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Full vehicle models at VW
(Abstract)

In order to reach the objective of replacing real with virtual prototypes VW uses ADAMS in a wide range of applications.
This paper gives you a process overview from generating/modifying suspension kinematics to using current data in full vehicle models including what purposes they are used for.

Gathering the subsystems:

At the beginning of a new suspension layout the designer has to carry out his initial studies within MOGESSA/Pro, an Pro/E based extension which enables you to add a mechanism to a Pro/E assembly. The final design can be carried over to ADAMS/Car via a template interface.

The engine used to be created within ATS a VW-specific ADAMS/Car based environment for design and analysis of drivelines. In the future this functionality will be included in ADAMS/Driveline and ADAMS/Engine.

Other subsystems such as brakes, steering, tires or driver-models were implemented as far as the task required a deeper or different modelling.

For NVH problems flex bodies were added to some templates (chassis, suspension subframe, twistbeam axle).

Analysis:

With ADAMS/Car the driveline-, suspension-, tire-, steering- and chassis-subsystems were assembled to full vehicle models which fit the required task. The main tasks are to determine vehicle handling, engine displacements, wheel envelopes and comfort analyses.
Upon request there were also carried out very special studies for example on rollover manoeuvres (crash-test) or obstacle designs.

Results:

Depending on the task the results could be ADAMS plots and animations, wheel envelopes or transformations (which are used in the CAD system to check for collision).
Where there is regular demand we supply customised tools to enable the client to perform the necessary postprocessing on his own (for example FREIA for engine displacement manoeuvres)

M.Kieltsch, M.Westphal, B.Wojke, M.Hache, Volkswagen, EZTB 2000-Feb-22

International ADAMS Users Conference 2000

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Martin Kieltsch / Berechnungsmethoden

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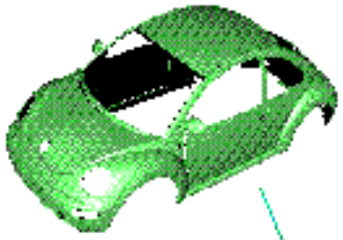
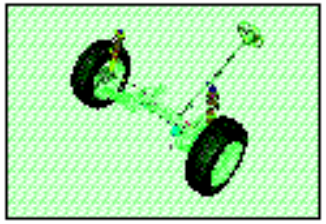
Overview

Chassis (Rigid or flex body)



Driveline ADAMS/ATS

Suspension Design Mogessa/Pro



Tire (Delft, Durability, Boehm)
Road (2D, 3D)
Driver (ADAMS, VW)
Brakes (Std., ABS)

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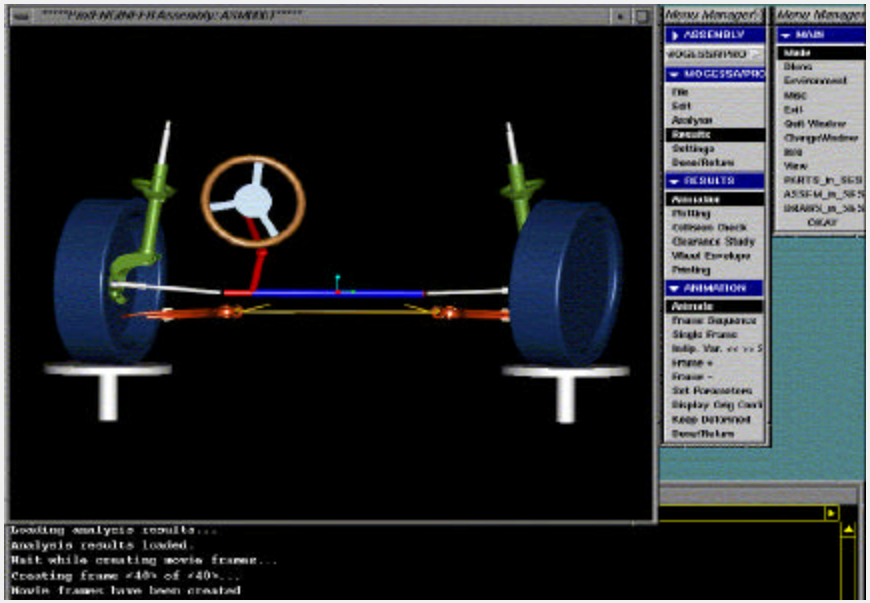
Suspension design with Mogessa/Pro

