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Representing Road Surfaces with OpenCRG: some insight into its background and applications

Jochen Rauh

2018-10-10

TireWheelTech 2006: Process Stability for Tire Simulation

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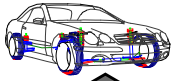
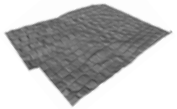
2. Requirements in the Process Chain Data Acquisition

ss oriented Data acquisition

Process oriented Parameter Identification



Tire Model Parameters



Qualification of tire models

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Qualification of Tire Models on Rough Roads

heel force
cleat test) very well.

h road) the longitudinal
antly too high!

ysis task: Reduction of
between tire and road surface

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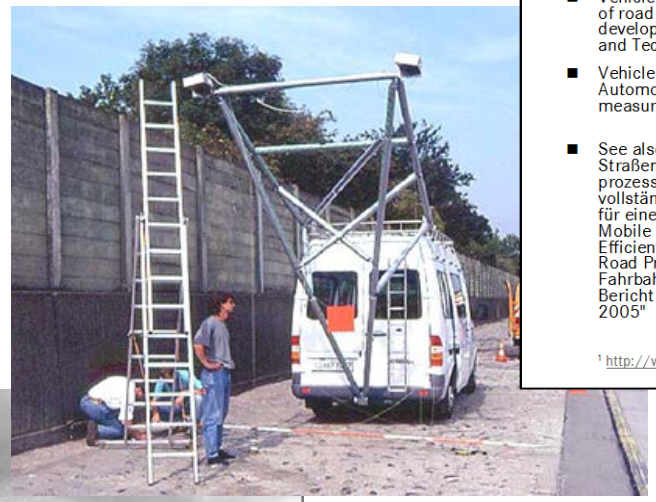
Parameterization of Local Friction

