Digitalisierung in der Unfallrekonstruktion und Event Data Recorder (EDR)

DI Michael Plank

8. gmttb Jahrestagung
19.4.. bis 20.4.2018, Konstanz

3-dimensionale Simulation – Unfallörtlichkeit

- Aufsitzen eines Tiefladers

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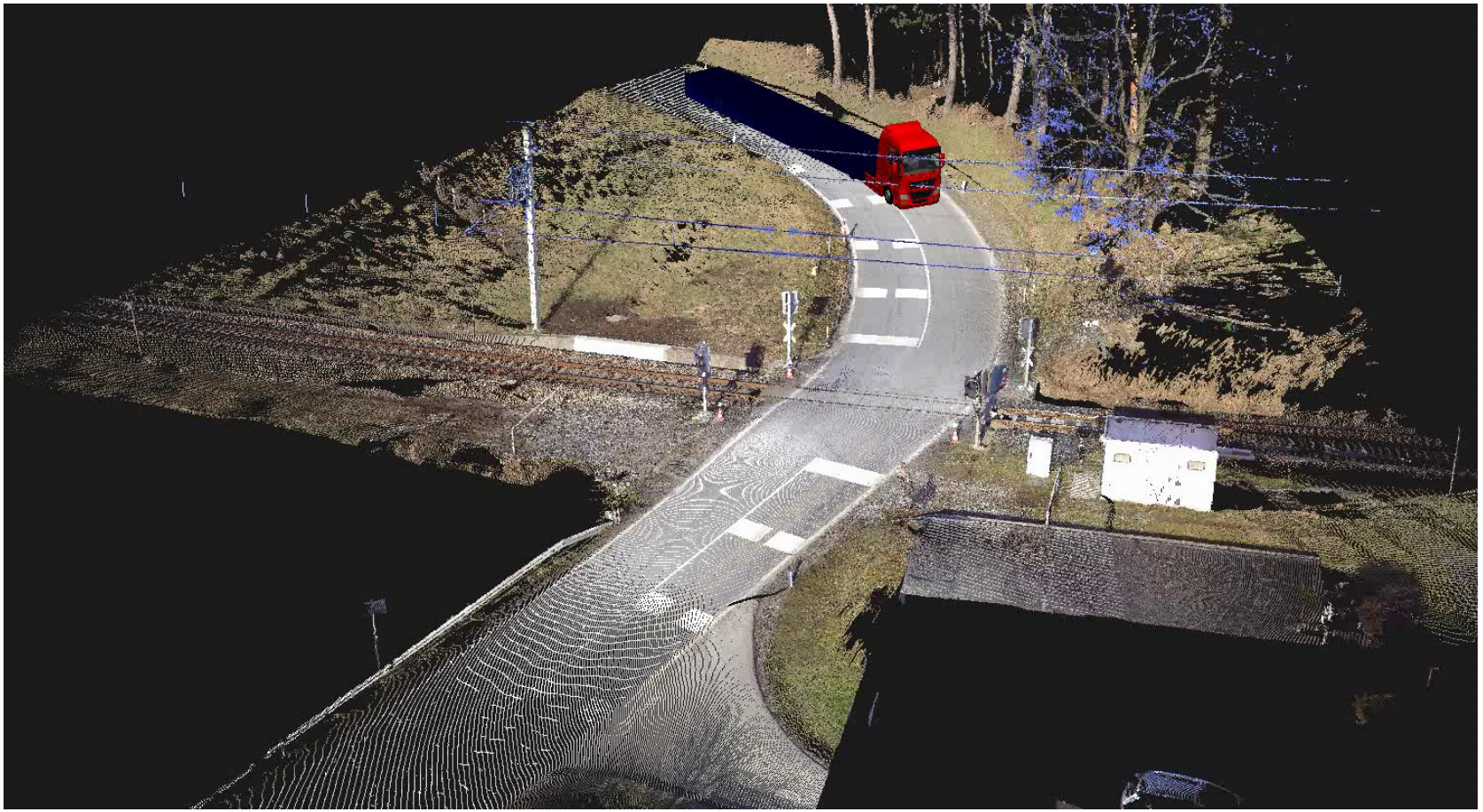

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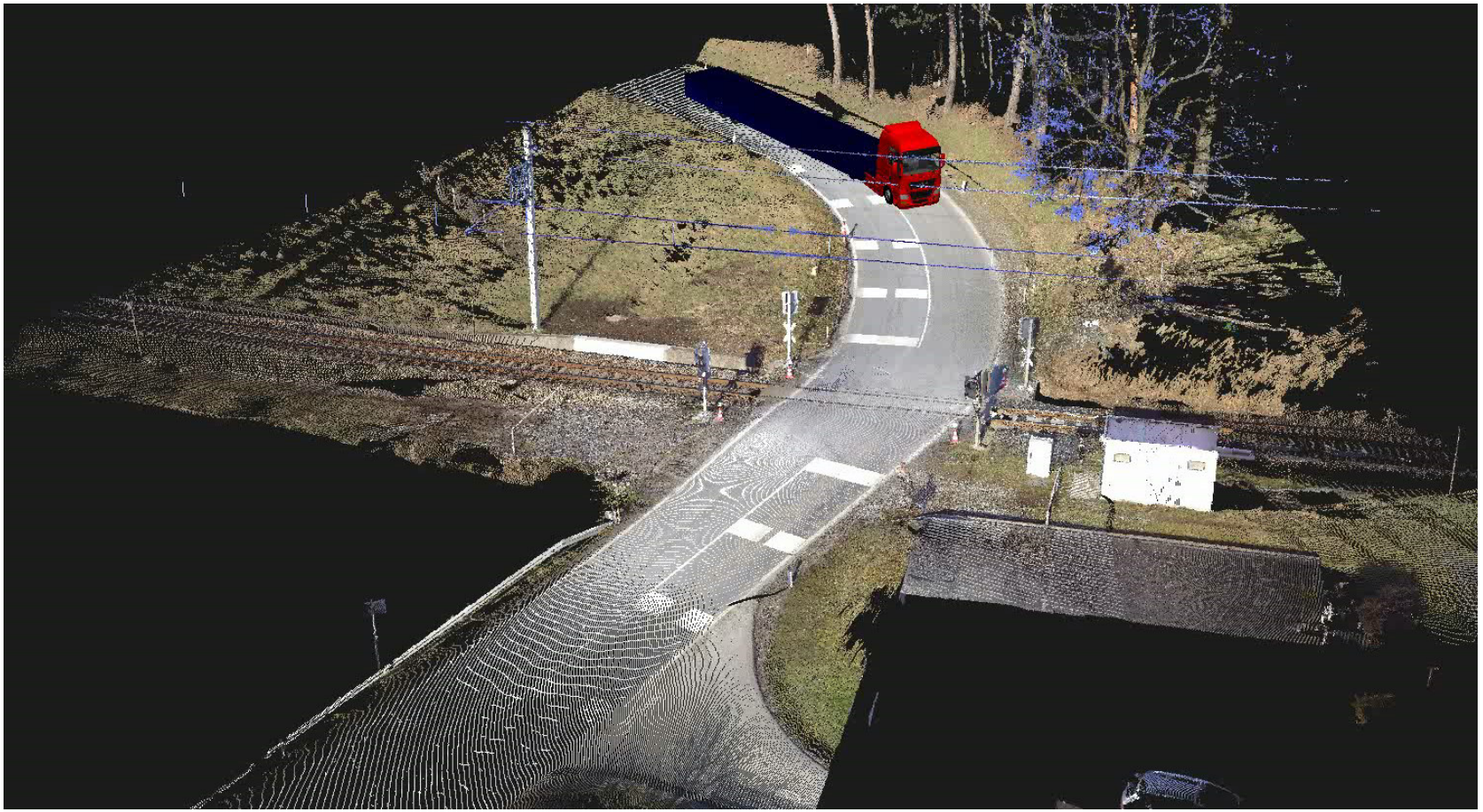

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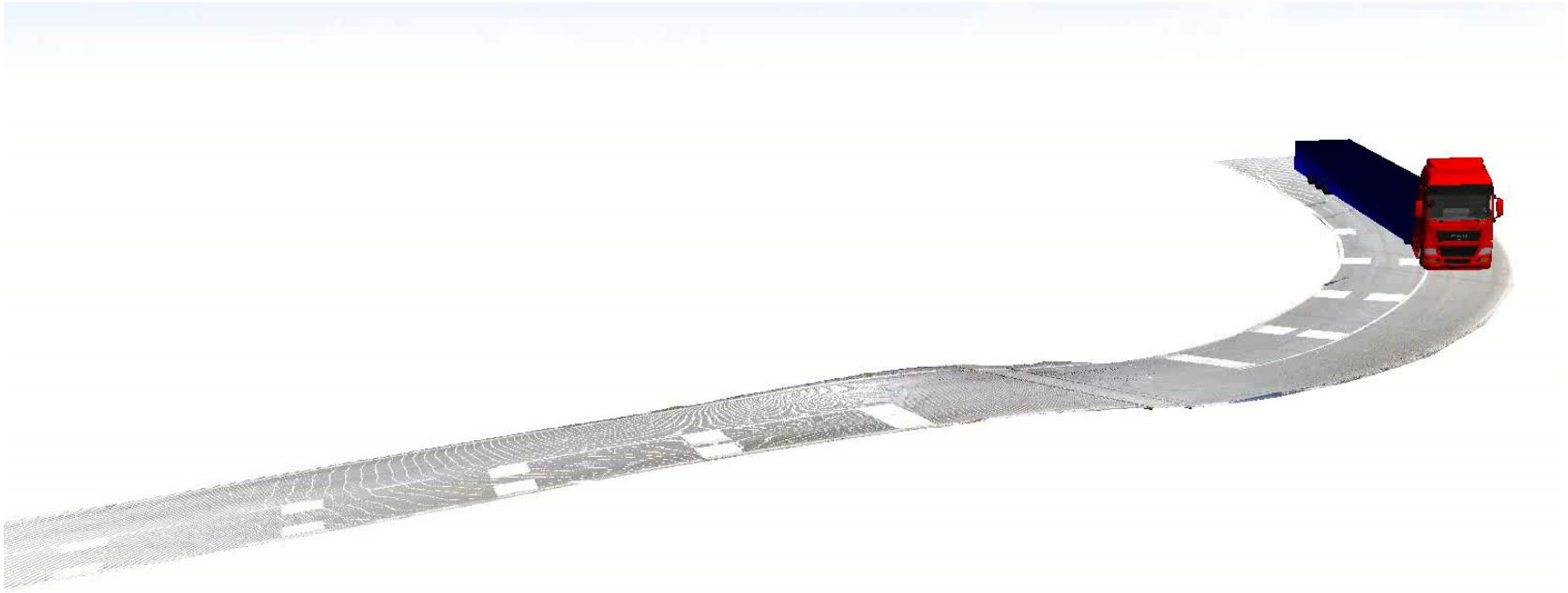

