



Uses of SIMPACK on the all new Land Rover Discovery

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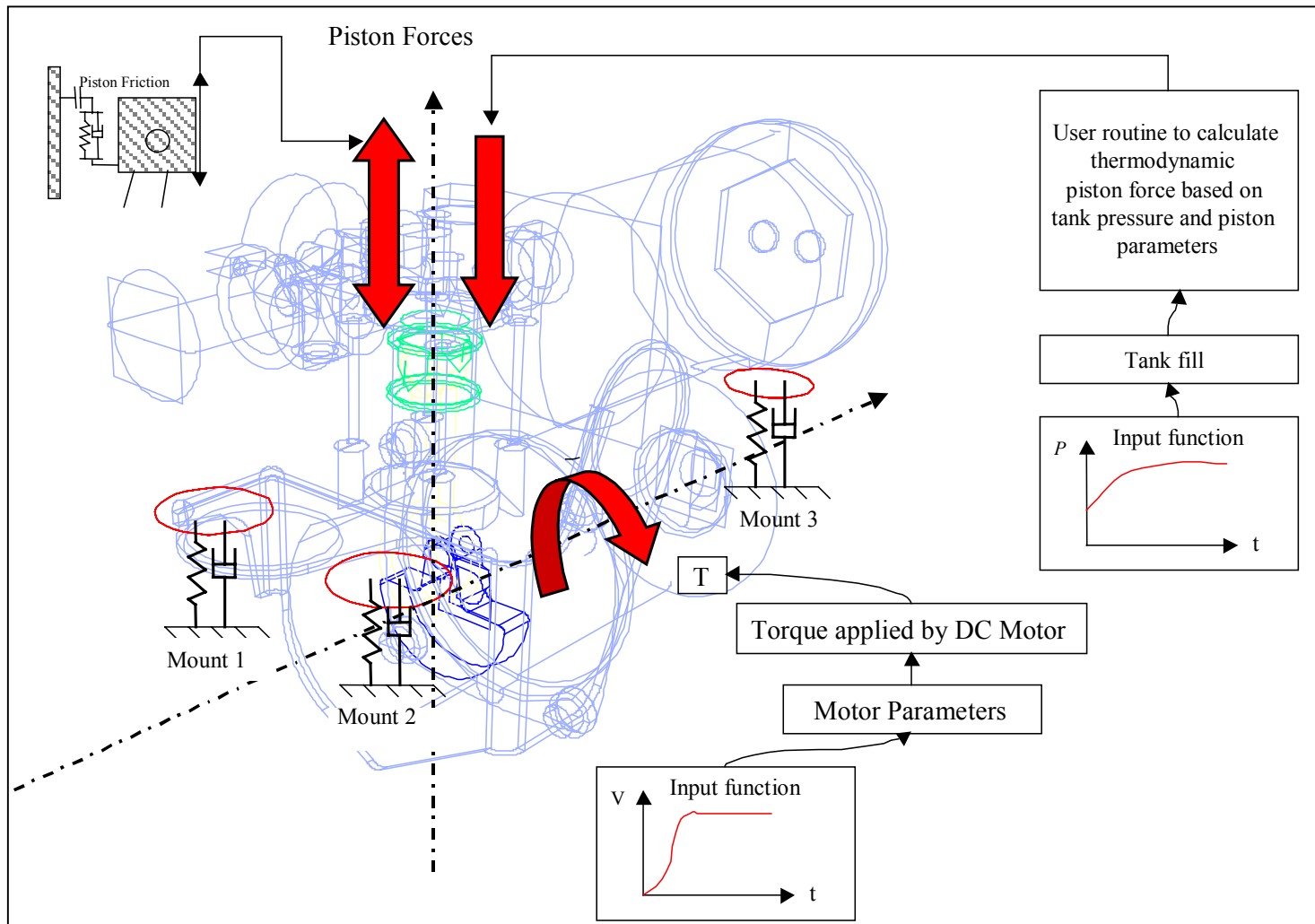


Air Suspension compressor refinement



- The Discovery uses 4 corner air suspension which requires a single acting piston pump to fill the air tank for system use.
- Often, air compressors are difficult to refine so that cabin noise and vibration are acceptable whilst the air tank is being charged with air.
- SIMPACK was used solely in defining the mounting strategy and rates so that the target force transmission was met under the operating conditions of the compressor.