Small contact patch
-> High local pressures

Evolution of road surface measurement technology

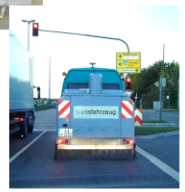


DaimlerChrysler

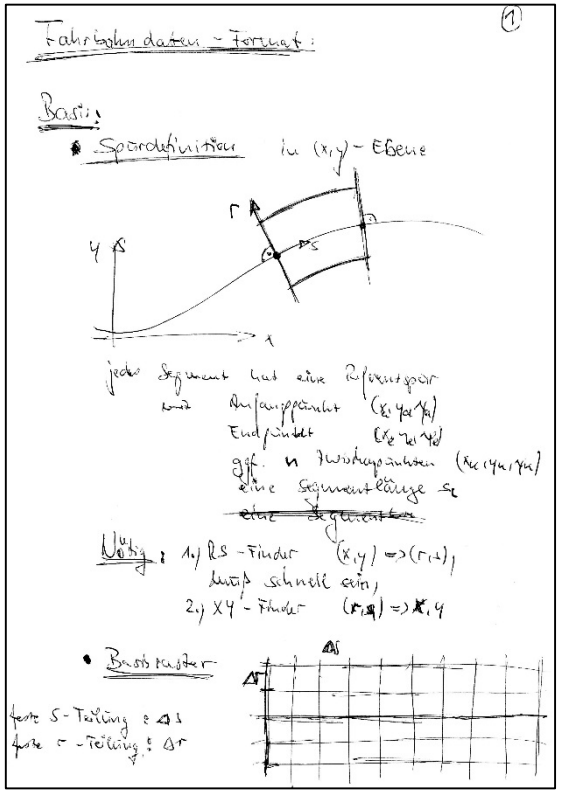
Road Measurements- Today

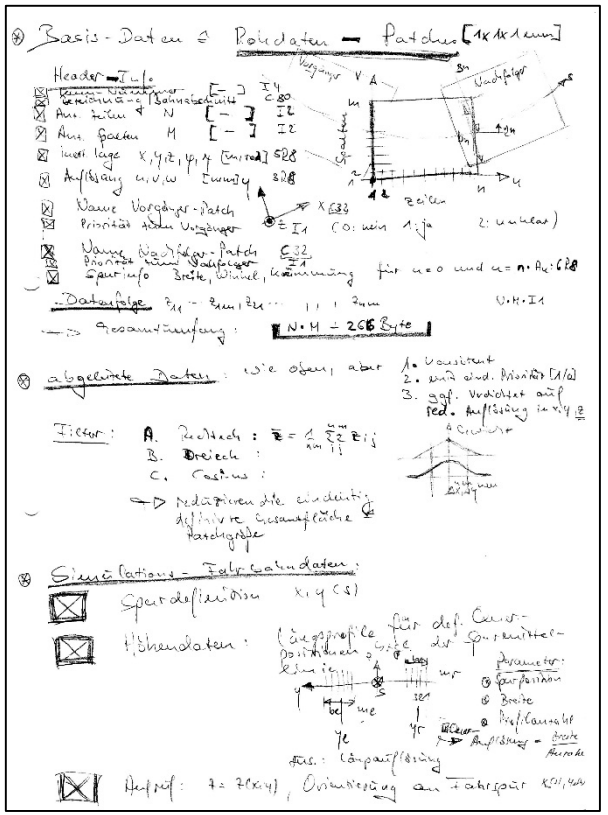
- Vehicle for high-resolution measurements of road surfaces in moving traffic was developed by DaimlerChrysler Research and Technology
- Vehicle is now operated by TÜV SÜD Automotive GmbH to provide measurements to everyone[1].
- See also: Gimmler, Rauh, Ammon: Straßenprofile: Mobile Messung, prozessgerechte Datenaufbereitung und vollständige Bewertung bereiten die Basis für eine effektive Simulation (Road Profiles: Mobile Measurement, Data Processing for Efficient Simulation and Assessment of Road Properties). In "Reifen-Fahrwerk-Fahrbahn Hannover 25./26.10.2005, VDI-Bericht 1912, VDI-Verlag, Düsseldorf, 2005"

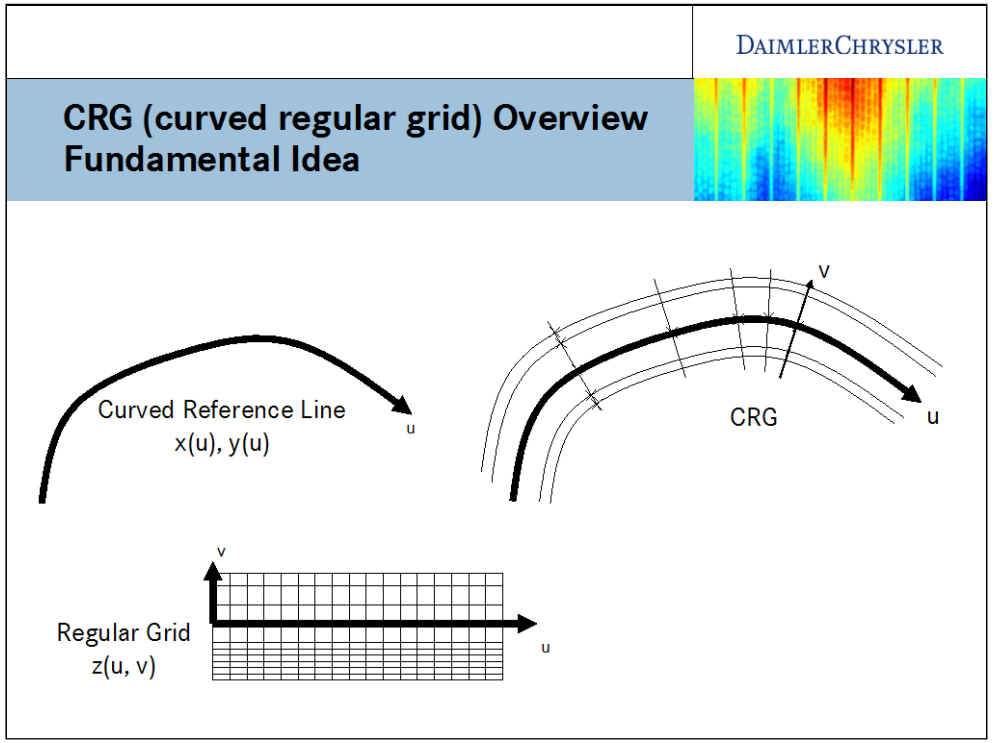
[1] http://www.tuev-sued.de/3D-Track



Looking for a road surface representation optimized for minimal memory and compute time consumption