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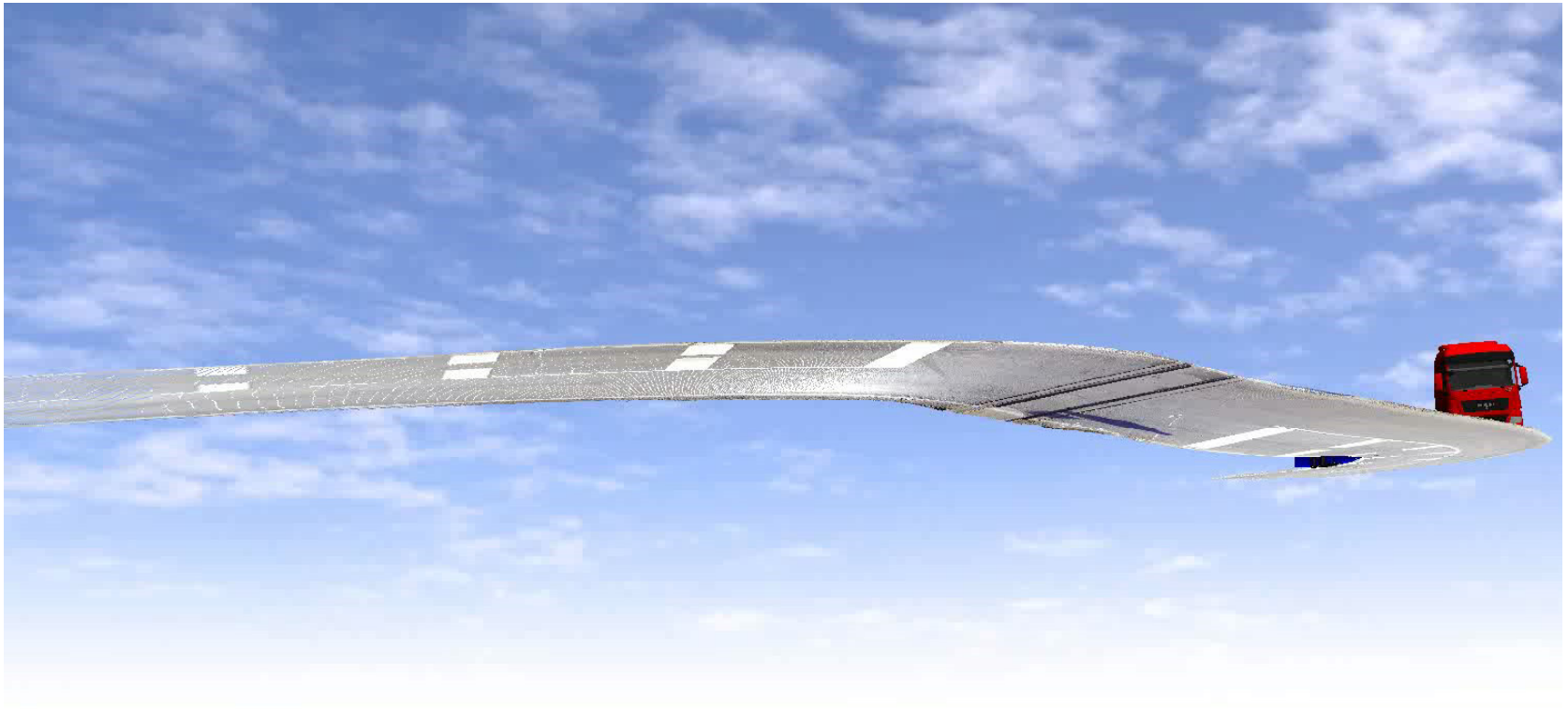

3-dimensionale Simulation – Unfallörtlichkeit

- Auswertung von Fotos – „Fotogrammetrie“

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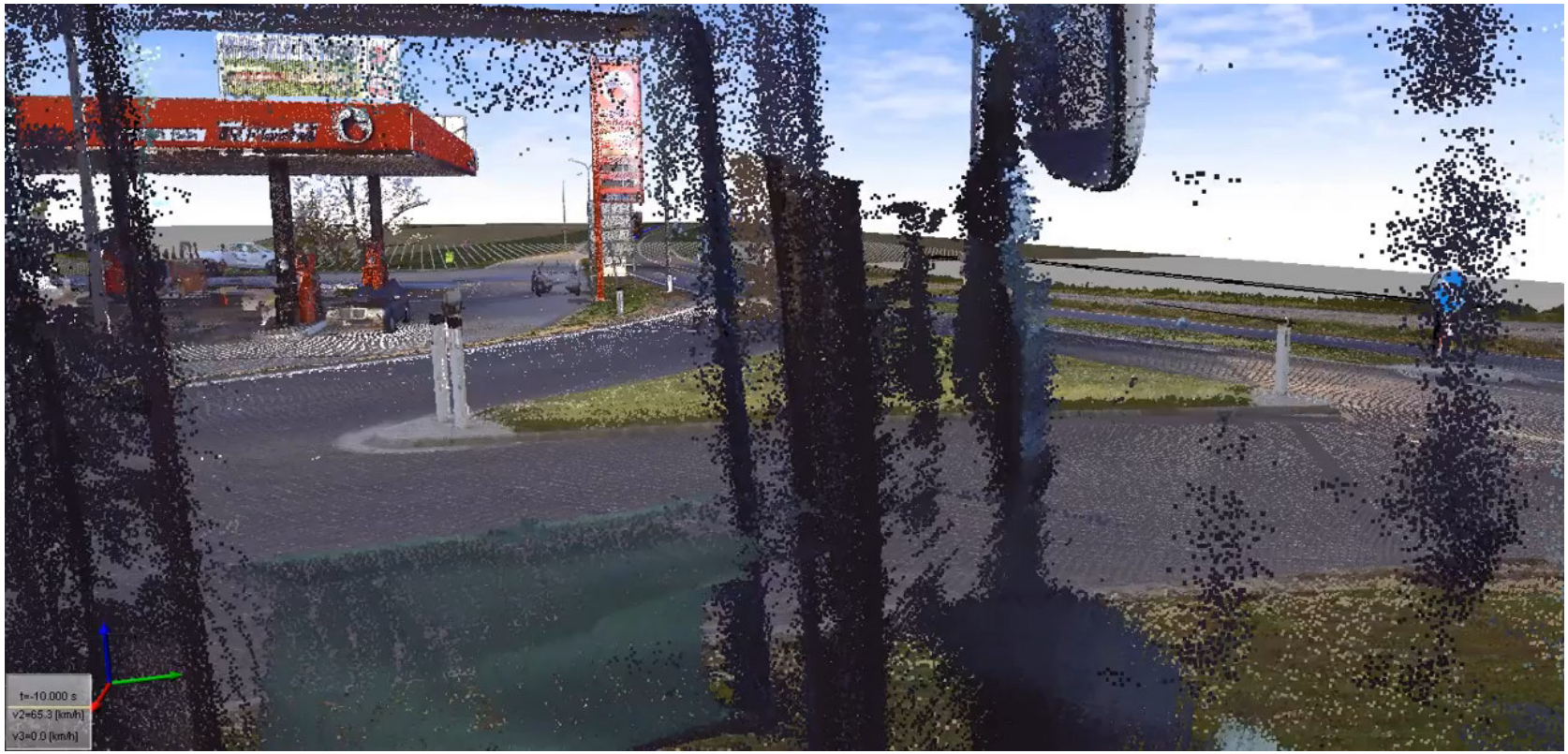