Model description



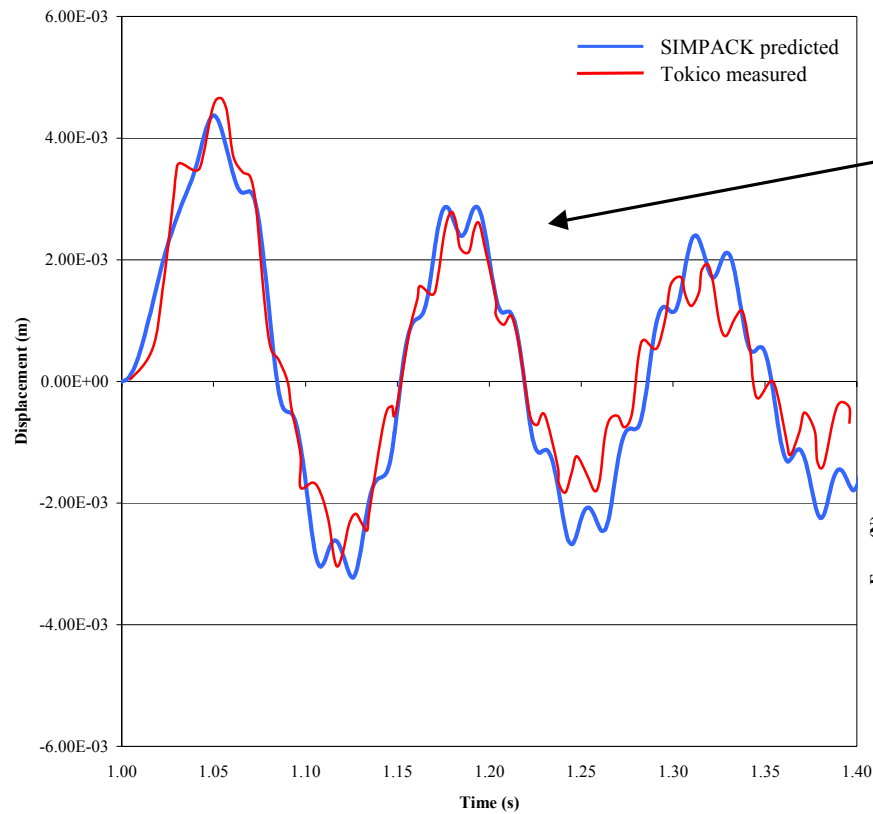


Correlation against TOKICO bench test

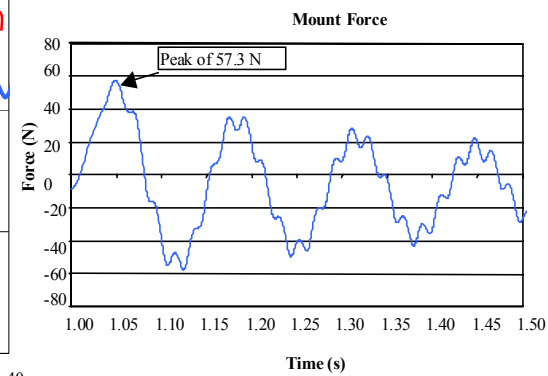
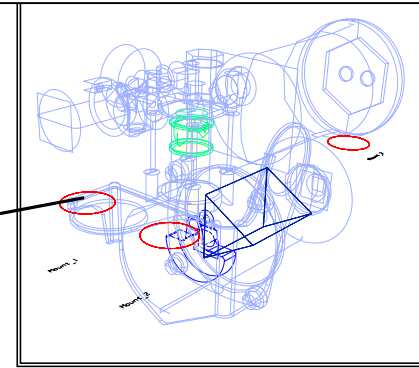