- **Create Control Part**
- **Create Pro/E Assemblies using real or dummy Pro/E Parts**
- **Define mechanism**
- **Create Subsystem and perform suspension analysis within Pro/E**
- **Export Car-Template/Subsystem**
- **Rework Templates slightly (add communicators and mount parts)**



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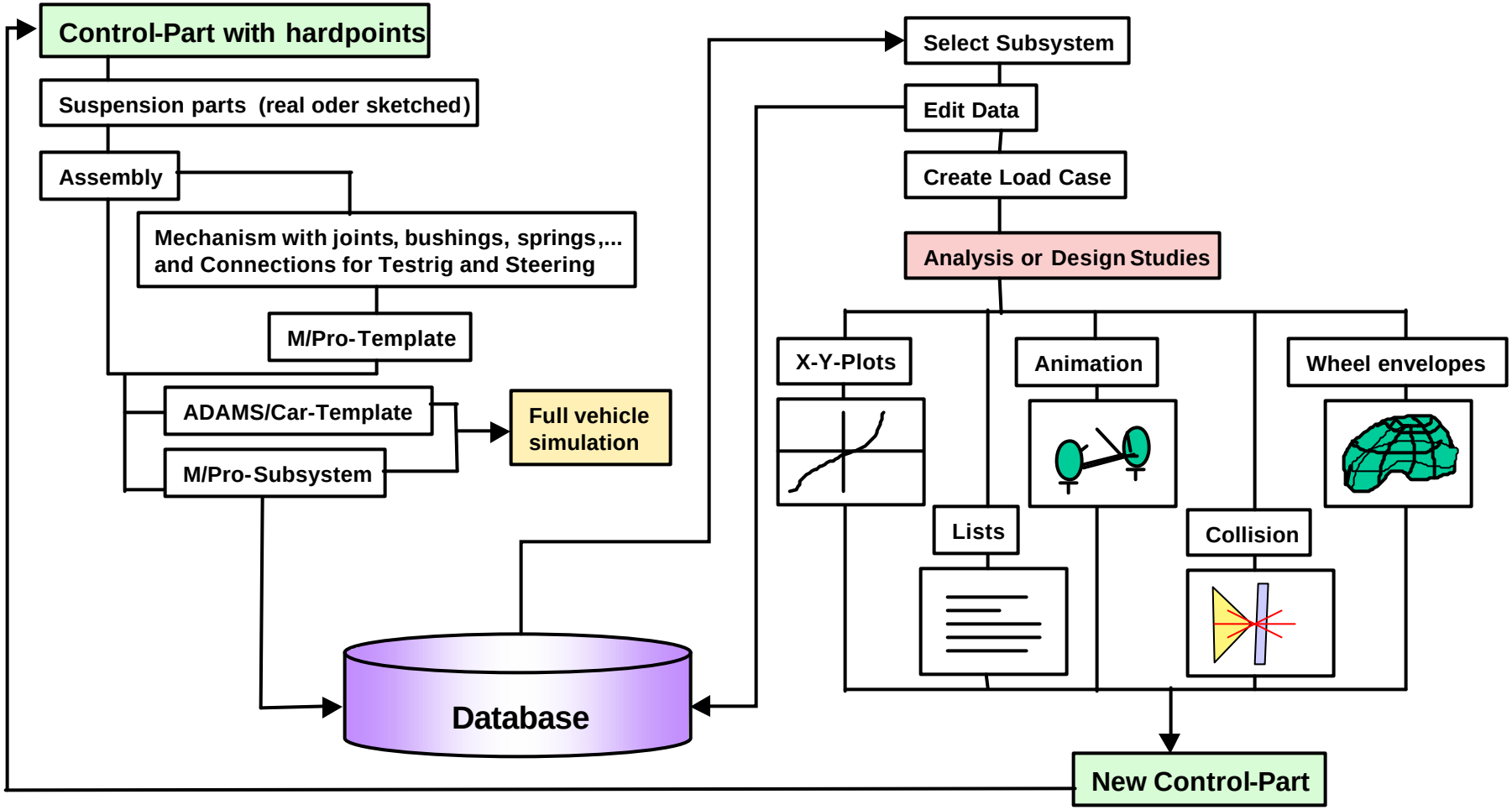
Suspension design with Mogessa/Pro



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Driveline design with ADAMS/ATS