3-dimensionale Simulation – Fahrzeuge

- Indirekte Sicht - Radlader

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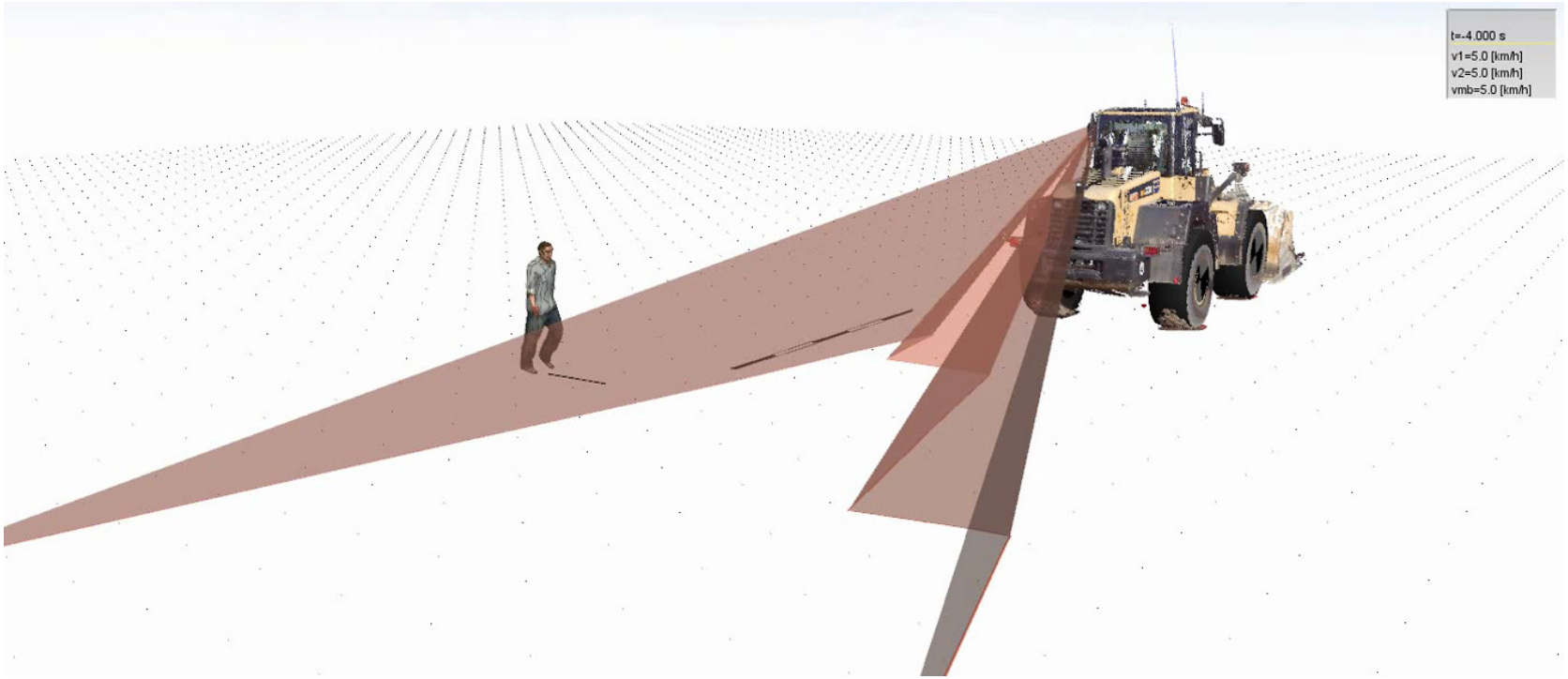

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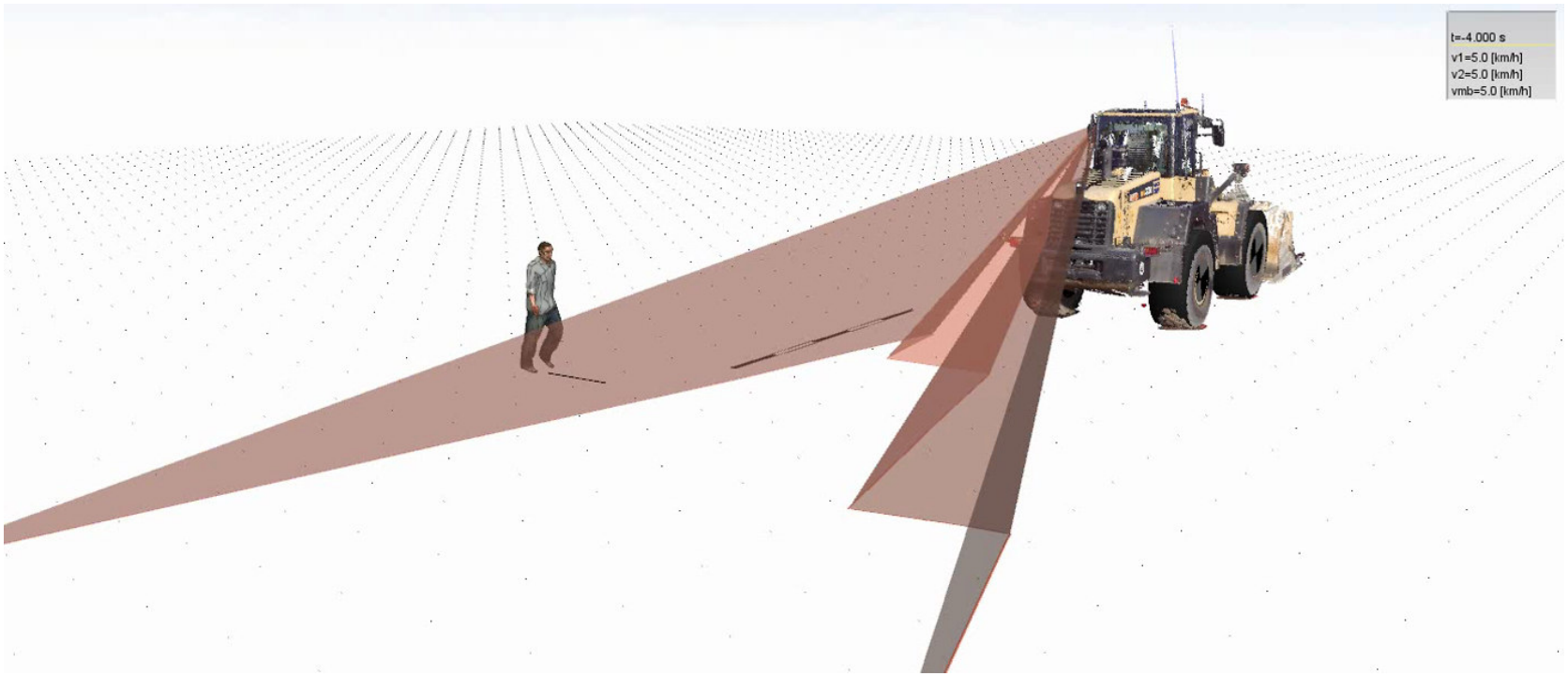

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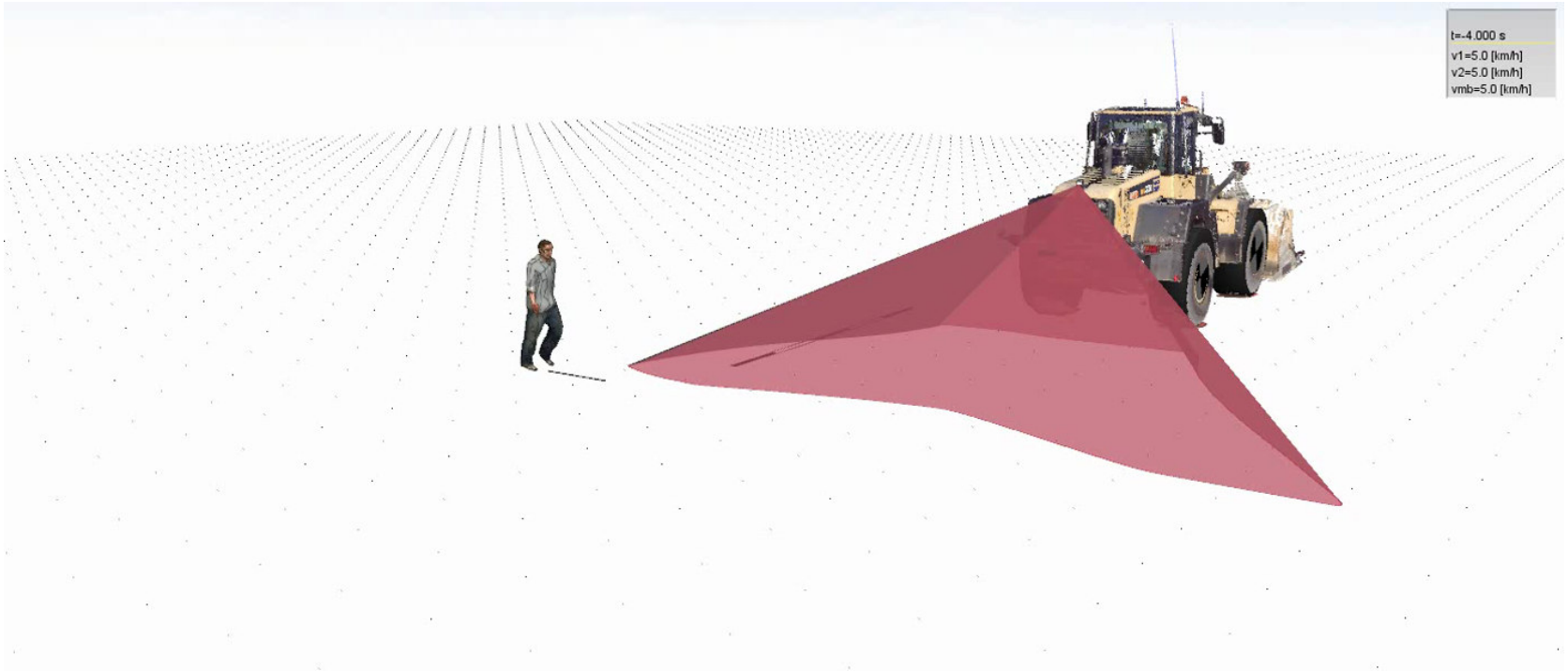