Start up: MT1

Tokico Air compressor



Mounts 2 and 3 show similar levels of correlation



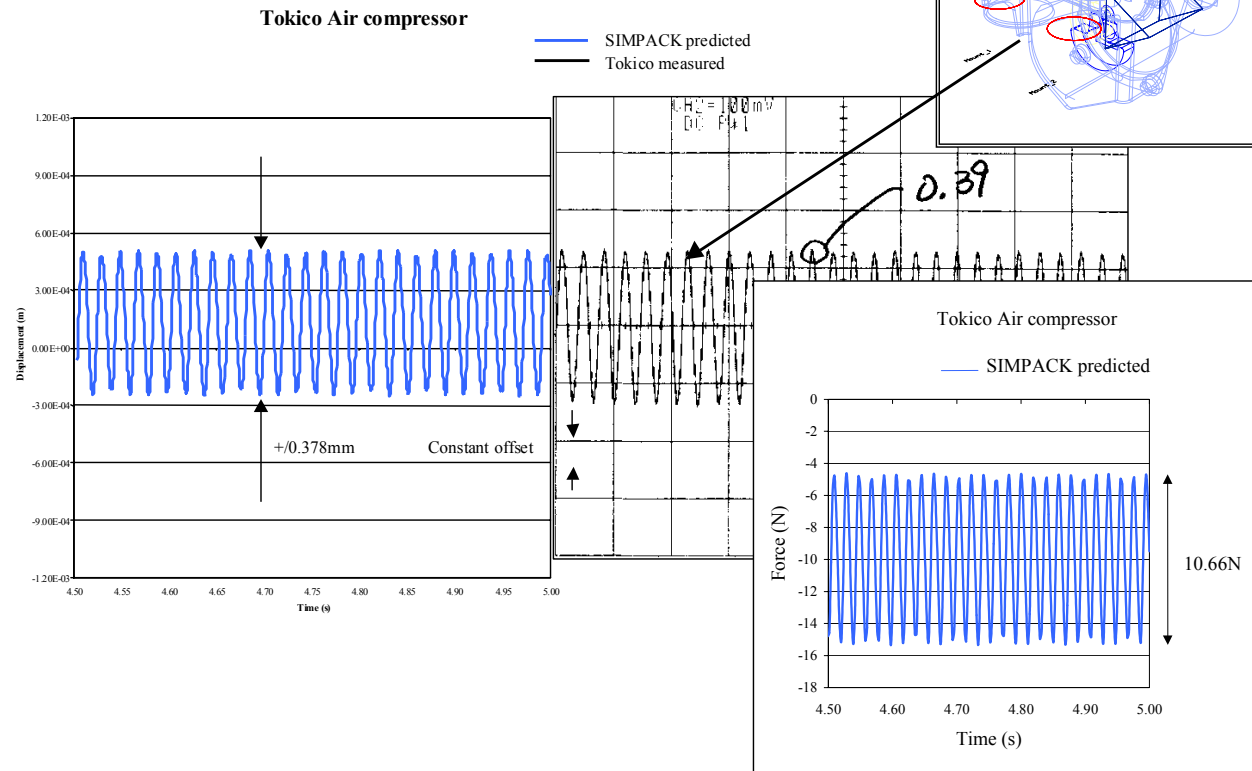


Correlation against TOKICO bench test



Steady state: MT1

Mounts 2 and 3 show similar levels of correlation

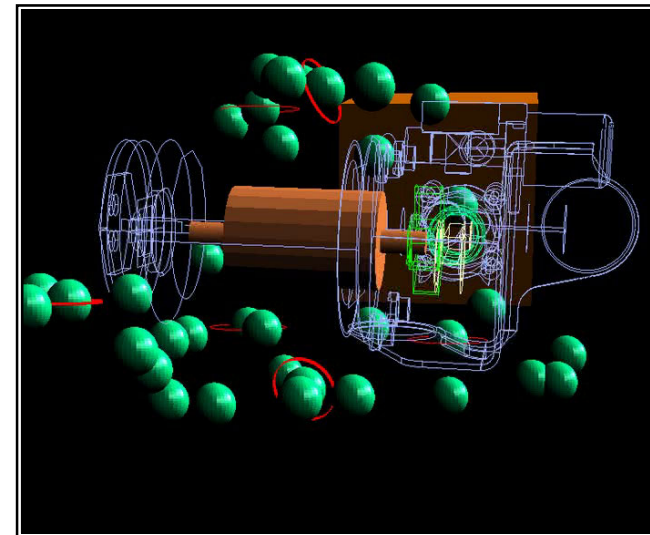
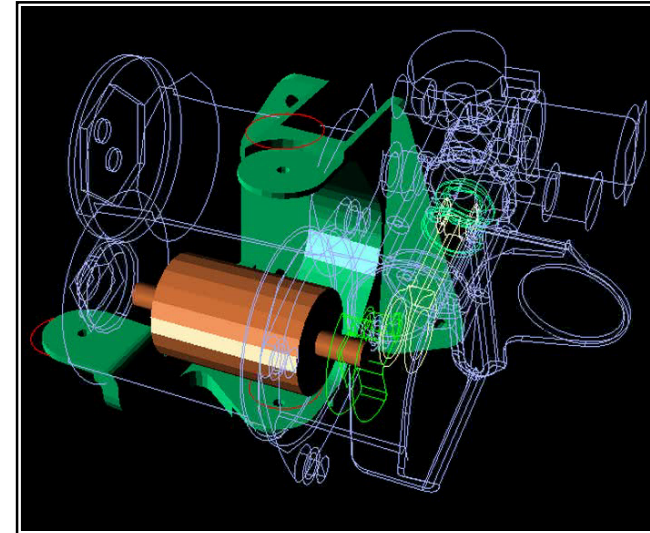




Final solution



- Revolutionary mounting positions derived using SIMPACK.
- No development work necessary in meeting the required cabin vibration and noise targets.
- SIMPACK model used further to aid in the off road load durability of the 'running' compressor





Case Study: L319 Ride simulation support



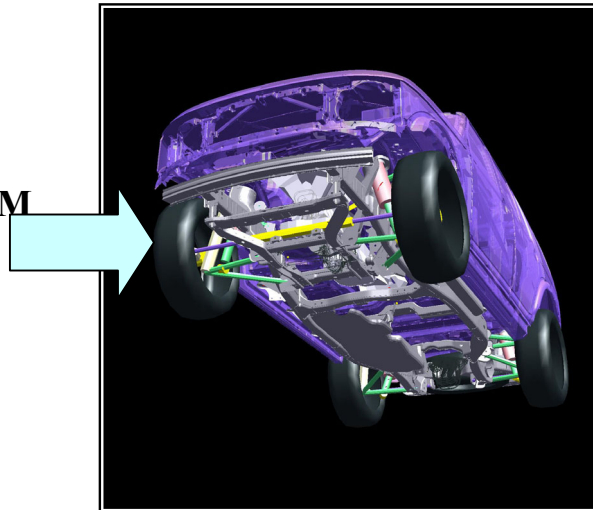
Objective

- To support the design and development activities in the simulation of ride and impact harshness whilst maintaining some level of focus on other attributes such as dynamic vehicle load generation and packaging support.

Method

- Using SIMPACK as the core tool for the project, a full vehicle model was created with the following;

- Flexible body and chassis frame from Nastran trimmed models
- Hydraulic PTU mounts + FLARM
- Non-linear bushes
- Swift durability tyre model
- Friction / Hysteresis



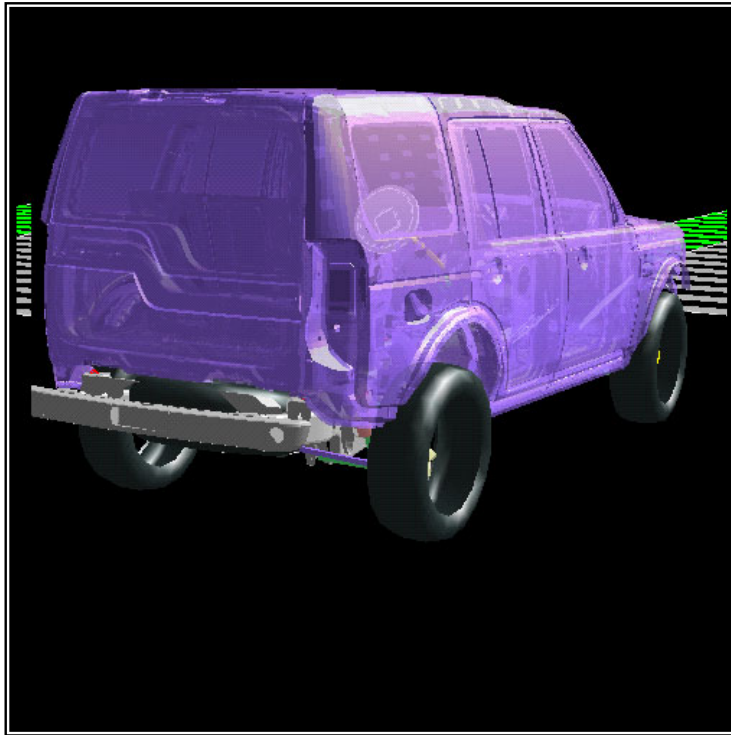
- Impact strip
- Sine wave ramps
- Ratley Road
- Naseby Road
- B4100 Road
- Constant Velocity Sine Sweep
- Eigen Value extraction
- Extreme non-linear manoeuvres
- XTD Load generation
- Dynamic package events



