Abstract

Abstract In the real scenario, accurate tracking of moving objects is very much essential for surveillance, performance analysis of any airborne vehicles, detection of any inbound threat, engagement of anti threat equipment, detecting the origin of the enemy threat launch point etc. Tracking Radar system, Electro-Optical tracking systems and passive target tracking systems are well known for moving object tracking systems. All these tracking systems are widely used throughout the globe. The measurement accuracy of moving object location and reliability of the measured location are based on two critical factors. To achieve a more reliable result instead of one, multiple sensors are normally used. If all measurements are in agreement with each other then reliability increases. Some times it may happen that one or more sensors capture erroneous measurements. In such a scenario if sensors are identified and eliminated then reliability of measurement can be significantly improved. Each sensor has its measurement accuracy level. To increase the measurement accuracy it is necessary to identify the error contributing factors of all sensors and impacts of the same. An efficient data fusion algorithm can be applied to get accurate measurement. The time efficiency of the algorithm is also a prime concern as all the system measurements are used for real-time applications.

We have focused our research on three different kinds of tracking system. These three tracking systems are namely Electro-Optical Tracking System (EOTS),

Tracking Radar System and Passive Target Tracking System. Working principles of all these sensors are different. We have worked with all of these sensors and tried to find out the best possible accuracy model for each. These models have significantly improvd the accuracy and at the same time helped in calculating the error boundary. Another important contribution focuses on a real-time remote visualization system is to know the real-time update of the moving object location.

In this research work, multiple EOS works together to produce the object location. In this each two EOS measurement combination can be used to compute object position. More than two numbers of sensors can produce a more reliable result. But in case, any one of the sensors is erroneous then the whole system becomes unreliable. Three different models viz "Prioritization and Elimination of erroneous sensor using perpendicular distance method", "Improvement in the Accuracy of the Moving Object Position by Eliminating Erroneous Sensors using Clustering Approach", "Multi Sensor Data Fusion Technique for Target Tracking Based on the Combination of Triangulation Method and K-means Algorithm" are established for identifying one or more erroneous sensors. And all these models are proved to successfully eliminate erroneous sensor(s) and produce accurate object location.

In case of multiple Radar scenario, all radars measure the object location as per their accuracy. Our research work focused on the factors and their impacts on the Tracking Radar measurement accuracy to develop the model viz Analysis of Factors and their Impacts in Measurement Accuracy and Prioritisation of Radars. The model quantify the measurement accuracy. To improve the accuracy we have established a model viz Multiple Radar Data Fusion to Improve the Accuracy in Position Measurement Based on Clustering Algorithm. At first it identifies presence of any erroneous measurement. After elimination, an efficient data fusion

technique have been applied to produce accurate position measurement.

A passive target tracking system is a combination of at least four numbers of time synchoronised receivers. Here we have established a "time difference of arrival" algorithm to find out the object location based on the time difference of arrival of the electro-magnetic signals from the target. Accuracy of the object position measurement depends upon the geographical location and time sync accuracy of the receivers. A model "Prioritization of Receivers for Minimum Possible Error Boundary in Time Difference of Arrival Algorithm" is established to find out the best possible combination of four receivers, in case there are more than four receivers. This model also finds the error boundary of the measurement and co-relation between error factor and the range of the moving object.

In the research work different techniques are adopted and improved for finding the erroneous sensor based on the unique error contributing factors of all three kinds of sensors. The Electro-Optical Tracking System, Tracking Radar System and Passive Target Tracking System are prioritized based on multiple critical criteria so that the best sensor can be used for data fusion and the most accurate result can be achieved. Different time efficient clustering algorithm is defined based on the tracking principle of each kind of tracking systems. And eash case clustering algorithm is efficiently implemented for eliminating erroneous sensors as well as grouping the best sensors for improvement in measurement. A numbers of experiments were carried out in this research work for all three kinds of tracking sensors to establish all the algorithms. The results obtained in all the experiments were satisfactory. Real-time remote visualization of the measured parameters is also an important task for monitoring and the same is analysed and discussed in the thesis in detail. Overall all these techniques and systems performances were tested rigorously with simulation to produce reliable accurate results in real-time.