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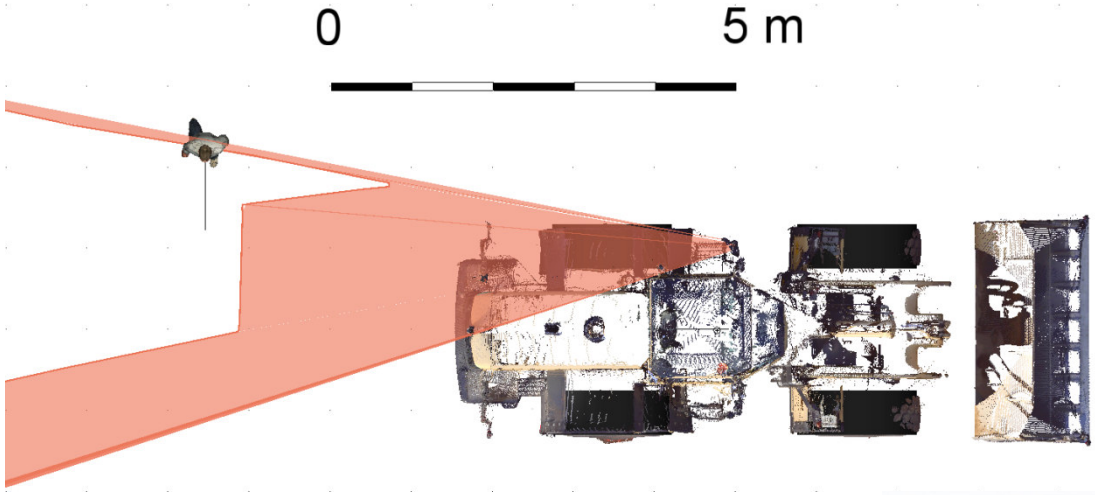

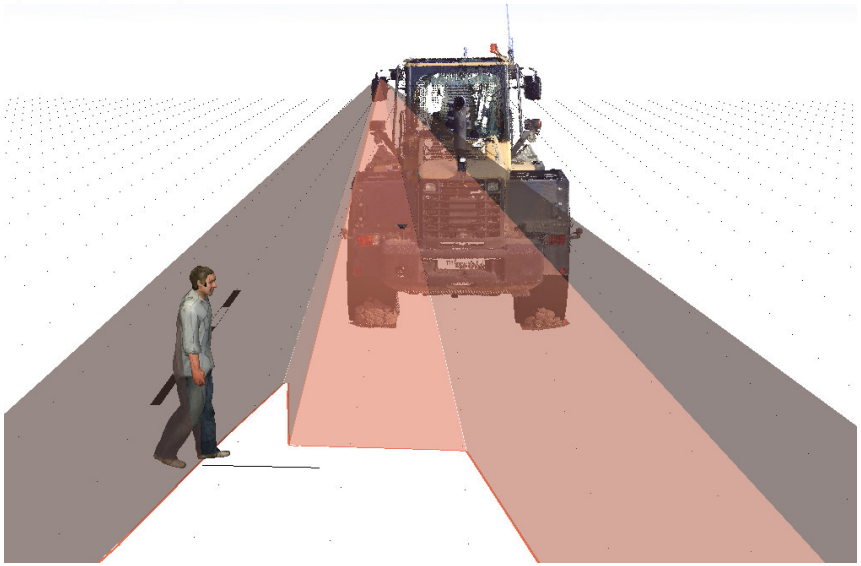

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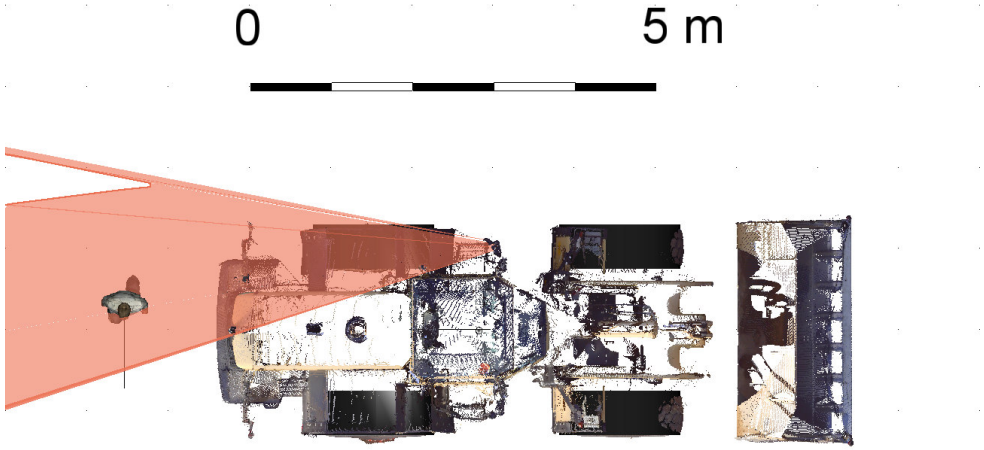

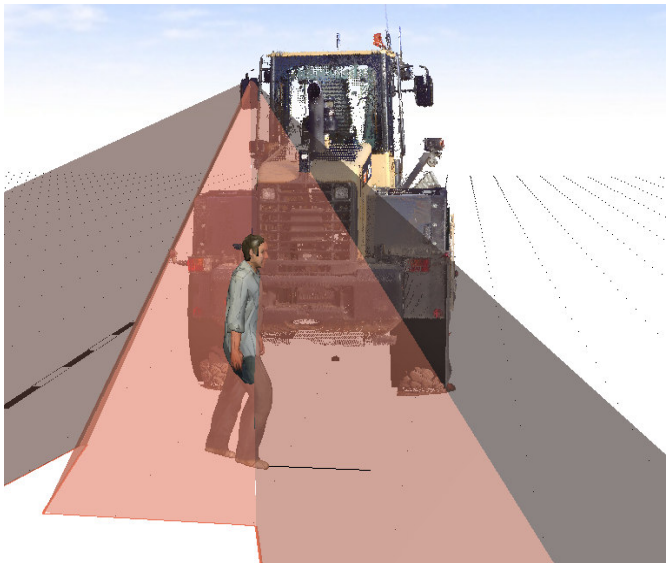

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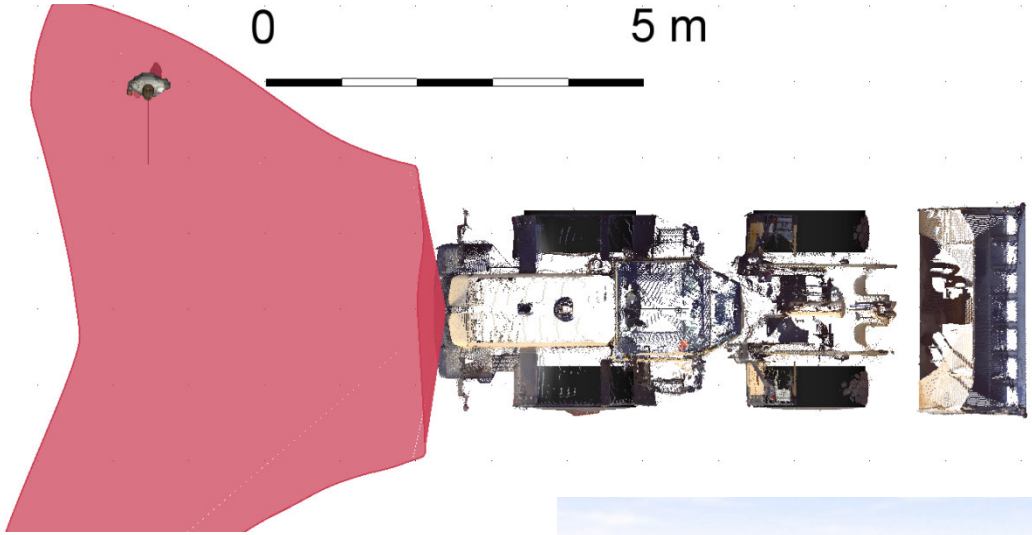
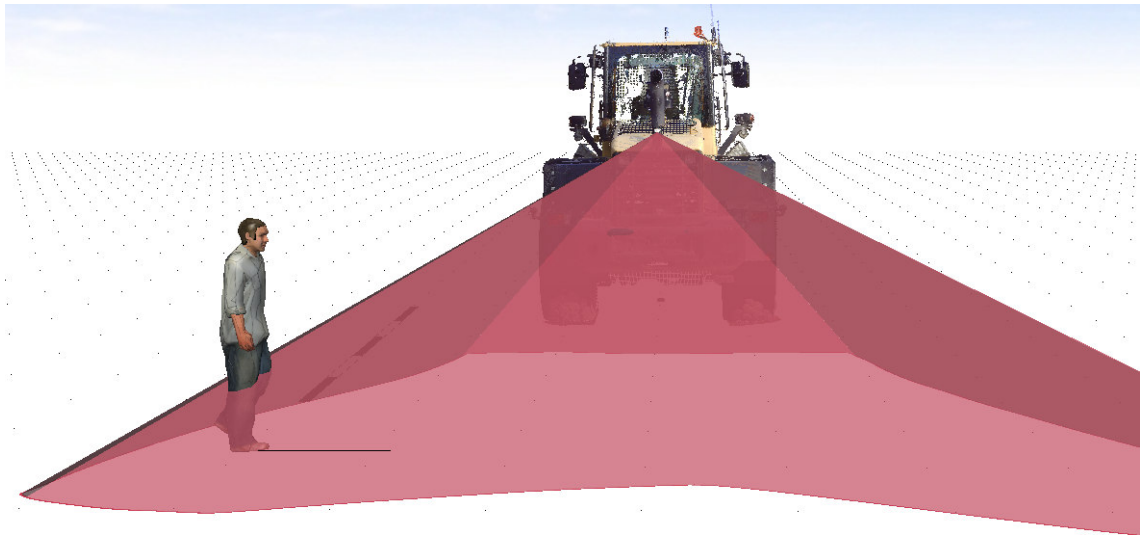
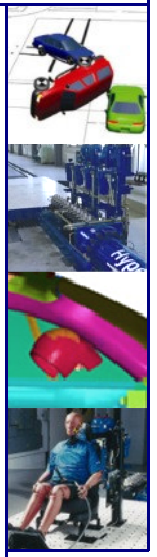