- **MDI Marburg consulting project for VW**
- **Based on ADAMS Car 4.x (ADAMS View 8.2)**
- **“Create” - macros for engine, gearbox, clutch, engine mounts, driveline, ...**
- **Perform analysis on “Engine-Testrig” in ATS**
- **Save to database: Car Template / Subsystem**
- **Convert the Template to Car 9.2**
- **Rework Templates slightly (add communicators and mount parts)**

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Other necessary Subsystems

- **Modified steering Subsystem**
  Uses hooke joints instead of convel joints
  Rigid connection to suspension subframe
- **Modified chassis Subsystem**
  Additional communicators
- **Tires**
  Delft tire model (Property files from measurements on VW testground in Ehra-Lessien)
  Pacejka tire model
  Durability option for handling tire models
  User tire models (tirsub)
  Boehm tire model (gfosub)

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Other necessary Subsystems

- **Standard Brake Subsystem**
  Uses variables to calculate brake torque for standard brake system according to existing brake calculation Software
  Uses information supplied from other Subsystems such as Marker positions to determine regulator switch pressure

- **ABS Brake Subsystem**
  Includes usersub to simulate a simple ABS

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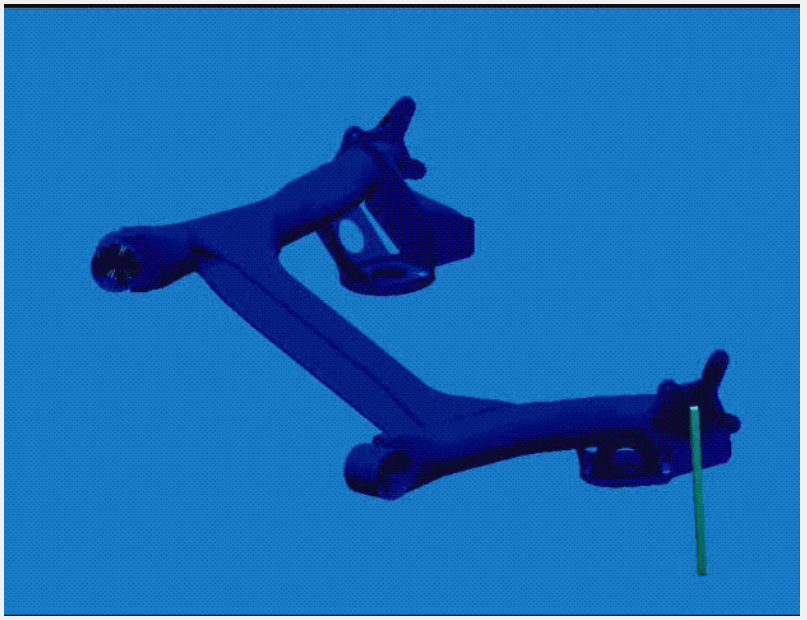
Optional Subsystems

- **Subsystems containing flex bodies**
  It's getting more and more common to use flex body elements for twist beam rear axles, front/rear subframes or even whole chassis.



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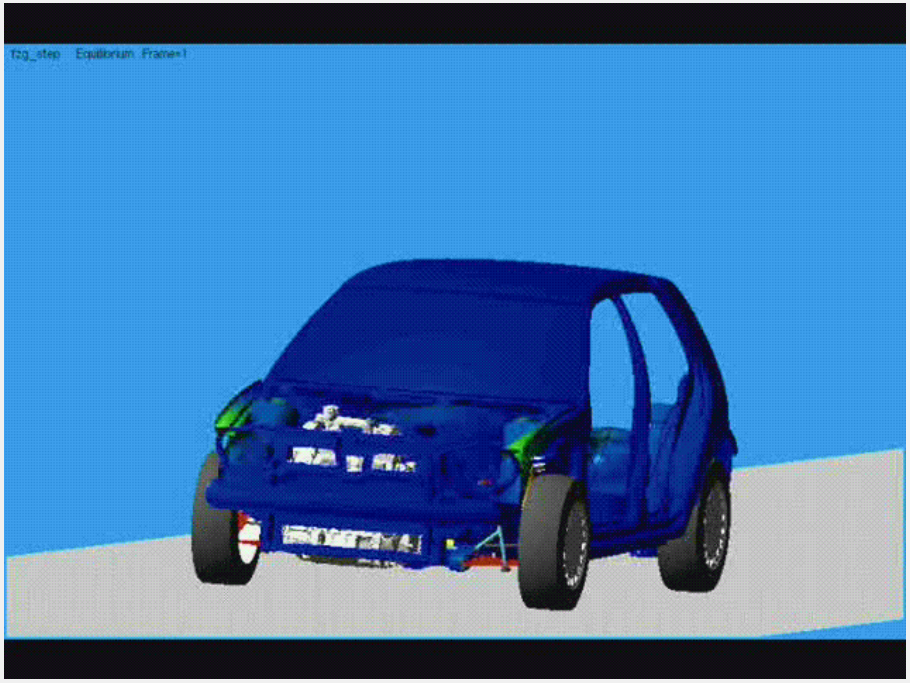
Examples: “Wellige Teerstraße”

