can be covered in an advanced course on wireless sensor networks. This book will be an excellent source of information for graduate students majoring in computer science, computer engineering, electrical engineering, or any related discipline. Furthermore, computer scientists, researchers, and practitioners in both academia and industry will find this book useful and interesting.

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