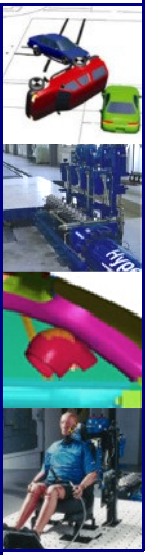
Fazit

- Umfangreiche 3D-Erfassung von Unfallörtlichkeiten
- Einfache und detaillierte Erstellung von 3D-Oberflächen
- Detaillierte Abbildung von Sichtverhältnissen
- Geeignet zur Fahrzeugvermessung
- Geeignet zur Rekonstruktion von Kollisionskonstellationen
- Realitätsnahe Darstellung von Unfallabläufen
- Neue Möglichkeiten in der Auswertung von Fotos
- Hohe Investition und Einarbeitung erforderlich
- Gesteigerte Ansprüche an Performance der EDV-Anlage
- Unter Umständen umfangreiche Nachbearbeitungen erforderlich



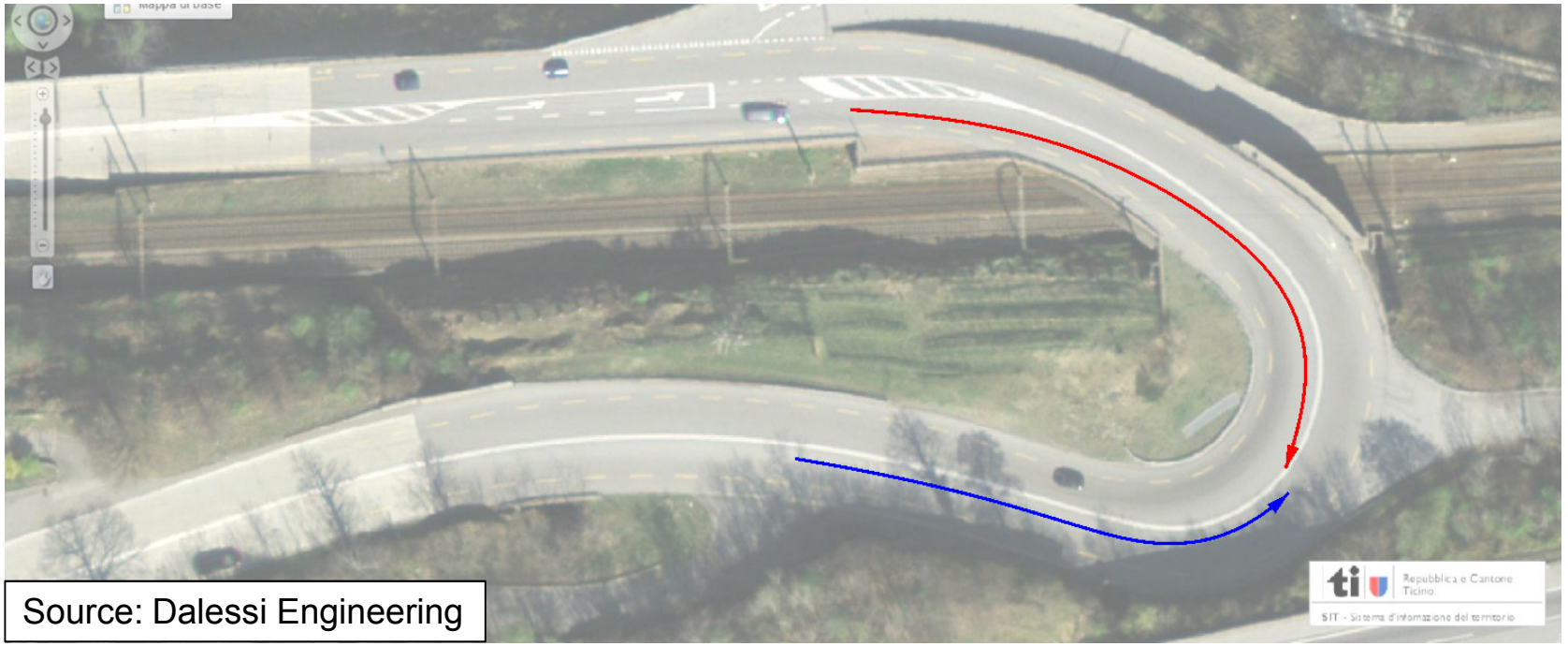
Usage of CDR-Data in PC-Crash

Dr. Andreas MOSER
DSD – Dr. Steffan Datentechnik GmbH
Linz, Austria



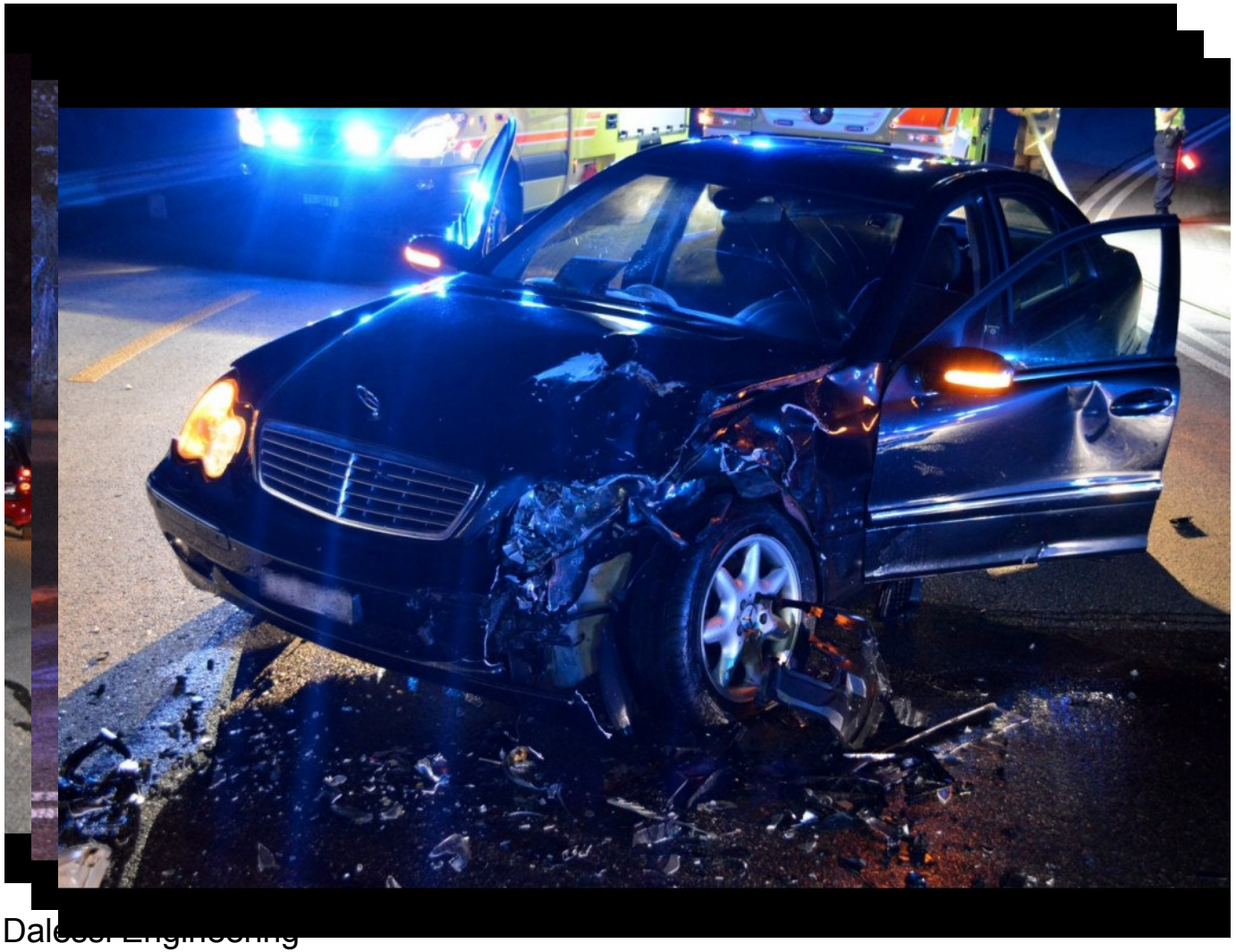
Introduction

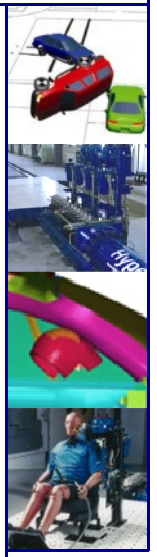
- Frontal collision in a turn
- EDR data available for 1 vehicle (2014 Chrysler Cherokee)