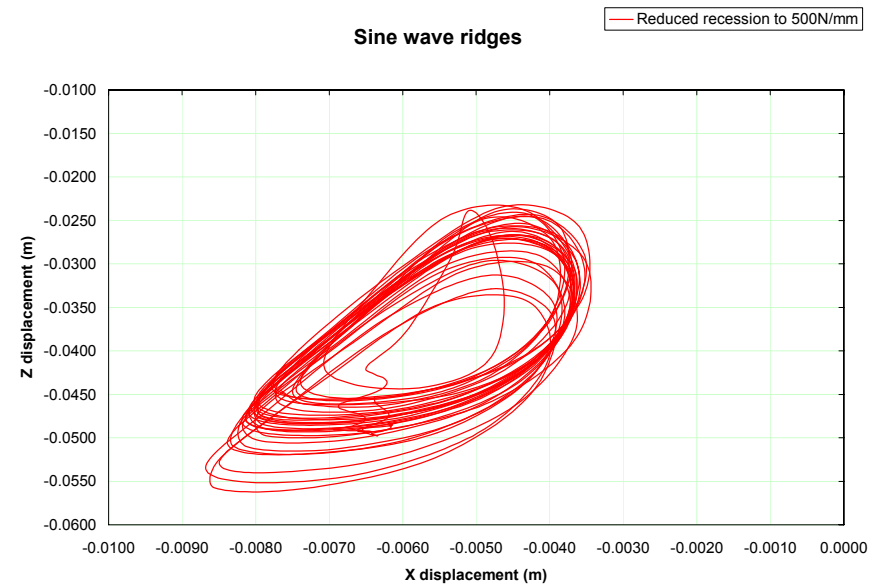
Case Study: L319 Ride simulation support



Sine wave ramps

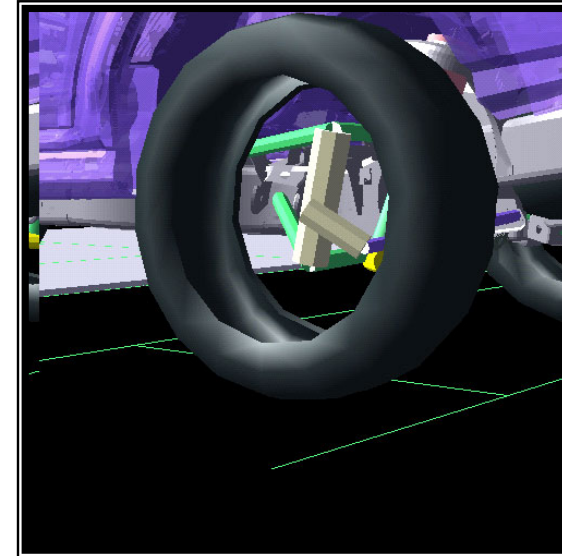
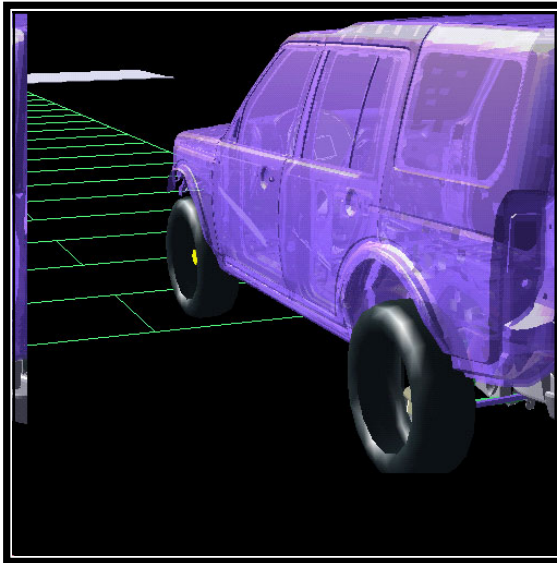


Rear wheel trajectory

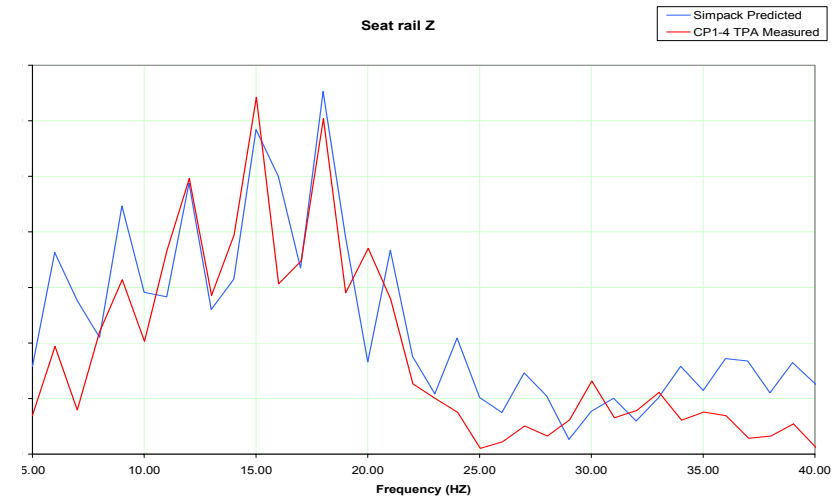
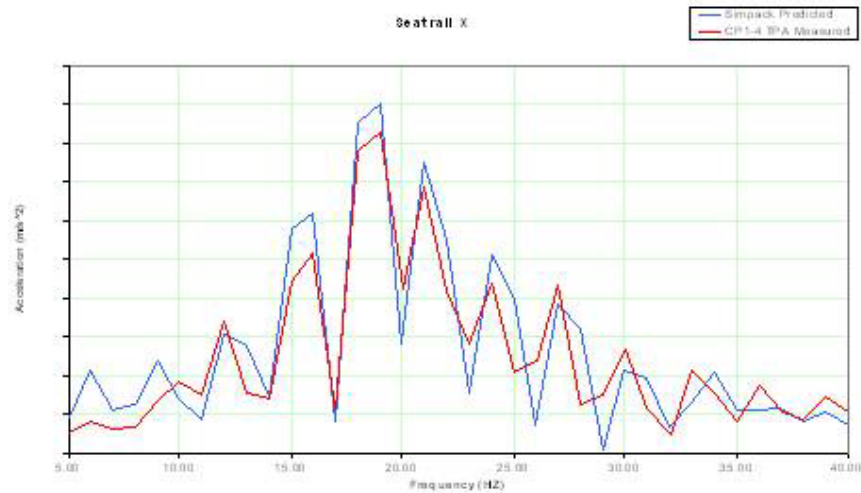