- **Objectives**: **Comfort analysis, Load determination for FEM**
- **Flex bodies: chassis, rear axle and front subframe**
- **Lot’s of communicators necessary to connect flex bodies**
- **Durability-Tire used**



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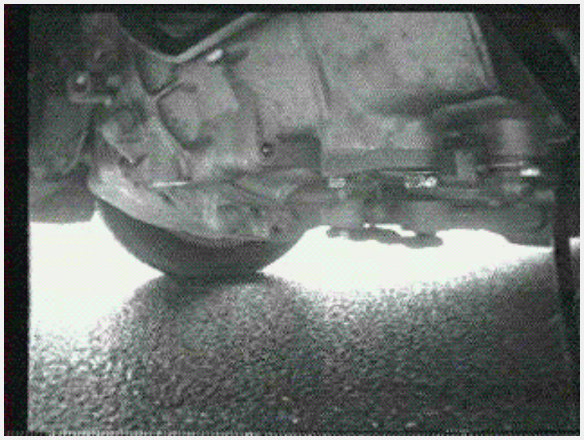
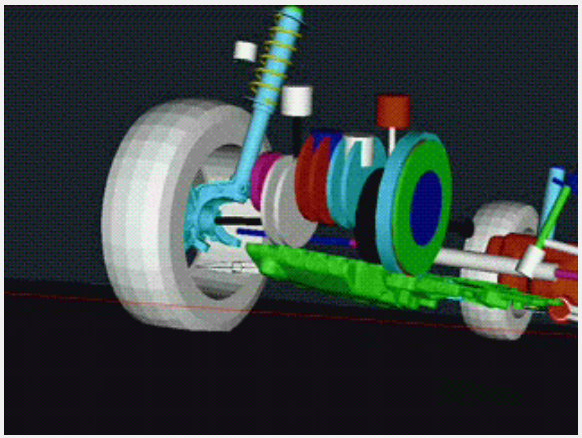
Examples: Ground clearance

- **Objective: Check ground clearance on uneven surface on VW testground for different vehicle speeds and tracks**
- **Full vehicle model including engine/driveline**
- **Model modified to use simple path controller to maintain staying in defined track**
- **Collision check with ADAMS/Animation, CAD (Pro/E, Tecoplan) or subroutine**





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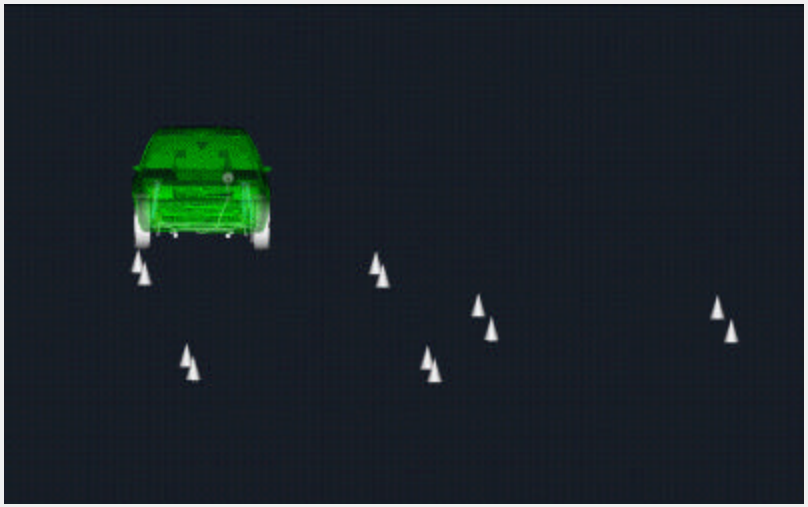
Examples: “Elchtest”

- **Objective: Check critical handling manoeuvre for concept vehicle with higher centre of mass**
- **No controller used: Changed steering-demand to step function and manually optimised steering angles to follow the given track layout**



