1 *Map viewer example*

2 *Route analysis incl. surrounding region with respect to hilliness*

VMC® – VIRTUAL MEASUREMENT CAMPAIGN

Geo-referenced analysis of environmental properties with respect to reliability and energy efficiency in vehicle development

Global geo-referenced data play an important role in the statistical assessment of reference loads or fuel consumption in the vehicle development. In view of the large usage variability especially for commercial vehicles, they complement and enhance the currently used methods by statistical evaluation of the additional geo-referenced data.

If, for instance, the road network including road quality (pavement, roughness), curves, slopes, traffic signs, traffic density etc. is known, one can derive vehicle independent distributions of such properties characterizing regions or routes.

Adding simple vehicle substitute models, one can, in addition, derive information about the expected longitudinal, lateral or vertical dynamics on the corresponding routes within a region. These are important

indicators for ranking routes and regions towards reliability or fuel consumption.

That way, it is possible to estimate the impact of the environmental conditions on vehicle classes without very detailed vehicle models. This sharpens the assessment of regions or routes towards the attribute of interest and provides valuable support during planning real measurement campaigns.

Components of the VMC concept
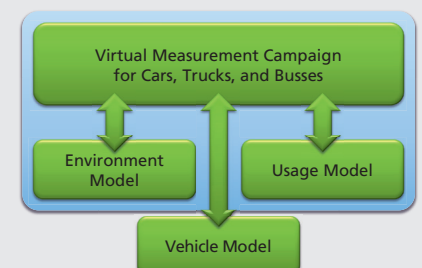
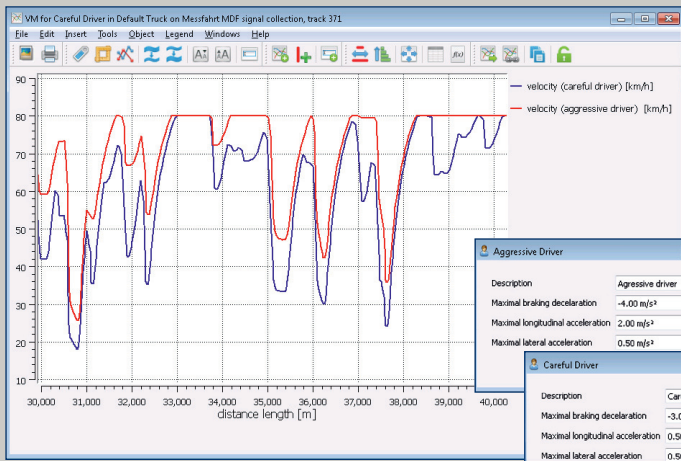**Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM**

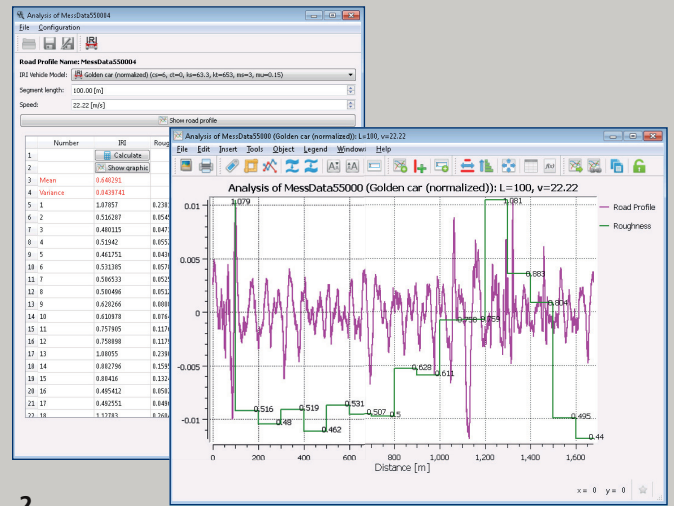Fraunhofer-Platz 1
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Typical Use Cases

- Comparison of regions or markets world-wide with respect to road properties (e.g. type, curviness, hilliness), climate etc.
- Assessment and ranking of routes within a region
- Goal-oriented planning of routes for a measurement campaign
- Utilizing existing data for the assessment of new markets
- Modelling vehicle usage in a region
- Statistically founded extrapolation of data towards customer load distributions

Database

- Road network worldwide
- Traffic signs and rules, one-way roads, bridges etc.
- Topography
- Traffic and road quality for selected regions
- Climate: monthly mean values (since 1900) for Min/Max-temperature, rainfall etc.
- Socioeconomic data for selected regions (extensible by the user)

Functions

- Flexible creation of histograms for all supported classes and road or environmental properties for regions and routes

- Calculation of fatigue-oriented measures for hilliness and curviness
- Classification of roads by type, curviness, hilliness, or other properties
- Import of routes, e.g. from KML-files
- Import of road profiles
- Calculation of roughness indicators (ISO 8608, International Roughness Index)
- Mathematical models for describing road profiles based on recent research results
- Calculation of speed profiles on routes taking into account speed restrictions, traffic density, and stochastic aspects
- Generation of longitudinal, lateral, and vertical loads for simple vehicle substitute models
- Export of results e.g. speed profiles or road profiles for usage in external tools

Configuration and extensibility

- Definition of new resp. modification of factors based on existing measures and factors
- Integration of new measures for specific applications on request
- Integration of specific vehicle models (e.g. drivetrain models) on request
- Regular data updates
- Integration of new data on request or by suitable interfaces
- Replacement of existing data by substitute data from another data source

System requirements

- Supported operating systems Windows 32 bit and 64 bit
- Database system PostgreSQL incl. Post-GIS-extension
- Storage requirement for worldwide database and user workspace approx. 2 TB
- Client-Server-Architecture

1 *Comparison of two speed profiles with different driver behavior*

2 *Road profile and IRI values*