OEM working group 6.1.3 on Tire Simulation
2007-03-06: Proposal of CRG as common road data format

Straßenprofile: Messung, Aufbereitung, Bewertung als Basis zur Simulation

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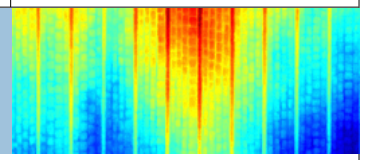
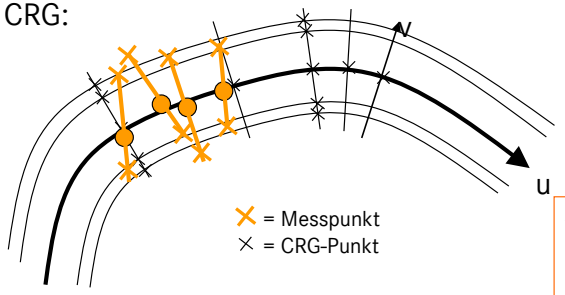
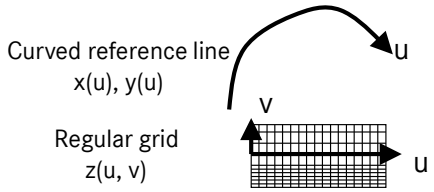
Neues Straßendatenformat: CRG (Curved Regular Grid)



CRG:





- bietet ein effizientes Speicherformat:
  1km x 2m; 1cm xy-Auflösung: < 80MB
- liefert konsistente Daten:
  z.B. Abweichungen leicht erkennbar
- verringert die Simulationszeit:
  Straße alleine: Faktor 10...100
- Daten sind schon vernetzt:
  keine zusätzlicheTriangulation nötig

3D-VDI-2005.ppt 9

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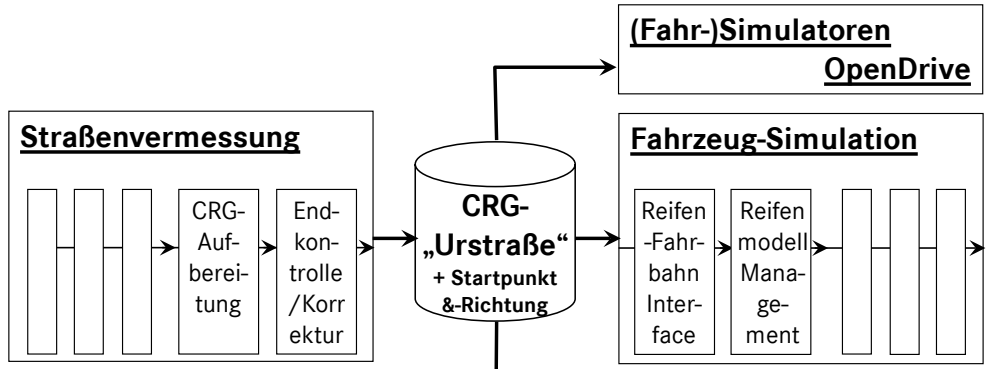
AK 6.1.3: CRG als einheitliches Bodenmodell

