Summary

In today's world of automation, it is impossible to imagine life without Automated Guided Vehicles (AGVs). AGVs are driverless vehicles which are used to transport goods and persons within the concerning environment. Advantages of AGV systems are a wide range of applicability, flexibility, improvement of the quality of work environment and the possibility for integration with other automated systems.
Yet, an AGV system brings along some significant risks. Due to the fact that all vehicles in the system function without a driver, the human acuteness and ability to react on unanticipated situations is absent. An automated system has to be designed in a way where collisions are avoided and exact location is known at all times. AGV systems use absolute and relative positioning systems to determine the exact positioning. Generally, absolute positioning systems are more inaccurate than relative positioning systems. On the other hand, relative systems encounter the problem that errors are accumulated. In practice, absolute and relative positioning systems will be combined to give accurate results without accumulated errors.

The objective of this research assignment is to find an adequate and relatively inexpensive solution of combining absolute and relative positioning systems to provide accurate speed and distance figures of an AGV. In this research assignment an AGV with one-dimensional motion will be used and investigated instead of a complicated AGV system.
A Global Positioning System (GPS) as absolute positioning system and an accelerometer as relative positioning system are used for the combined positioning system. With the use of a Kalman filter the input signals of both absolute and/or relative positioning systems will be filtered and combined to create an accurate combination of both positioning systems.

A simulation model is made to find a solution for the main objective. The simulation model is programmed in Delphi/TOMAS. In this simulation model the AGV with one-dimensional motion will be modeled as a simple point-mass with one-dimensional motion.
On this point-mass with one-dimensional motion significant experiments will be done. In order of using a relevant model with relevant positioning systems, the point-mass will be expressed by an athlete moving in one-dimension. An athlete will act with similar properties, like acceleration, velocity and distance as the simple point-mass. Obvious positioning systems for athletes are relatively cheap and easily obtainable, both in absolute and relative positioning systems.

The GPS device is the determining device above the accelerometer. Taking different accuracies for the accelerometer will not influence the total error with respect to the actual distance much. But taking different accuracies for the GPS will influence the error with respect to the actual distance. Because of the GPS device being the determining device above accelerometer, it is obvious that a GPS device with a certain accuracy-level will be chosen to consider the accuracy of the system. The accelerometer can be left out of consideration.

In speed profile 2, the error on the actual distance decreases from 4.91 to 0.13 when comparing combinations of the least accurate devices with the most accurate devices.
Speed profile 2 shows the most accurate results overall. Speed profile 3 shows the least accurate results.

Comparing results when using both positioning systems separately, speed profile 2 gives by far the most accurate results. When using solely the accelerometer, the accuracies of the GPS device do not influence the results. Logically, the accelerometer is the modifying device.
The reason for such accurate results are due to the fact speed profile 2 has proportional increasing acceleration. Speed profile 1 and 3 has unrealistic increasing acceleration where the accelerometer makes large errors.
In case of using solely the accelerometer, a recommendation is to provide more real-life situations for speed profile 1 and 3, to see if the results for the different speed profiles will show more similar results.
In case of using solely the GPS device, these problems do not exist.