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Correlation

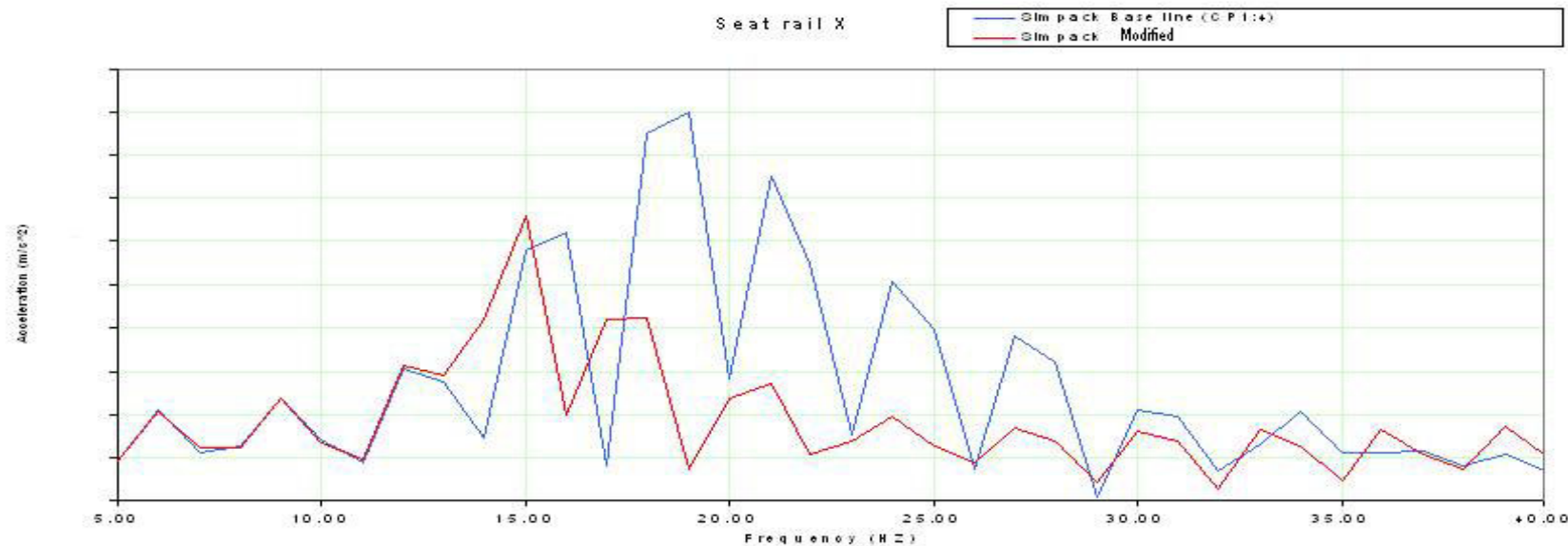




Case Study: L319 Ride simulation support

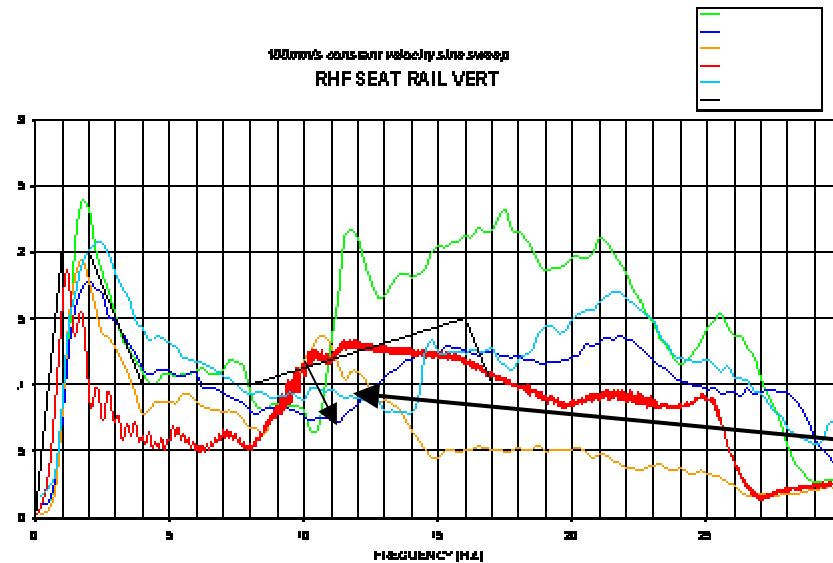


- Numerous DoE's, and trials within SIMPACK developed a revised specification for the suspension and body mounts to improve the impact response of the vehicle
- The new specification was derived within a few days of detailed analysis from SIMPACK for the ride comfort.
- The use of SIMPACK at this time was quite remarkable at the accuracy of both the correlation and end result for impact harshness.



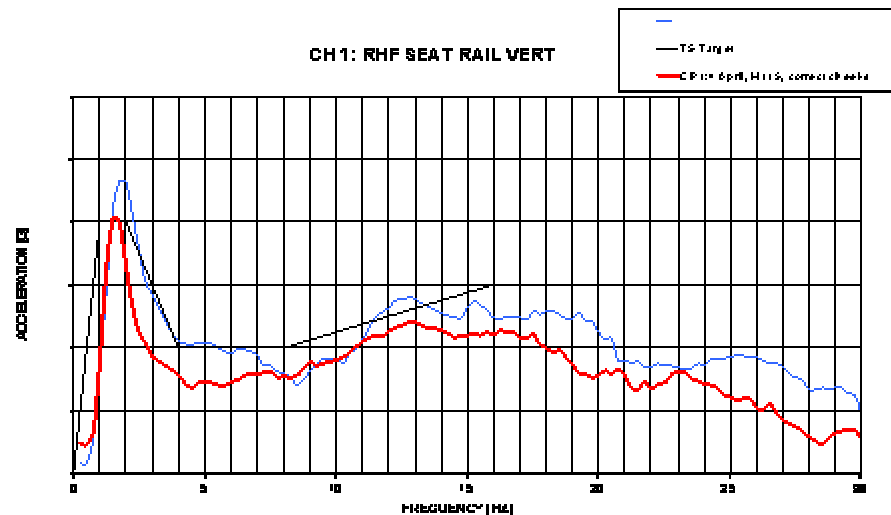


Case Study: L319 Ride simulation support



Early SIMPACK prediction at the beginning of the project

The shake performance has been improved by the tuning of the body mounts and power unit mounts during the development programme.