Source: Dalessi Engineering

Real accident





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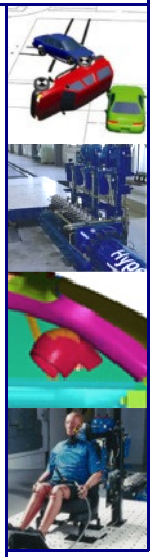
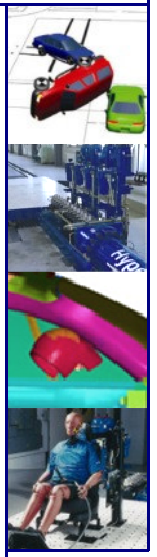


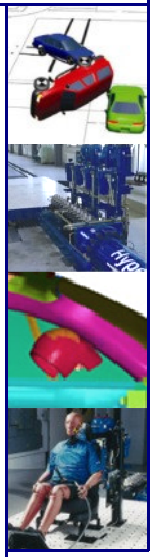
Questions

- Impact velocities ?
- Pre impact trajectory
  - Which car passed the middle lane ?
- Avoidance ?
- Driver actions ?
- Failure in active systems, brake system ?



EDR-data

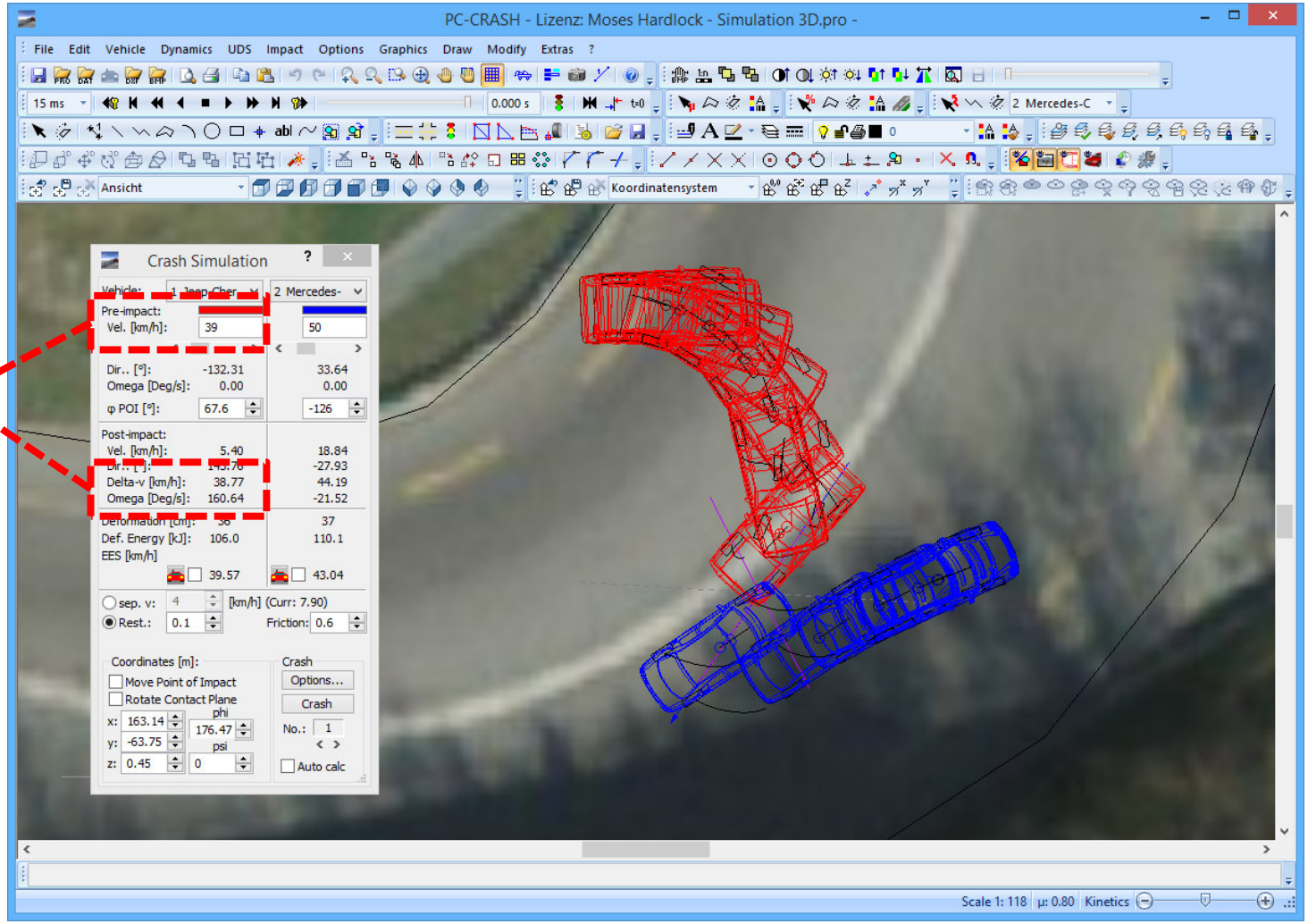
- Crash phase (0 to 300ms @ 500 Hz)
  - Long. and lateral crash pulse, Δv
- Rollover crash pulse (-2500 to 2500 ms @ 50 Hz)



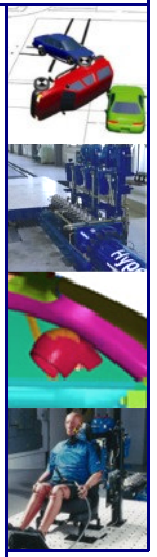
EDR-data

- Pre crash data (-5 to 0s @ 10 Hz)
  - Speed, Vehicle Indicated
  - Accelerator pedal
  - Service brake
  - Engine speed
  - ABS activity
  - Stability control
  - Steering input
  - ABS MIL
  - Yaw rate
  - Wheel speed

Impact calculation – PC-Crash



EDR



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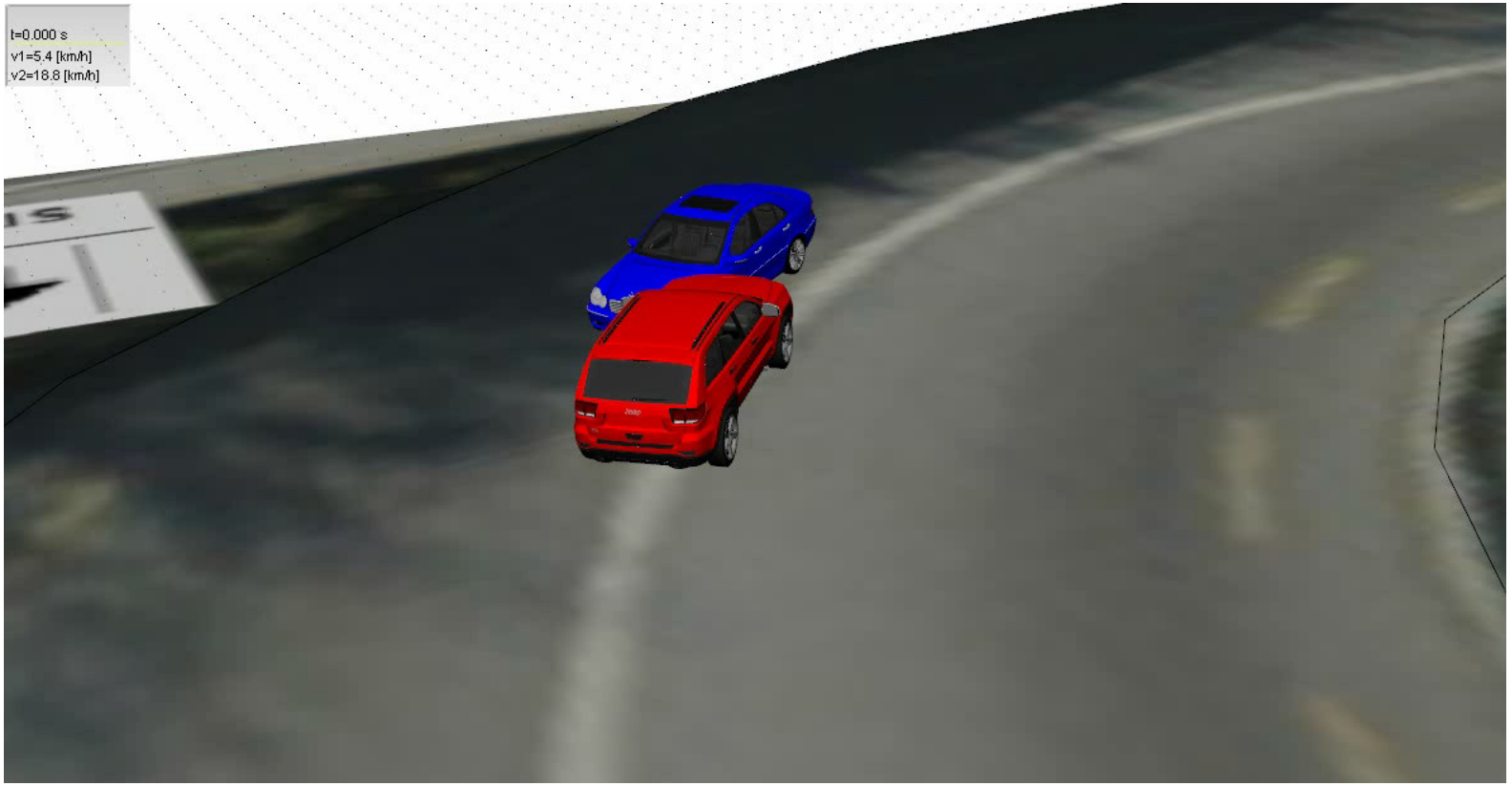
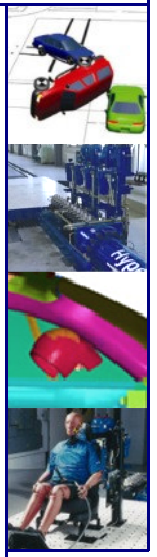
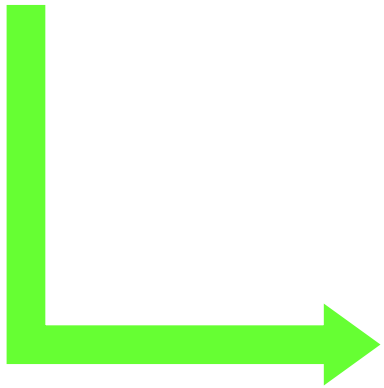