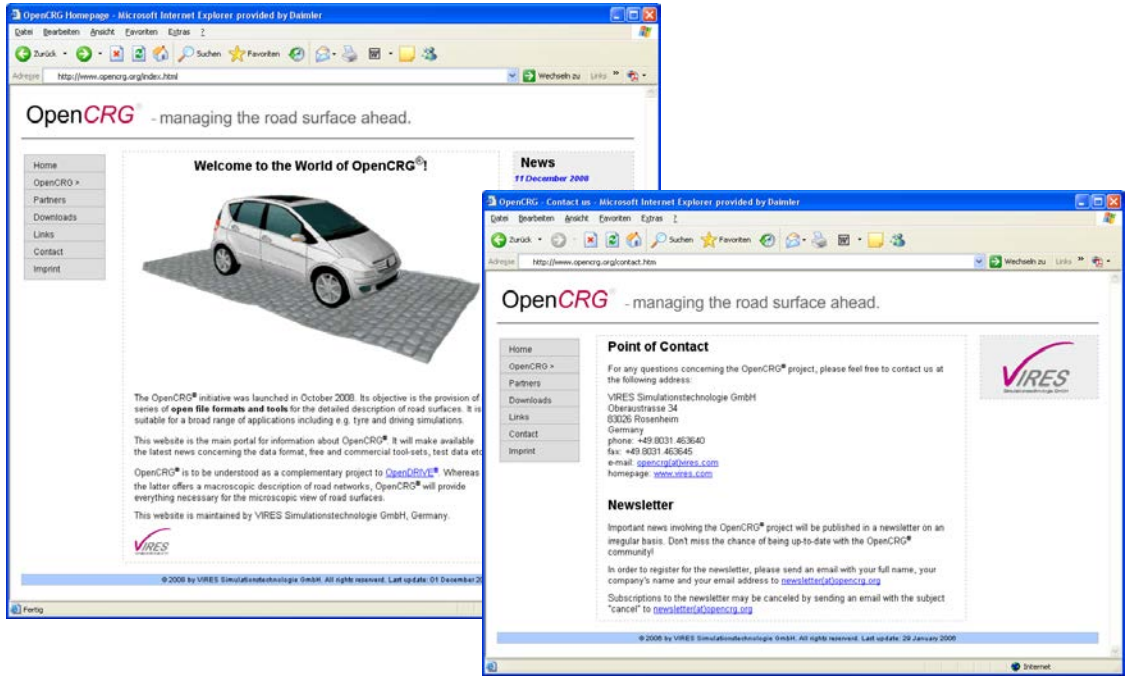
CRG: Single Source Straße - vielfach verwendbar