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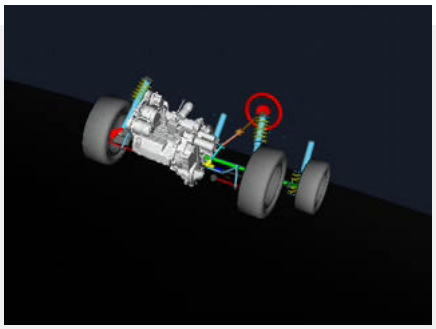
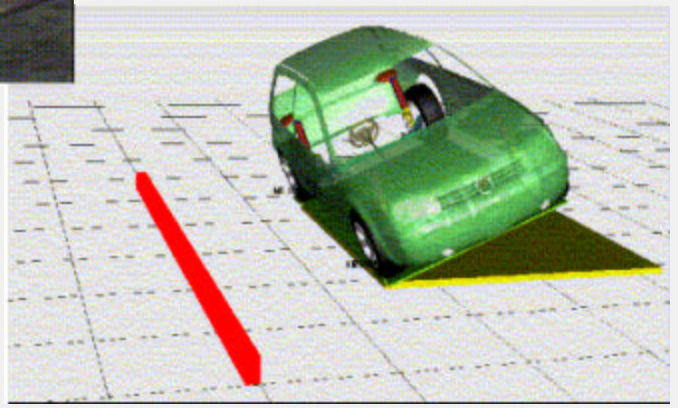
Examples: Rollover





- **Objectives: Determine the first contact (location, forces) of chassis to road for crash simulation; Determine influences such as slider speed or tire to road friction ; Steering controller development for ramp maneuvre**
- **Full vehicle model from ADAMS Car with manually modelled slider-testrig**
- **Using durability tire option**
- **Using sphere to plane contact for chassis/road interaction**

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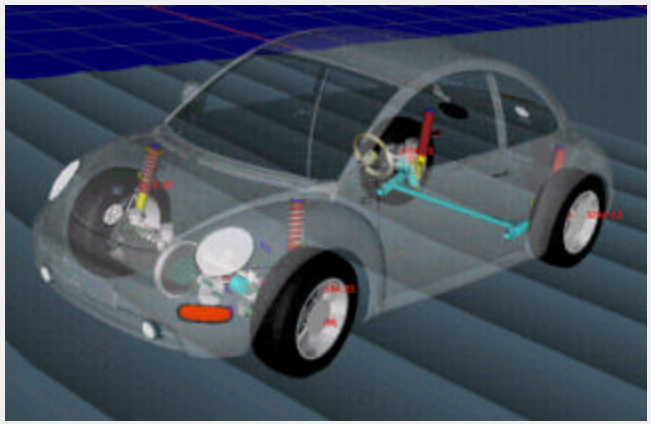
Examples: Manoeuvres for critical engine displacements

- **Objective: Check given list of different manoeuvres for most critical engine displacement**



- **Full vehicle model including engine/driveline**
- **Using durability tire option with measured uneven roads**
- **Using handling tire option on flat tracks**
- **Export VDA transformation matrix for engine part to FREIA to check displacements of specific hardpoints or comparison with measurements**

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Examples: Measurement of engine displacements