Pre crash data – wheel speeds

Pre-Crash Data [10 samples/sec] (Most Recent Event - table 2 of 2)
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	ABS MIL	Yaw Rate (deg/sec)	Wheel Speed LF (km/h)	Wheel Speed RF (km/h)	Wheel Speed LR (km/h)	Wheel Speed RR (km/h)
-5.0	On	-13.60	51.63	50.03	0	50.06
-4.9	On	-13.36	51.42	49.70	0	49.79
-4.8	On	-13.60	51.09	49.45	0	49.45



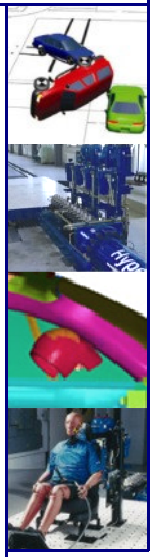
$$v_{avg}^{n} = \frac{v_l^{n+} v_r^{n}}{2} \tag{1}$$

$$\omega^{n} = \frac{v_r^{n} - v_l^{n}}{TW} \tag{2}$$

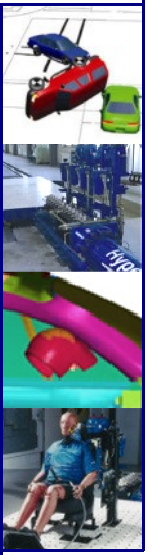
$$\varphi^{n} = \varphi^{n-1} + \omega^{n} \cdot \Delta t \tag{3}$$

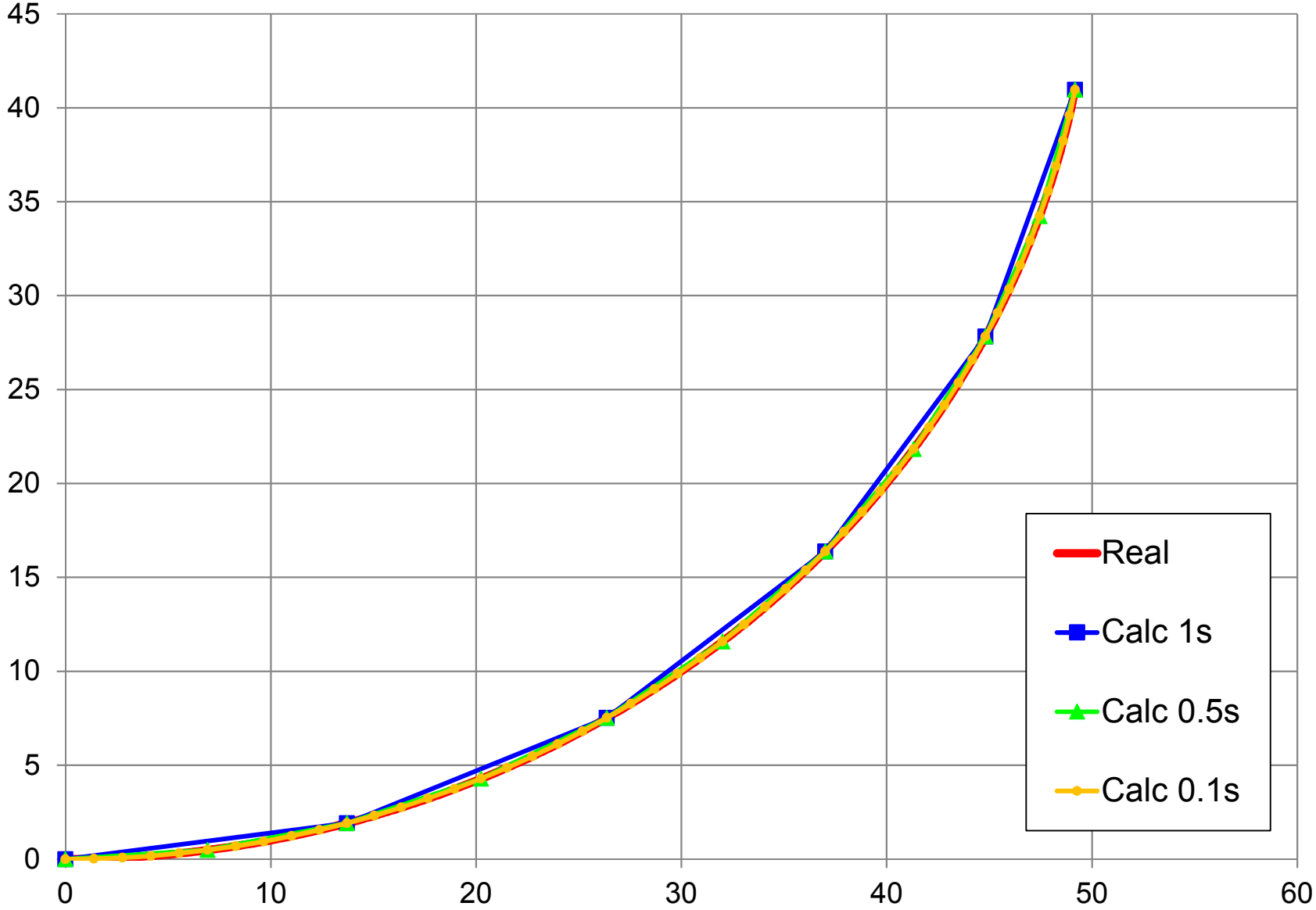
$$R^{n} = \frac{v_{avg}^{n}}{\omega^{n}} \tag{4}$$

$$\begin{pmatrix} x^n \\ y^n \end{pmatrix} = \begin{pmatrix} x^{n-1} \\ y^{n-1} \end{pmatrix} + \begin{pmatrix} cos(\varphi^{n-1}) & -sin(\varphi^{n-1}) \\ sin(\varphi^{n-1}) & cos(\varphi^{n-1}) \end{pmatrix} \cdot \begin{pmatrix} cos(\omega^n \cdot \Delta t + \frac{3\pi}{2}) \\ sin(\omega^n \cdot \Delta t + \frac{3\pi}{2}) + 1 \end{pmatrix} \cdot R^n \tag{5}$$

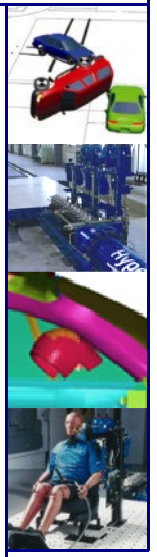


Trajectory reconstruction (50 km/h)