Dr. Jochen Rauh / GR/EAV / 12.02.2008 7

OpenCRG gets public tire.wheel.tech 2008-12-11

OpenCRG is on http://www.opencrg.org



References

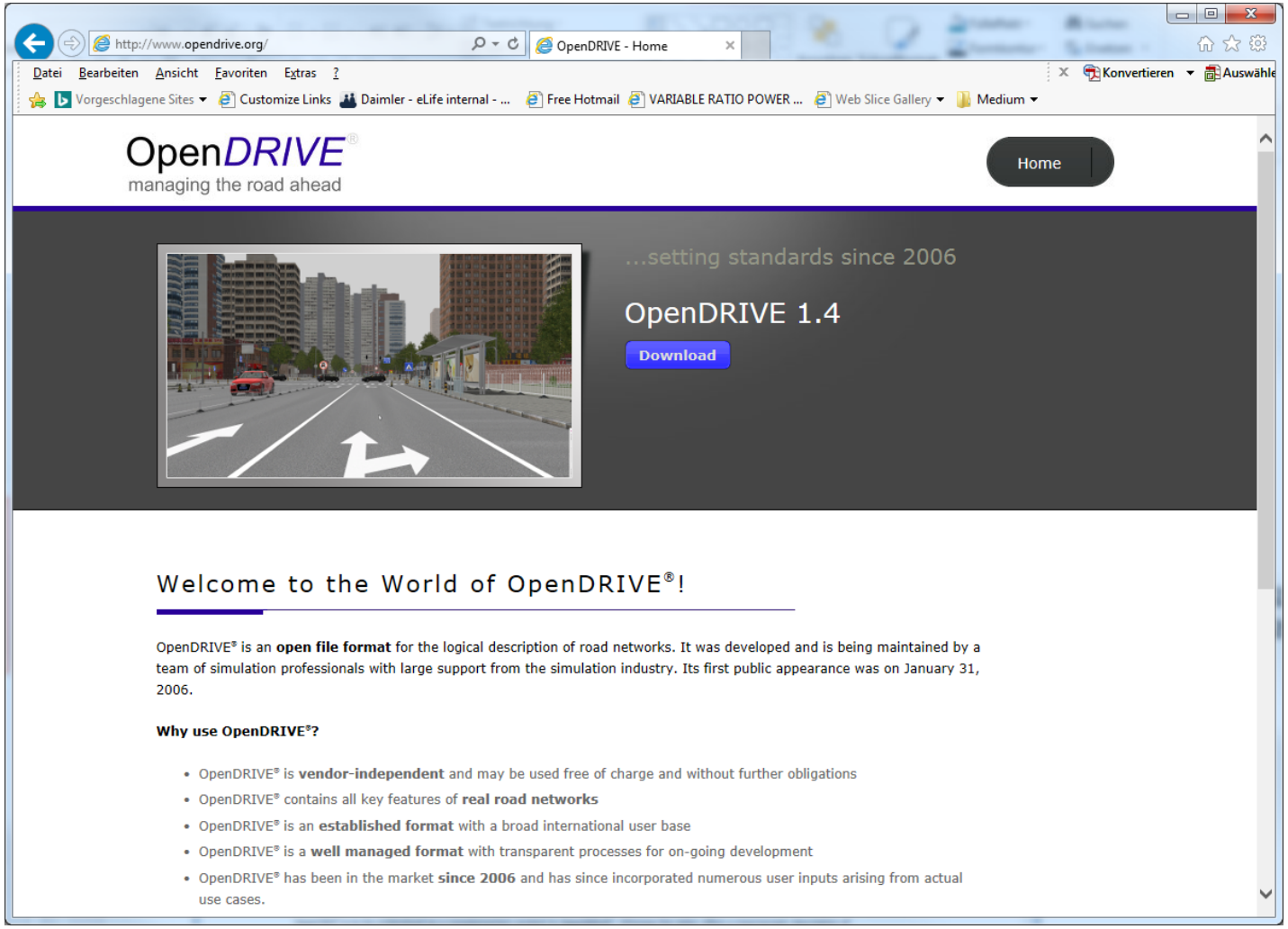
1. Gimmler H., Ammon D. & Rauh J. (2005). Road Profiles: Mobile Measurement, Data Processing for Efficient Simulation and Assessment of Road Properties. VDI-Report No. 1912, 335-352 (in German).
2. N.N. (2007). Announcement of OpenDRIVE extension with CRG (Curved Regular Grid) Road Profile Data Format. http://www.opendrive.org
3. N.N. (2008). Announcement of OpenCRG http://www.opencrg.org
4. Rauh J. (2003). Virtual Development of Ride and Handling Characteristics for Advanced Passenger Cars. Vehicle System Dynamics 40(1):135-155.
5. Rauh J. (2005). CRG (Curved Regular Grid) Road Profile Data Format. http://www.tuev-sued.de/3D-Track.
6. Rauh J. & Mössner-Beigel M. (2008). Tyre simulation challenges. Vehicle System Dynamics, 46 (Supp 1), 49-62.
7. Schick B., Gimmler H., Rauh J. & Witschass S. (2006). 3D-TRACK – Give the simulation the chance for a better work! Mobile, high-resolution topology and roughness measuring of road surfaces to create 3D track models. F2006V095 FISITA automotive world congress, 22.-27.10.2006, Yokohama.

Hosting of OpenCRG as OpenSource Project supported by Vires – thank you!

