Target Tracking for Mobile Sensor Networks

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Abstract: In that document, the objective checking issue is actually researched for any checking technique with cell phone range-only sensors. Becoming different from most previous scientific studies, equally chemical as well as multiplicative sounds throughout sizes usually are taken into consideration. The optimum coordination strategy, such as sensor variety as well as sensor movements, is actually recommended to improve the particular checking accuracy. In particular, by means of completely utilizing the particular components of objective purpose, the particular lookup place as well as specifics from the initial seo issue may be appreciably lowered. Determined by that lessening, 3 algorithms are created, respectively, for that subsequent: 1) effective number of process sensors; 2) lessening with mixtures of process sensors; as well as 3) effective lookup of optimum sensor movements. This performance from the recommended coordination strategy is actually highlighted by means of simulations.

Keywords: Mobile Sensor, Network, Additive & Multiplicative Noises (AMN).

I. INTRODUCTION

In this paper, the target tracking problem is investigated for a tracking system with mobile range-only sensors. Being different from most previous studies, both additive and multiplicative noises in measurements are taken into consideration. An optimal coordination strategy, including sensor selection and sensor motion, is proposed to maximize the tracking accuracy. In particular, by fully utilizing the properties of objective function, the search space and variables of the original optimization problem can be significantly reduced. Based on this reduction, three algorithms are designed, respectively, for the following: 1) efficient selection of task sensors; 2) reduction on combinations of task sensors; and 3) efficient search of optimal sensor motion. The performance of the proposed coordination strategy is illustrated by simulations.

A. Objective

The development of sensor network technology has enabled the possibility of target detection and tracking in a large scale environment. There has been an increased interest in the deployment of mobile sensors for target tracking, partly motivated by the demand of habitat monitoring and illegal hunting tracking for rare wild animals [1]. In this paper, we are primarily interested in target tracking by considering both moving targets and mobile sensors as shown in Figure 1. Specifically, we are interested in the spatial resolution for localizing a target’s trajectory. The spatial resolution refers to how accurate a target’s position can be measured by sensors, and defined as the worst-case deviation between the estimated and the actual paths in wireless sensor networks [2]. Our main objectives are to establish the theoretical framework for target tracking in mobile sensor networks, and quantitatively demonstrate how the mobility can be exploited to improve the tracking performance. Given an initial sensor deployment over a region and a sensor mobility pattern, targets are assumed to cross from one boundary of the region to another. We define the spatial resolution as the deviation between the estimated and the actual target traveling path, which can also be explained as the distance that a target is not covered by any mobile sensors. Given the mobility of both targets and sensors mobility, it is particularly challenging to model such a stochastic problem for multiple moving objects.

Furthermore, we are also interested in determining the minimum number of mobile sensors that needs to be deployed in order to provide the spatial resolution in mobile sensor networks. It turns out that our problem is very similar to the collision problem in classical kinetic theory of gas molecules in physics, which allows us to establish and derive the inherently dynamic relationship between moving targets and mobile sensors. The binary sensing model of tracking for wireless sensor networks has been studied in several prior works. The work in [3] showed that a network of binary sensors has geometric properties that can be used to develop a solution for tracking with binary sensors. Another work [4] also considered a binary sensing model. It employed piecewise linear path approximations computed using variants of a weighted centroid algorithm, and obtained good tracking performance if the trajectory is smooth enough. A follow-up work explored fundamental performance limits of tracking a target in a two-dimensional field of binary proximity sensors, and designed algorithms that attained those limits in [5]. Prior works in stationary wireless sensor networks have studied the fundamental limits of tracking performance in term of spatial resolution. Our focus in this paper is completely different from all prior works. There are two distinctive features of our work:

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1. We try to identify and characterize the dynamic aspects of the target tracking that depend on both sensor and target mobility;
2. We consider tracking performance metrics: spatial resolution in a mobile sensor network. By leveraging the kinetic theory from physics, we model the dynamic problem, and examine its sensitivity under different network parameters and configurations. To the best of our knowledge, we believe this is a completely new study of target tracking in mobile sensor networks.

The rest of this paper is organized as follows. Section II describes the network and mobility model, as well as defining the target tracking problem in a mobile sensor network. Section III formulates the target tracking problem. Section IV examines the tracking performance sensitivity under different network parameters and configurations, and finally Section V concludes the paper.

B. Existing System

Tracking accuracy is one of the most important goals for sys-tem designers, which strongly depends on the relative positions between sensors and target. In the optimal sensor placement for range-only target tracking system is analyzed, and the optimal angular configuration is derived. Reference studies the optimal sensor–target geometries for range-only-, time-of-arrival, and bearing-only-based localization and identifies the optimal sensor–target configuration for different number of sensors. Undoubtedly, by providing mobility to the sensors, the tracking accuracy can be significantly improved via sensor motion coordination. In a motion strategy for the mobile sensors is designed to satisfy the optimal angular configuration, in which there is no limitation on the mobility of sensors. It is assumed that each sensor can move a given distance at each time step, and the motion strategies are designed under the constraint. Reference develops a distributed flocking algorithm for multiple robots to track the estimated target and avoid collision.

