A new approach to distributed data fusion

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Abstract

The data fusion process considered in this thesis is typical for a defence context. The main military applications use sensors and other sources of data (e.g. GIS-database) to compile pictures of battle situations to support military Command and Control. The battle situations of interest can occur on land, at sea, in the air or in combinations thereof. The objective of this study was to develop a new data fusion architecture which is flexible enough to instantiate data fusion systems with centralized, distributed or hybrid processing. Special attention was given to developing new algorithms to reduce both computation time and communication load. For the different experiments, only radar sensors have been considered.

To reduce the probability of processing delays, algorithms have been developed that reduce the load on the platform computational resources. In cases that this approach is not sufficient to guarantee timely availability of the compiled battlefield picture, a parallel processing model has been developed which distributes the necessary calculations over a network of available computing resources.

The information in the battlefield picture can be used to engage hostile targets. Tactical ballistic missiles (TBM), which can be used to deliver weapons of mass destruction, represent a new threat. Due to the large ranges at which TBM’s will be detected, results produced by the current tracking algorithms in data fusion applications are very sensitive to sensor error biases. This will prevent the required position and velocity accuracies to be achieved. To improve TBM tracking, a new method based on the use of range and Doppler information has been developed which is not sensitive to sensor error biases.

Based on the new architecture, a demonstrator has been developed. Two trials have been carried out, in which real data was collected. The first trial has validated the claim that it is possible to maintain an accurate track using artificial measurements. The second trial showed that multisensor data fusion is operationally very useful to improve the tracking performance.