VIRES Simulationstechnologie GmbH

http://www.opencrg.org
mailto:opencrg@opencrg.org

OpenDRIVE represents details of road surfaces using OpenCRG



VIRES Simulationstechnologie GmbH

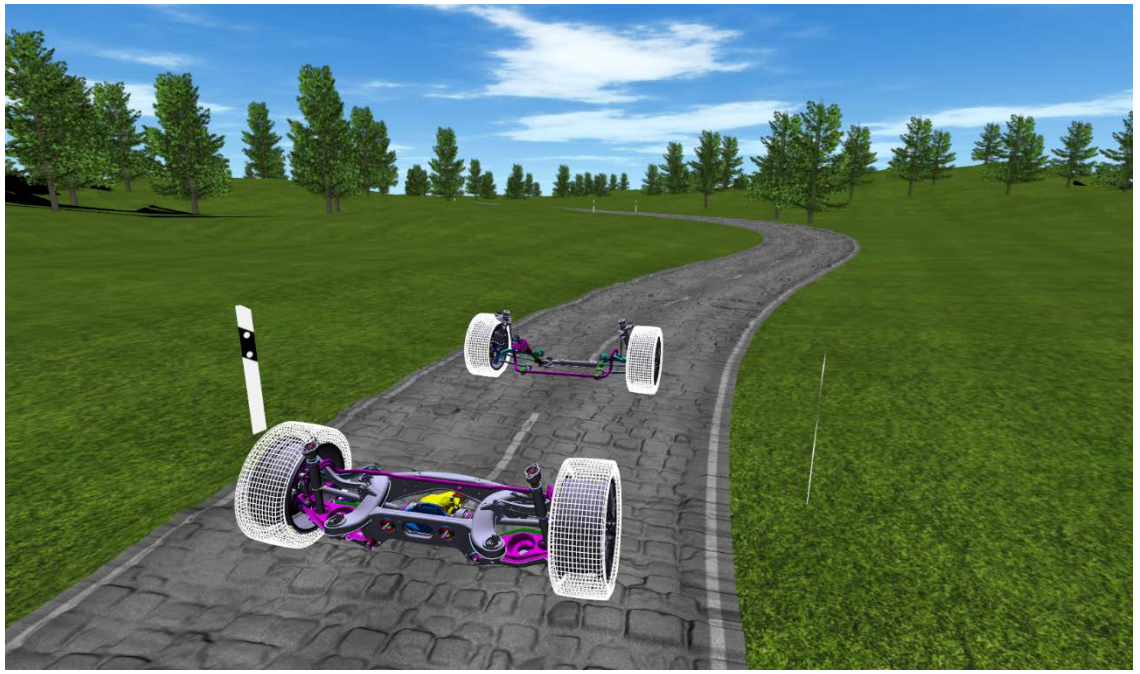
http://www.opendrive.org
mailto:opendrive@opendrive.org

2018: Today’s OpenCRG applications

Most intense application area is still road surface representation for comfort and durability simulation,
but we also use CRG to represent distributed scalar properties of the road, e.g.

- Friction attributes (friction coefficient)
- Visual attributes (grey value)
- …

We use data from real road measurements as well as data generated synthetically to represent deliberate operating conditions and disturbances.



2018ff: What's next?

- OpenSource projects like OpenCRG need supporters and contributors!
- During 10 years of OpenCRG, VIRES Simulationstechnik GmbH did an excellent job to code and document the C reference implementation, to continue hosting, bug fixing, answering user questions and user support – thank you for all effort!
- 3D Mapping Solutions GmbH also supported OpenCRG by hosting a workshop and supporting many users with their questions related to OpenCRG – thank you, too!
- Jochen Rauh provides some internal support at Daimler, and sometimes gets involved in more complex support topics – mostly answering at night or weekend ☹☺
- OpenDRIVE is on its way to ASAM – OpenCRG will do the same!