Final developed ride better the original target by some margin.

100mm/s constant velocity sine sweep



Case Study: L319 Ride simulation support

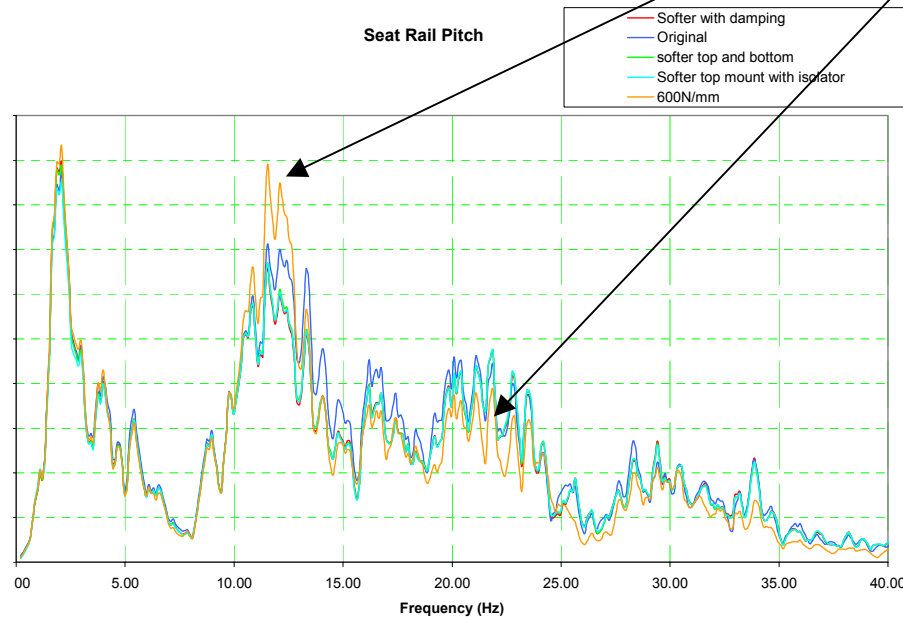


Damper Top mount selection

SIMPACK was used exclusively to determine the specification of the top mount using a DoE approach.

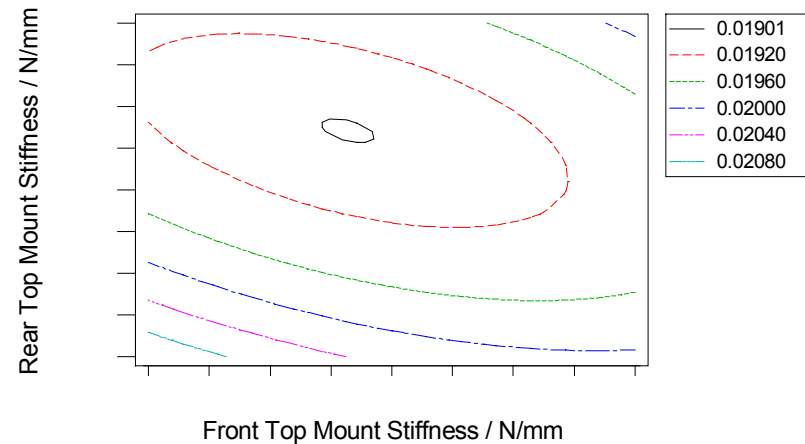
- Response surface design with three top mount factors
 - Base stiffness
 - Snubbing gap
 - Snubbing index
- Damping characteristics held constant at 6 degrees loss angle .

Balance of wheel hop vs. general comfort seen here, wheel hop penetration far greater on 600N/mm but with lower general acceleration.



