EXAMENSARBETE Robust Route Prediction in Raster Maps
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Saving fuel using a self-learning map

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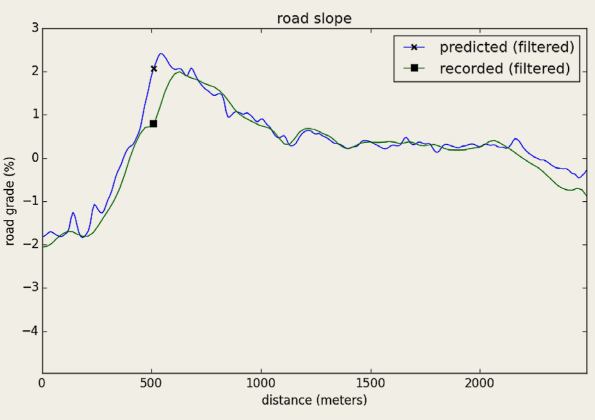
To save fuel in trucks, the use of a self-learning map is explored. By predicting the path, and then the road grade for this path, fuel savings can be achieved via intelligent cruise control and gear shift timing.

As competition in the logistics industry hardens, pressure on heavy-duty truck manufacturers to save fuel, and thus costs, reaches unprecedented levels. Fuel-efficient engines no longer being enough, attention increasingly turns to intelligent software solutions. One idea for such a solution is to predict upcoming hills and crests for intelligent cruise control that saves fuel by driving smoothly and avoiding sudden braking.

A self-learning map that uses statistical data to generate a route prediction, and from this prediction a road grade prediction, proves an efficient means to solve this problem. A unique feature of this system is its ability to build a complete map from scratch that contains information about statistical travel as well as topographical data. Each time the vehicle drives along the same road, the information is updated. After 10 such drives the upcoming road slope can be predicted up to 2,500 meters with an average error of less than 10 percent.

As the vehicle drives through a known area, the road grade for the path ahead is predicted. To do this, the path the vehicle will take must be predicted. Then, the road grade for this path is predicted. The end result is a diagram that shows what road grade the vehicle will encounter. By using this information, and for example letting off the throttle before a crest, unnecessary fuel consumption is avoided.



A diagram showing the predicted road grade in percentage points and the actual road grade

At the heart of this system are directional heat maps that store data in frequency grids. The world is divided into small "pixels" of 20 by 20 meters. Each pixel has three layers, divided into three direction ranges. Each pixel contains a value that represents the likelihood of travel through this pixel. The way this works is, when the vehicle drives through a pixel, the pixel corresponding to the current position is selected. Then the direction of travel determines which direction layer to use. Finally, the selected pixel has its value ("heat") increased by one for this direction.

When doing the prediction, the neighboring pixels are examined to find the one with the highest "heat" for the current driving direction. This pixel is selected as the next prediction, and the process is repeated for the desired prediction length.

The main advantage of this system, as compared to other solutions, is that it does not require any previous knowledge of the road network. This means that it can be used in areas and countries where topographical data is scarcely available. Furthermore, the system is designed in a lightweight manner such that it may be used in embedded automotive hardware already present in all Scania heavy-duty vehicles.