1. Disadvantages

1. In an existing system, the experimental data show the existence of multiplicative noise (MN), and the variance of MN is often three to four times larger than that of AN. Due to the existence of MN, the measurement error will significantly increase with the increase in sensor–target distance.
2. Therefore, MN cannot be ignored in the design and analysis of a target tracking system. Unfortunately, the target tracking problem with MN is quite different from that with AN; thus, it cannot be treated as a simple extension of previous results.

C. Proposed System

In this paper, the target tracking problem with both additive and multiplicative noises (AMN) is investigated for mobile range-only sensors. The ultimate goal is to design an optimal sensor coordination strategy, including sensor selection and motion, to improve tracking accuracy. Following a target tracking framework similar to this task can be transformed into optimizing a certain metric, which represents the localization accuracy of each step, by properly selecting sensors and adjusting their positions. Then, the optimization of such metric can be formulated as a multivariable nonlinear optimization problem.

1. Advantages of Proposed System:

1. The relationship between the metric and the sensor–target distance, the search space of each sensor, as well as the optimization variables associated with each sensor, can be greatly reduced. This reduction enables the following algorithmic design.
2. By utilizing the reduction of search space, two algorithms are designed to reduce, respectively, the number of possible task sensors and the number of possible sensor combinations, such that the computational complexity is significantly simplified.
3. According to the reduction of optimization variables, an iterative algorithm is applied to efficiently solve the nonlinear optimization problem and yield the optimal motion strategy of mobile sensors.

II. SYSTEM IMPLEMENTATION

Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective. The implementation stage involves careful planning, investigation of the existing system and it’s constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.

A. Input Design

The input design is the link between the information system and the user. It comprises the developing specification and procedures for data preparation and those steps are necessary to put transaction data in to a usable form for processing can be achieved by inspecting the computer to read data from a written or printed document or it can occur by having people keying the data directly into the system. The design of input focuses on controlling the amount of input required, controlling the errors, avoiding delay, avoiding extra steps and keeping the process simple. The input is designed in such a way so that it provides security and ease of use with retaining the privacy. Input Design considered the following things:

- What data should be given as input?
- How the data should be arranged or coded?
- The dialog to guide the operating personnel in providing input.
- Methods for preparing input validations and steps to follow when error occur.

B. Objectives

1. Input Design is the process of converting a user-oriented description of the input into a computer-based system. This design is important to avoid errors in the data input process and show the correct direction to the management for getting correct information from the computerized system.
2. It is achieved by creating user-friendly screens for the data entry to handle large volume of data. The goal of designing input is to make data entry easier and to be free from errors. The data entry screen is designed in
such a way that all the data manipulates can be performed. It also provides record viewing facilities. 
3. When the data is entered it will check for its validity. Data can be entered with the help of screens. Appropriate messages are provided as when needed so that the use will not be in maize of instant. Thus the objective of input design is to create an input layout that is easy to follow.

C. Output Design
A quality output is one, which meets the requirements of the end user and presents the information clearly. In any system results of processing are communicated to the users and to other system through outputs. In output design it is determined how the information is to be displaced for immediate need and also the hard copy output. It is the most important and direct source information to the user. Efficient and intelligent output design improves the system’s relationship to help user decision-making.
1. Designing computer output should proceed in an organized, well thought out manner; the right output must be developed while ensuring that each output element is designed so that people will find the system can use easily and effectively. When analysis design computer output, they should identify the specific output that is needed to meet the requirements.
2. Select methods for presenting information.
3. Create document, report, or other formats that contain information produced by the system.

The output form of an information system should accomplish one or more of the following objectives.
1. Convey information about past activities, current status or projections of the
2. Future.
3. Signal important events, opportunities, problems, or warnings.
4. Trigger an action.
5. Confirm an action.

III. SAMPLE RESULT

Fig1. Network.
Fig2. Commander.
Fig3. Hunter.
Fig4. Alerts To Server.
IV. CONCLUSION

In this paper, a coordination strategy, including sensor selection and motion, has been proposed for a range-only tracking system with mobile sensors randomly scattered. Accordingly to the properties of the tracking accuracy metric, which derived based on measurement model with both AMN, the search space of each sensor is reduced from a round to a curve. Then, considering the movable region of each sensor, an algorithm is designed to select the candidate task sensors at each time step, following upon an algorithm for the reduction on the number of sensor combinations. They both simplify the process of sensor selection in a great deal. An iterative algorithm is adopted to move sensors for the improvement of tracking accuracy. Simulation results illustrate the efficiency of our proposed strategy. Our proposed coordination strategy can be extended to other cases. For the case of bearing-only sensors with AN the FIM-based metric is also a function of sensor-target distance and angles and a shorter distance leads to better tracking performance, which is in the same mathematical form of the range-only sensors we considered. Therefore, our proposed coordination strategy can be easily extended to the case of bearing-only sensors. In addition, multiple target tracking is an interesting extension of our work, which will involve much more complicated problems, including data association, task assignment, and balance on sensor motion.

V. REFERENCES

[1] User Interfaces in C#: Windows Forms and Custom Controls by Matthew MacDonald.