Front to rear balance

Contour Plot of Peak Pitch Acc between 10 Hz and 20Hz





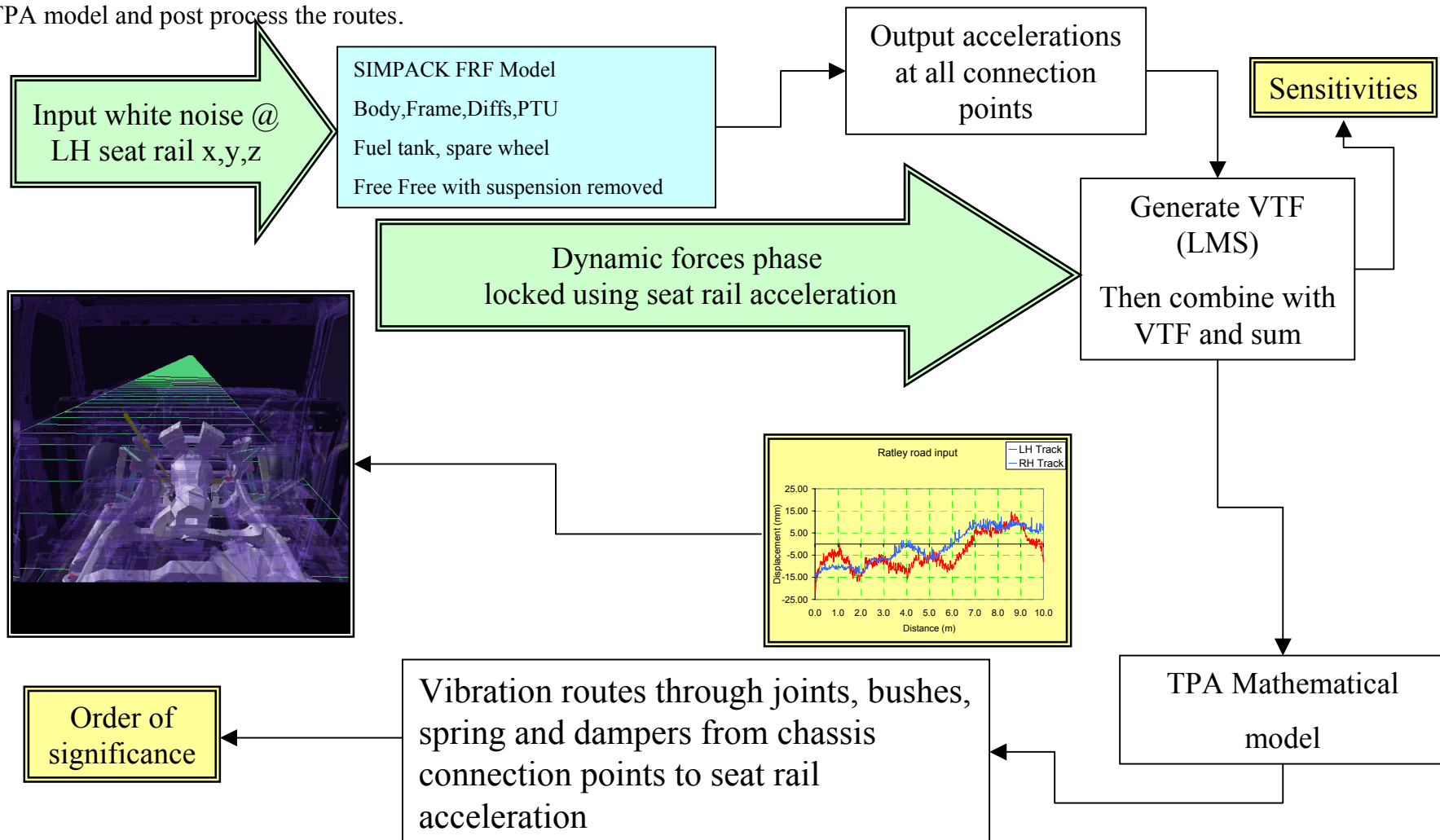
Ride Transfer Path Analysis

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SIMPACK was used in conjunction with LMS and Vehicle Refinement to determine the TPA for ride.

- The SIMPACK model used was to provide all of the data for a full TPA for ride, LMS was used to generate the internal TPA model and post process the routes.