2018ff:
upcoming contribution by Jochen Rauh

Forward/backward transformation

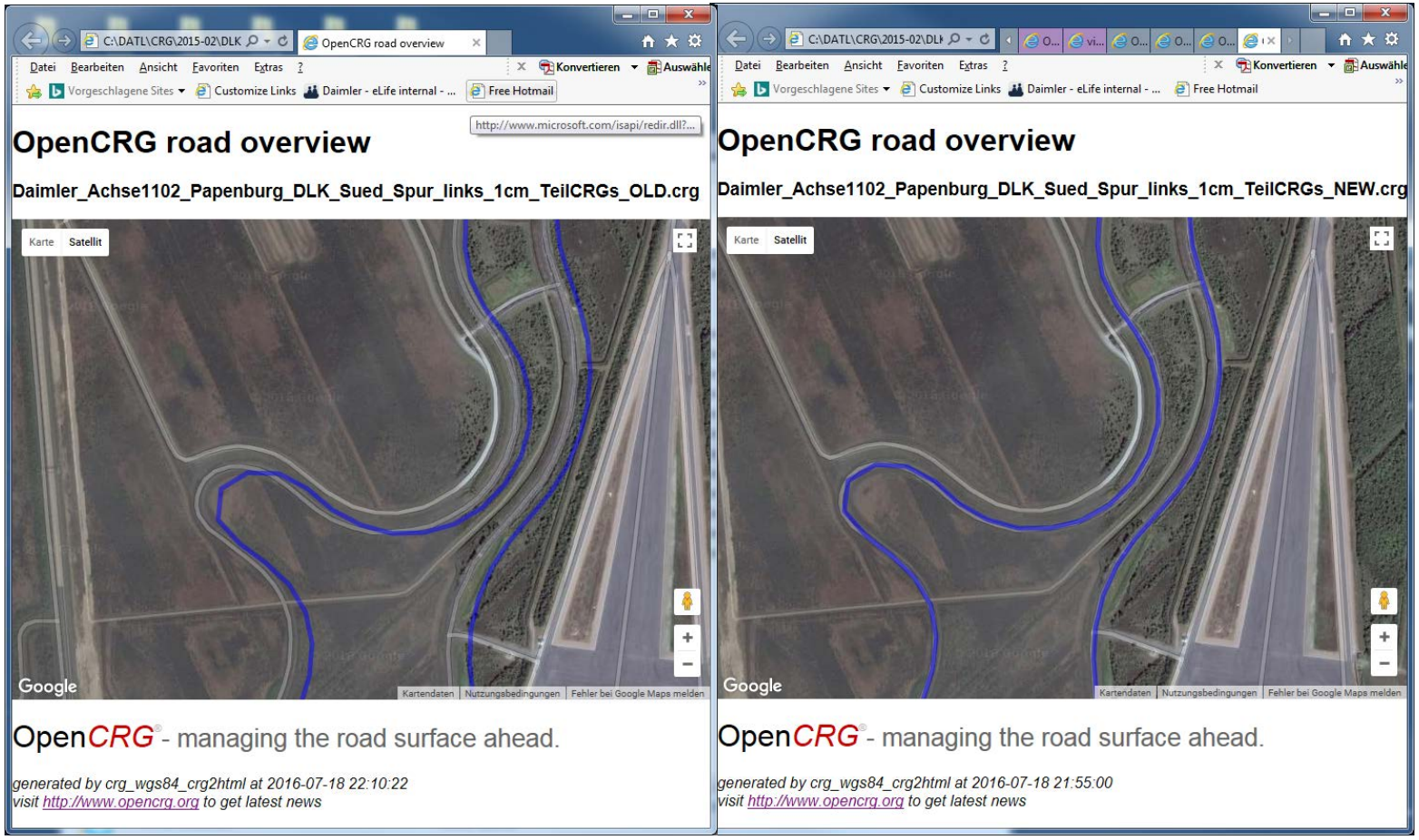
GEO-coordinates (lon/lat) <->

CRG-coordinates (x/y)

from meter accuracy to centimeter accuracy by simply adding some projection information, e.g.

```
pro.proj.nm = 'TM_6';
pro.proj.f0 = 0.9996;
pro.proj.e0 = 500000;
```

(will soon be available in Matlab reference implementation of OpenCRG)



Open*CRG*®- managing the road surface ahead.