Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 93 (2016) 728 – 734

Procedia
Computer Science

6th International Conference On Advances In Computing & Communications, ICACC 2016, 6-8 September 2016, Cochin, India

Distributed target localization and tracking using distributed bearing sensors

Lakshmi K Raju [a], Febi Ibrahim [b], P Muralikrishna[b,*],

[a]School of Engineering,Cochin University of Science and Technology,Cochin,India
[b]Naval Physical & Oceanographic Laboratory,Cochin,India

Abstract

Tracking of a moving target has attracted considerable interest in both military and civilian applications. There are different methods used for estimation of target position. One of these methods is to find the target position by using relative angle measurements of radiating source measured using direction finding sensors. In this method, direction finding sensors are deployed and their positions are known. The sensors provide relative bearing measurements of radiating source whose location has to be estimated. These bearing measurements and sensor position information are used to estimate the position of a target. In this paper we use two techniques (a) Single baseline model and (b) Least square estimation method for bearing only source localization. We also analyse the effect of noise on bearing measurements and the effect of number of sensors on position estimation error.

Peer-review under responsibility of the Organizing Committee of ICACC 2016

Keywords: Wireless sensor network ; Localization ; Tracking,Single baseline ; Least squares

Nomenclature

A	position of sensor1
B	mid point of line joining two sensor positions

* Corresponding author MK.NPOL@GMAIL.COM

Peer-review under responsibility of the Organizing Committee of ICACC 2016
doi:10.1016/j.procs.2016.07.280

BL	distance between two sensors
C	position of sensor2
R_i	distance between i^{th} sensor and target
T	position of target
x_i	x coordinate of sensor
y_i	y coordinate of sensor
x_T	x coordinate of target
y_T	y coordinate of target
θ_i	angle between i^{th} sensor and target

1. Introduction

One of the important applications of sensor network is tracking of moving targets. Tracking of moving targets involves the detection and localization of the object of interest, which is a radiating source, by processing the information provided by the sensing nodes along with their location information. The measured data from direction finding sensors may be sent to a base station for further processing. The essential components that are required for radiating source tracking applications are follows. a) Node localization, which is used to enable the sensor nodes to determine their location. b) Target localization technique, which is used to determine the target location at regular intervals of time and c)Timing synchronization between the nodes

The estimation of the position of a radiating source from angle measurements is a widely investigated problem[1,2,3]. The relative bearing measurements taken from direction finding (DF) sensors, can be intersected to determine the target location. In principle, the range prediction can be made with hundred percentage accuracy but in practice, the limitations in the accuracy of the measurements in bearings introduce an error in the range prediction. In bearing-only localization system, the target location accuracy is relevant to some factors, such as the angle measurement error, the relative geometry, position of the sensors, distance between radiating source and sensor etc. A bearing-only location system has the advantage of high concealment and can deduce many properties of radiating source.

Triangulation is the method applied to estimating a radiating source position by calculating the most likely point for the target, given the intersection of two or more line of bearings from sensors at known locations. The position of a target is often estimated from the intersection of simultaneous bearings taken from two or more sensors whose positions are accurately known. There are several techniques for measuring the azimuth angles of arrival of signals from radiating source. Noise and measurement errors limit the position fix accuracy.

In this paper we give an overview of results obtained after simulation of two popular target position estimation techniques a) Single baseline model and b) Least square estimation method. The sensitivity for source position accuracy to variation in bearing accuracy is dependent on source orientation. This is analysed using single baseline method. The effect of number of sensors on source position estimation error is analysed using least square estimation method.

2.Algorithms

2.1 Single baseline model

The single baseline model, involves two sensors, located at points 'A' and 'C', as shown in figure(1) from where bearing measurements are made[4].Baseline 'BL' is the line joining two sensors. Target is located at point 'T'. Sensor1 and 2 are at a distance R1 and R2 from the target respectively. B is a reference mid-point on baseline(BL) between two sensors. Range 'R' is the distance from point B to the source. Measurements are not made at point 'B'. The bearing measurements are θ_1 and θ_2 from sensor 1 and sensor 2 respectively as shown in figure.

The significant assumptions of the model are: