RUF Self Driving Cars

INTRODUCTION

Self Driving Cars (SDC) get a lot of attention because of their promise of taking the driver out of the loop and thereby saving a lot of lives.

GOOGLE has gained a lot of respect because of their successful search algorithms and their maps. It is natural for them to try to capture a new market using IT tools and there is a lot of hype regarding the prospects of SDC operations on the normal roads.

This report will discuss another option, namely a completely separated system for running automated on a special monorail infrastructure and also manually driven on the normal roads.

The system is called RUF (Rapid Urban Flexible) and has been tested in Denmark.
SDC challenges

The human driver is a very skilled person.

The super computer (the brain) and the car has been developed together in a long and often painful process, so that they are highly optimized for the task and the combination works surprisingly well.

It is not easy to change to a system where part of the trip is automated.

In the beginning people will get scared and they may not act rationally if they are suddenly required to take over control again.

The systems controlling the cars will have to work 100.00% correctly all the time and at high speed together with all other cars.

SDC promises a reduction in energy consumption due to shorter distances between cars on the highway. This may not be enough in a time where the climate challenge forces all sectors to limit energy consumption dramatically.

Who will be responsible when a system fails? Will the car owners be able to be insured at a reasonable cost? Will all cars be owned or will some be rented.

Will close driving SDC’s “inspire” other drivers to also drive closer?

Will it be possible to ensure access to 4 GPS satellites all the time in the big cities with high rise buildings?

Can hacking be prevented. Will a laser beam confuse the laser scanner system.

The RUF solution (DualMode)

Many of these problems can be reduced if the self driving cars are completely separated from the others using an exclusive infrastructure.

RUF cars are driven as normal electric cars in the suburbs and in the center of cities. But in stead of using only highways, they will also use a network of monorail guideways where they collect power for the propulsion and for recharging their small batteries.

“Riding” on the monorail will feel completely safe since the vehicle is running on the monorail so that its stability is very high at all times.

A fail safe redundant control system placed in the guideway is controlling all vehicles all the time and is impossible to disrupt from the outside.

All RUF vehicles are constructed according to the RUF standard, so that they can be closely coupled in small trains (typically 3-10 vehicles). They have smooth support wheels and a special rail brake for emergency braking. This way the climate friendly effects from this transport system can be sustainable everywhere in the world.
The RUF implementation strategy

Every society needs Public Transit.

With RUF it is possible to create a very attractive kind of Public Transit using small electric busses called maxi-ruf. It has 10 seats and can run in two modes. It can either use the normal roads driven by a chauffeur or it can use the RUF monorail where it can operate as a driverless metro.

According to a study made with support from the EU program CyberMove, such a system for the Greater Copenhagen will cost the same as one new metro line, but cover the whole city with a network with a mesh size of 5 x 5 km.

The quality of this network has been calculated in a Cost Benefit analysis. The results were that the IRR(30) was 29% for the society. See: www.ruf.dk/rufcba.xls and www.ruf.dk/rufcba.doc

RUF Public Transport will be able to compete with or surpass the car regarding travel time and comfort. It will use far less energy and no parking is required. Door-to-door public transit is possible with RUF and it will make many responsible commuters use maxi-ruf for the daily commute.

Once this network (320 km) has been created in the Copenhagen region, RUF cars can use this high speed network for the automated part of the trip.
The RUF standard

The car manufacturers will now begin mass production of electric cars following the open RUF standard. The public will get a choice between different designs, but the critical parts will all comply to the RUF standard, as defined by RUF International in Denmark.

One of the most important parts of the RUF standard is the drive system.

It has normal road wheels as well as wheels to support the vehicle when it is using the monorail. The monorail support wheels are smooth wheels. They produce very little noise and minimal rolling resistance.

The drive wheels press against the vertical part of the top of the monorail. This means that the pressure can be adjusted, so that friction is only present when it is needed for acceleration or climbing a hill.

This means that the effective rolling resistance for RUF self driving cars will be extremely low. A reduction factor of 4 times is possible.

The RUF standard also demands that all vehicles (despite different design) can be coupled close together (less than 10 cm separation). This means that air resistance can be lowered by a factor of more than 4 (10 for ideal shaped vehicles in a 10 car train).
Pro / Con

Insurance
It will be much easier to get insurance for a vehicle which in the self driving mode is controlled by a monorail than a vehicle which depend on a complex IT system.

Transition
From day one the users will get maximum benefit from a monorail solution. There would be no congestion problems.
In the highway scenario, the benefits will not be significant until a large number of vehicles use the SDC mode.

Electrification
RUF SDC will benefit from electric supply directly from the monorail. The batteries only need to be small and they can be recharged on the monorail.
Electric self driving cars will suffer from almost the same range limitation as the normal electric cars.

Hacking
The control system in RUF is build into the monorail, so interference from outside is extremely difficult. All vehicles drive in a fail safe mode.

Chicken and Egg
Normal SDC can use the normal roads from day one
RUF SDC needs a monorail in order to work. This makes it difficult to implement as a car system from the beginning, but not as a Public Transit system (maxi-ruf).

Visual problems
RUF SDC needs a monorail system, which represent a visual challenge. There are many ways of making this problem minimal.
Normal SDC looks almost normal when they are mixed with other traffic.

Cost
In the future, energy consumption will be the big problem which will have to be reduced very significantly.
Even if a monorail infrastructure is costly, the savings in energy consumption will very soon make it a very good investment.

Confusion
It is vital that the “driver” knows what to do and how to do it.
In the RUF scenario, there is no doubt. Driving is always automatic on the monorail.
In the highway scenario the driver may have to be ready to take over control any time and making that transition could be very confusing at first.

De-learning
RUF SDC drivers will drive normally at low speed the short distance between the monorail and the destination. He/she will maintain the driver skills they will still need.
A normal SDC user will gradually loose the driver skills and will have big problems when the automated system in their vehicle breaks down.