Summary

Whether we are on land, at sea or in the air: we are surrounded by transportation systems. An ever-growing world population and further globalisation increases the dependency of humankind on efficient transportation methods.

This thesis is about autonomous vehicles, which means that there are no human pilots or drivers involved in the control of the vehicle. Examples of relevant questions within this topic are: How do you plan the route of an autonomous airplane? How can you guarantee that an autonomous car brakes in time? How can an autonomous vehicle adopt a certain driving style, following the driver’s preference? These are the type of questions that this thesis considers.

The thesis is divided into three parts. The first part is about autonomy in unmanned aerial vehicles. When there is a trade-off to be made between exploration (see as much as possible) and exploitation (identify as much as possible) of some unknown terrain, it is possible to make the plane adapt its flight path according to its observations while flying. If the plane encounters an interesting object, it can decide to circle above this object for some time, before continuing its pre-determined flight path. The pre-determined flight path is found using a Particle Swarm Optimiser.
Chapter 1. Summary

The second part is the main part of the thesis. Its topic is self-driving cars on highways. There is an ongoing trend towards intelligent transportation systems, where cars and the infrastructure become more and more autonomous. Sensors such as radar, GPS and Wi-Fi can measure state information about the vehicle and its surrounding area, and by using this information, the autonomous vehicle ‘knows’ what the minimum safe distance is that it should keep. An important aspect here is safety. Sensors are not perfect: radars have uncertainty in their measurements, Wi-Fi communication can drop. This thesis describes a method that can compute the minimum safe distance between two vehicles, given the uncertainty of the vehicle’s sensors, vehicle behaviour and communication system.

A more futuristic chapter of this thesis is about translating user preferences into vehicle controllers. Some drivers like speed, others prefer comfort or fuel economy. These objectives are potentially conflicting. This chapter describes a method that uses multi-objective evolutionary computing to evolve not one, but a whole range of controllers, that each signify a different prioritisation between a number of user objectives.

In the final part of this thesis, I describe a generalisation of the multi-objective evolutionary algorithm that was introduced in part II. This chapter reports on the performance of this algorithm on a well-known set of multi-objective optimisation problems.

Autonomous vehicles, especially on the road, are an important part of our future. This thesis addresses some important aspects of getting closer to this future. Some contributions in this thesis are relevant in the development of current systems, while other contributions become relevant in a more distant future. But we do not doubt that this future is upon us.