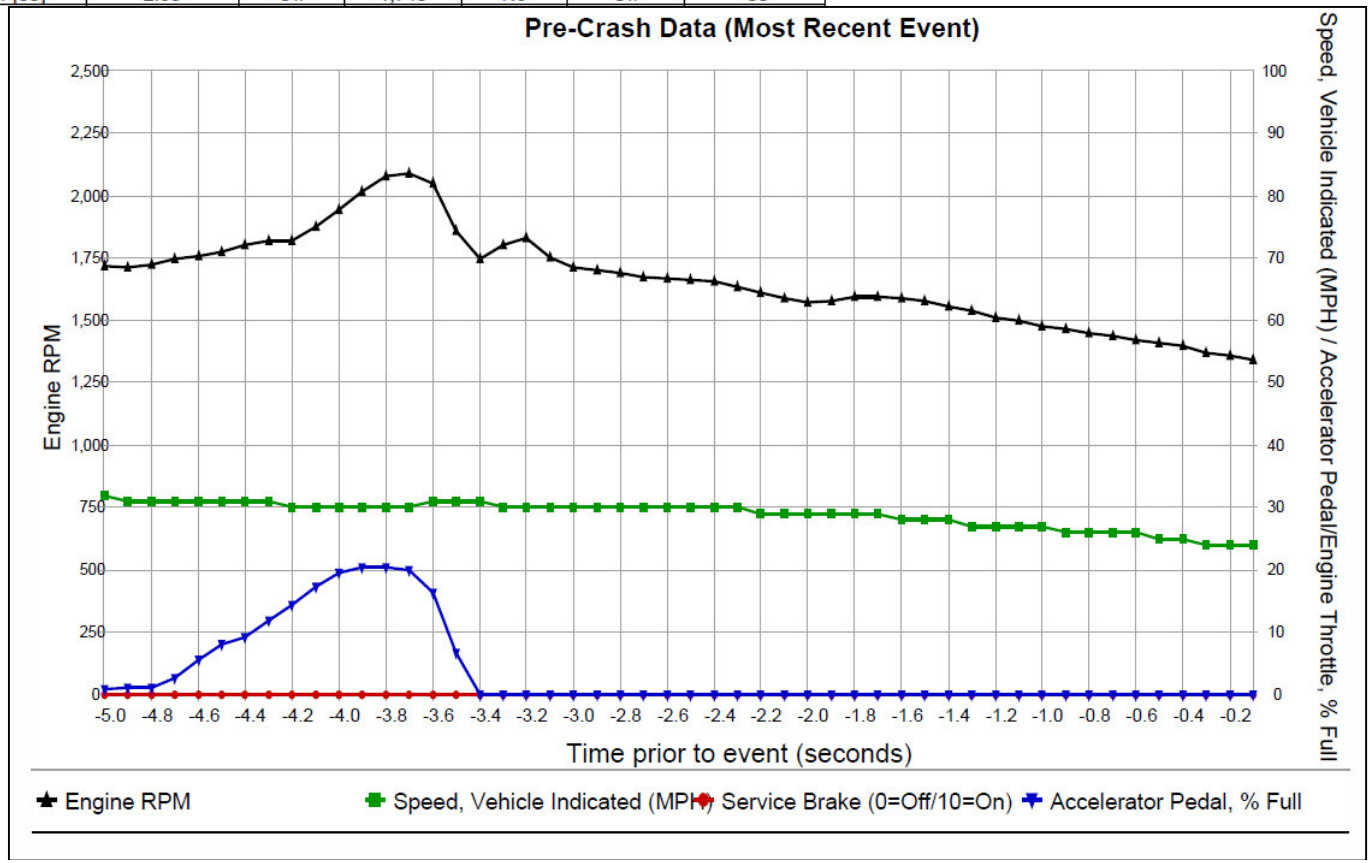
Trajectory reconstruction

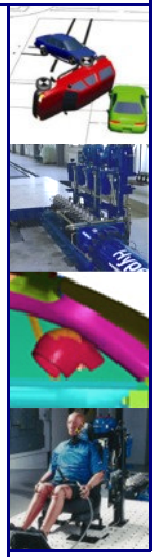


Pre crash data – vehicle speed

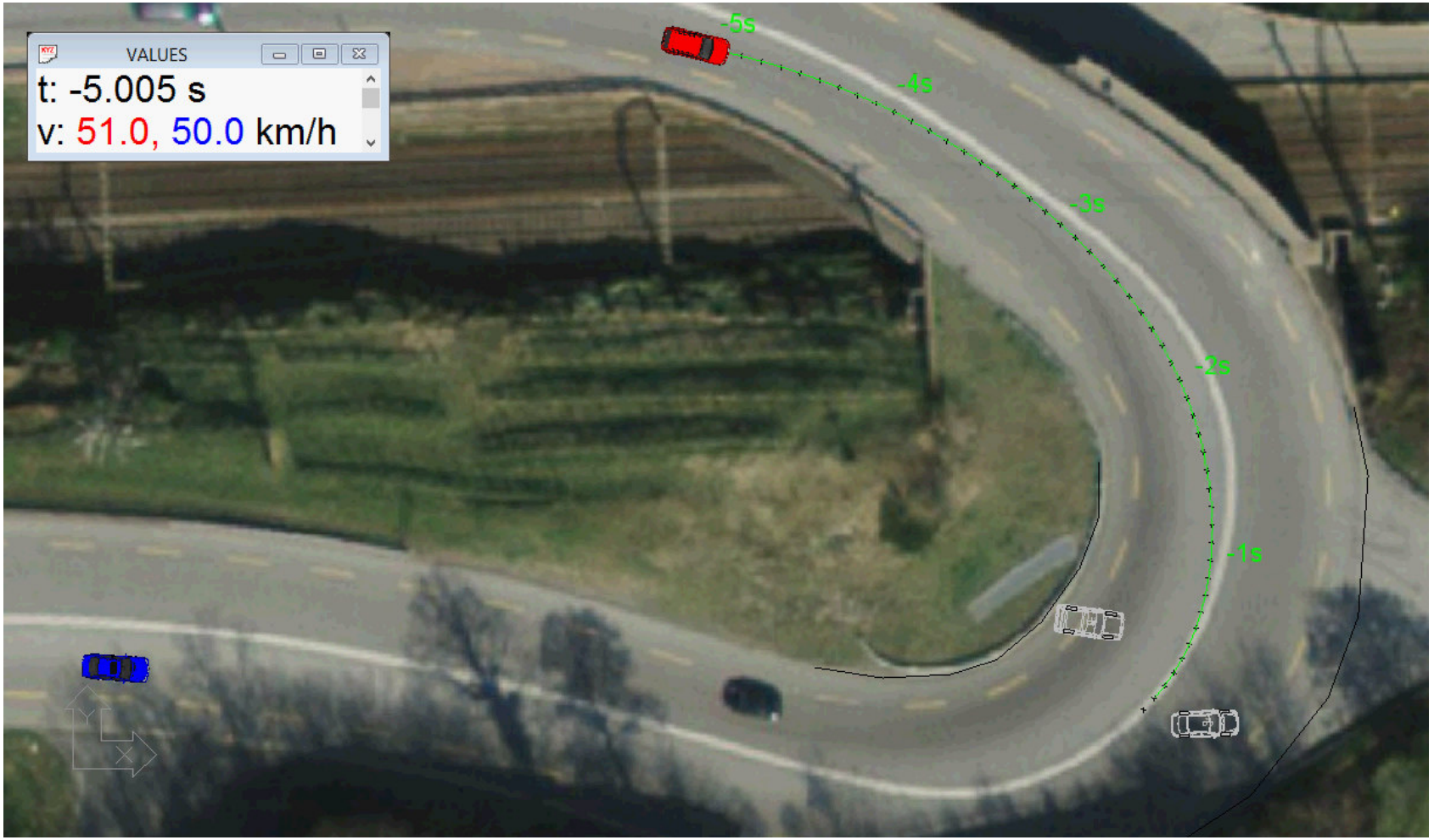
Pre-Crash Data [10 samples/sec] (Most Recent Event - table 1 of 2)
(the most recent sampled values are recorded prior to the event)

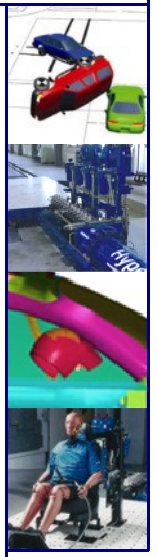
Time Stamp (sec)	Pre-Crash Recorder Status	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % Full	Service Brake	Engine RPM	ABS Activity	Stability Control	Steering Input (deg)
-5.0	Complete	32 [51]	0.80	Off	1,718	No	Off	-50
-4.9	Complete	31 [51]	1.20	Off	1,713	No	Off	-50
-4.8	Complete	31 [50]	1.20	Off	1,725	No	Off	-50
-4.7	Complete	31 [50]	2.80	Off	1,745	No	Off	-50





Pre crash data – PC-Crash





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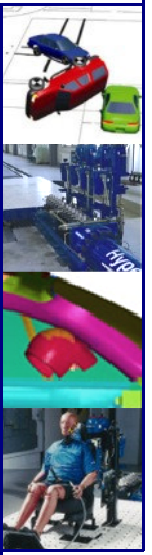
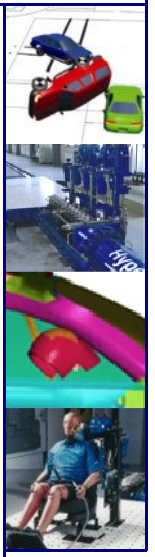


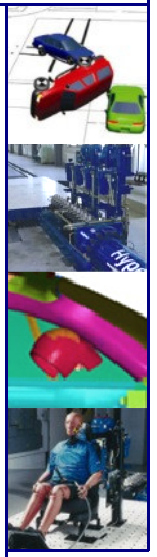
- Impact velocities ✓
  - EDR data for one vehicle
  - 2nd vehicle using PC-Crash
- Pre impact trajectory ✓
  - Which car passed the middle lane ?
    - Impact calculation, scene examination
    - Trajectory data based on EDR wheel speeds
- Avoidance ✓
  - Vehicle speed too high (supported by EDR data and dynamic simulation)



Questions

- Driver actions ✓
  - No braking based on EDR data

- Failure in active systems, brake system ✓
  - ABS MIL was active before collision (EDR data, one wheel speed is 0)
  - ACC, cruise control not active
  - ABS sensor is not the cause of the accident as brake was not activated (EDR data)
  - Stability control off (Stability control MIL ?)



Summary

- EDR data in conjunction with PC-Crash allows to perform a very detailed reconstruction of the accident
- Vehicle specific status information (ABS, stability control, ACC, brake pedal, etc.) can only be obtained using EDR data
- With increasing numbers of active systems EDR data gains even more importance
- The additional use of EDR data with classical accident reconstructions allows to answer more questions and at a higher level of detail
- Limitations of the recorded data has to be taken into account (tire slip, sampling rate etc.)

Vielen Dank für Ihre Aufmerksamkeit.