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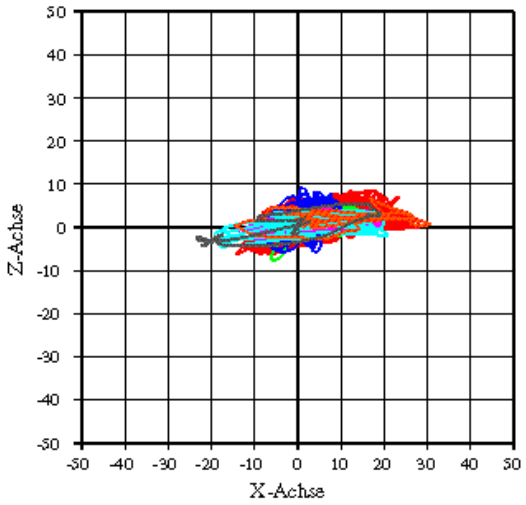
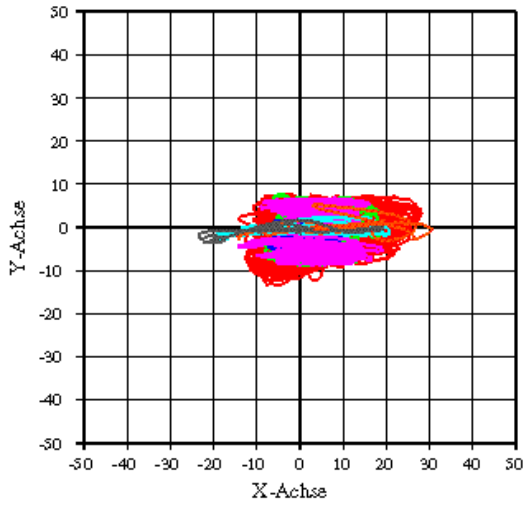
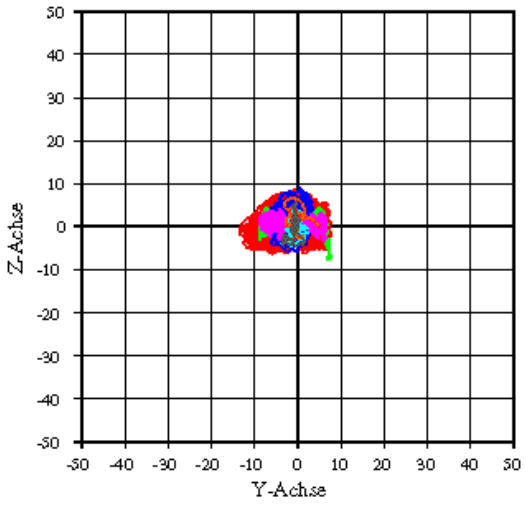
Examples: Postprocessing with FREIA







Relativbewegung eines Punktes im Fahrzeugnetz

Fahrzeug:	VW[illegible]
Motor:	Otto[illegible]
Getriebe:	[illegible] Syncro
Punktlage in KL:	-300.00 / 0.00 / 500.00
	Messpunkt 1

Fahrmanöver:

MESS_VW[illegible]_Otto[illegible]_Syncro_WASCHBRETT_3

MESS_VW[illegible]_Otto[illegible]_Syncro_WEDELN_1

MESS_VW[illegible]_Otto[illegible]_Syncro_FLADEN_1

MESS_VW[illegible]_Otto[illegible]_Syncro_KREIS_1

MESS_VW[illegible]_Otto[illegible]_Syncro_RUCKELN_1

MESS_VW[illegible]_Otto[illegible]_Syncro_KUPPLUNG_VORW_1

MESS_VW[illegible]_Otto[illegible]_Syncro_KUPPLUNG_RUECK_1

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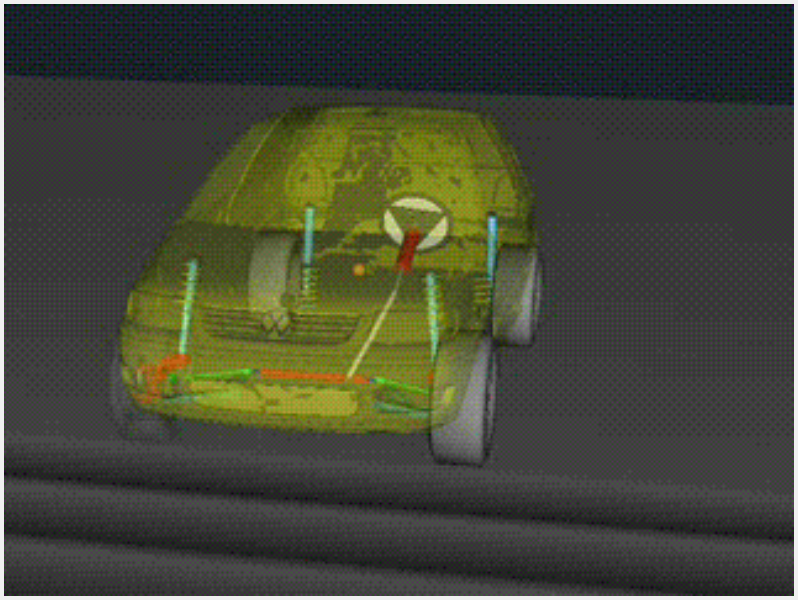
Examples: Wheel envelope manoeuvres

- **Objective: Determine critical manoeuvres for maximum size of wheel space requirement**
- **Simple full vehicle model**
- **Depending on track using handling or durability tire option**



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Examples: Resulting wheel envelope