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Themenbeschreibung für Forschungsarbeit

Titel:
Practical fuel consumption models for calculating environmentally friendly routes

Project description for master thesis or internship (TomTom)

Background
With rising fuel prices and focus on minimizing the CO2 footprint more and more drivers are interested in optimizing their fuel consumption. Expected fuel consumption becomes another important property when comparing alternative routes next to travel time, length, toll charges, etc. Hence, drivers demand navigation systems which

- provide visibility on the expected fuel consumption and CO2 emissions for a given route and
- offer environmentally friendly routes (*eco routes*) that minimize fuel consumption.

TomTom navigation devices can already calculate routes that represent a suitable trade-off between minimizing travel time and fuel consumption. Such routes are often similar to the fastest route but they also take additional properties of the route into account. For example, they avoid long detours that save little time or short-cuts with many turns and crossings that are likely to result in the need to brake and accelerate frequently.

However, TomTom navigation devices do not not yet provide an estimate of the expected fuel consumption. A fuel consumption model that delivers such an estimate would benefit drivers twofold by increasing the awareness of expected fuel consumption and by forming the basis of a route calculation model. A route calculation model that directly optimizes expected fuel consumption is likely to result in routes that are more environmentally friendly than current models which indirectly achieve the same effect by avoiding long detours, frequent acceleration, etc.

TomTom navigation devices make use of data derived from anonymous position logs of millions of drivers world-wide, e.g, to avoid routes through areas that are typically congested at a given time. This data source provides rich information about the behaviour of drivers in given parts of the road network and can also be used to estimate fuel consumption and to calculate environmentally friendly routes.

Objective
The objective of the project is to design a fuel consumption model that is sufficiently accurate to provide an estimated fuel consumption that is meaningful to drivers and to

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properly influence route computation. The solution should be scalable such that

- it works with the limited data and computing power available in typical navigation devices but
- can also make use of additional resources if executed in a server environment.

It shall exploit the wealth of data available in historical position logs and its accuracy shall be benchmarked against real-world fuel consumption logs.

Project scope
The following points shall help to provide a rough sketch of the work. The detailed approach taken in the project will be discussed with the candidate and refined throughout the project.

Project outline:

- Use existing tools based that implement physics-based micro models to calculate the fuel consumption from historical position logs and calibrate the model against historical fuel consumption logs.
- Design a simple fuel consumption model that does not use historic position logs but only simple averaged data (like the average fuel consumption at a certain speed on a certain type of road) and benchmark it against the physics-based micro model.
- Extend the fuel consumption model to also use data derived from historic position logs (like the average expected fuel consumption on a given road segment). Benchmark this model against the simpler variant and against the physics-based micro model to assess the impact of historic position logs on the accuracy of the model.
- Calibrate the fuel consumption model both for concrete vehicle types as well as for generic vehicle classes (e.g. modern middle-class passenger car) and assess how this impacts the accuracy of the model.

Follow-up work (e.g. in a second project phase with a separate candidate or for a more extended thesis):

- Integrate the fuel consumption model in the routing algorithm.
- Evaluate the calculated eco routes by comparing them against standard fastest routes and the current TomTom eco routes (using measured data and a physics-based micro model).
- Let the model 'learn' based on measured fuel consumption.
- Enhance the model to take live traffic data into account.

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