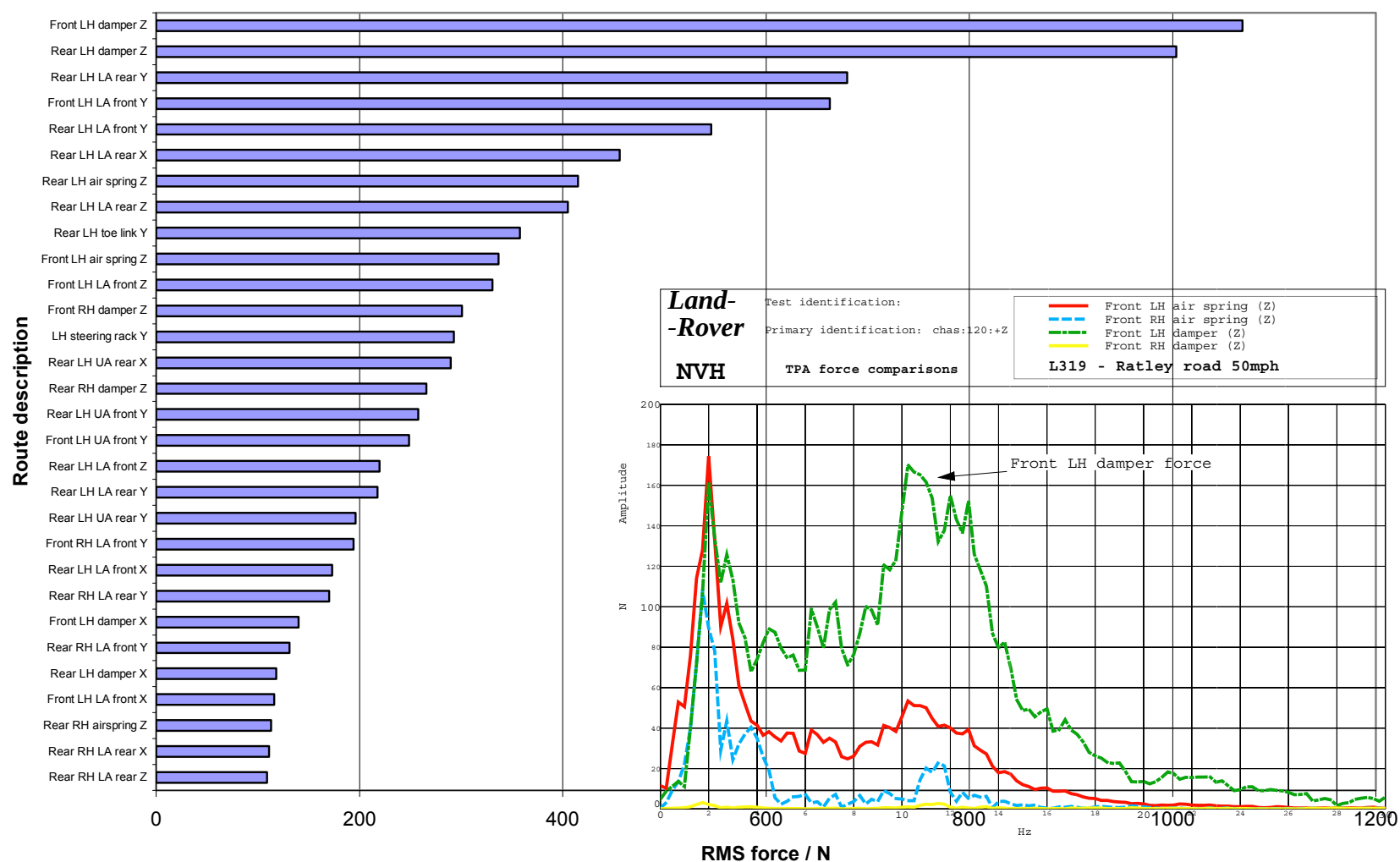


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TPA Conclusions

RMS forces (4-30Hz) Ratley road at 50mph



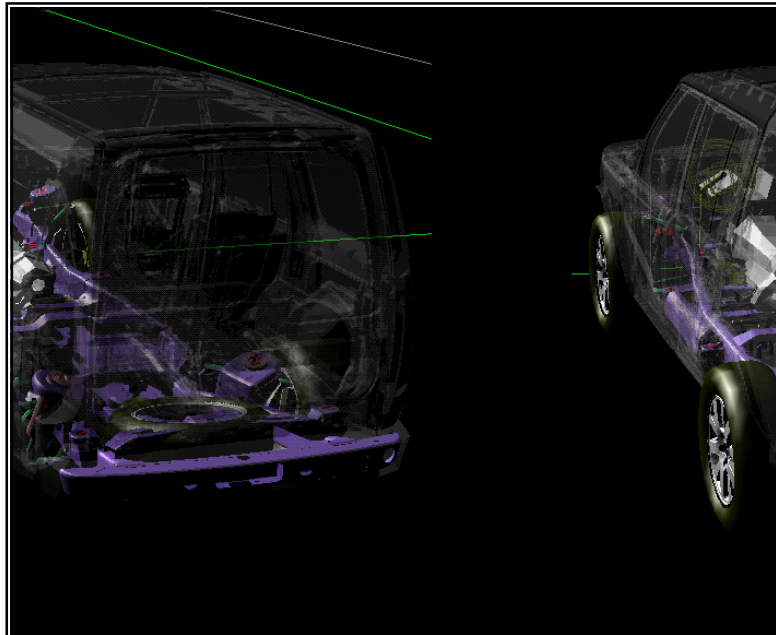


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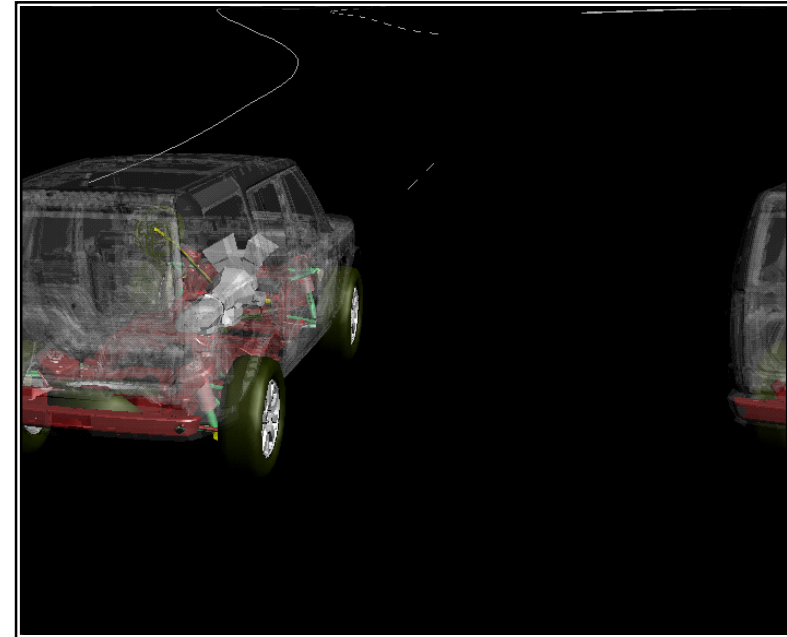
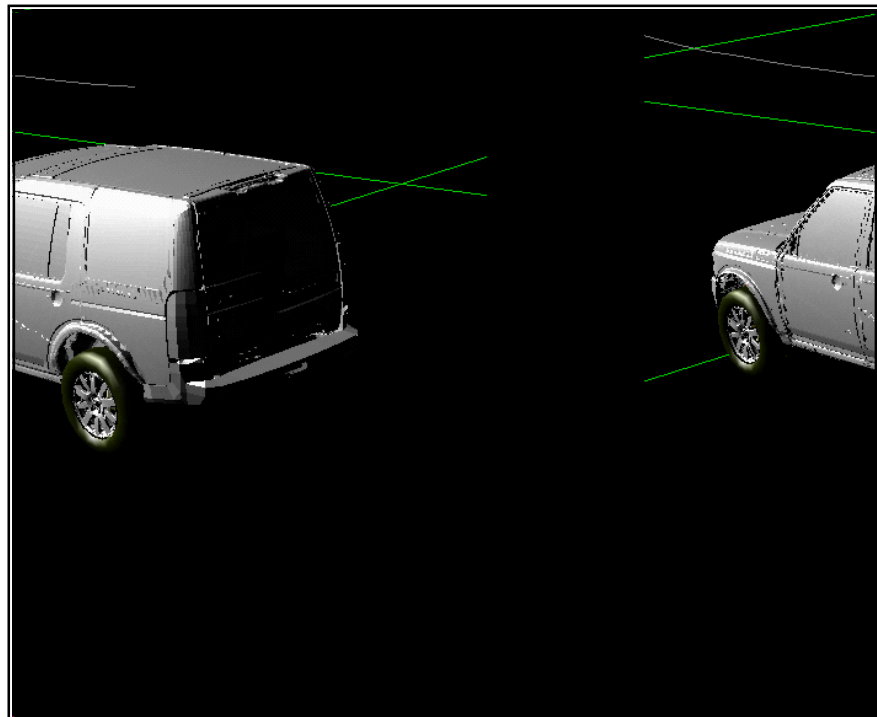
Durability load generation

- XTD Four poster data,
- 6 inch kerb strike
- Road 'R' bridge jump
- Driveline loads for 'idiot' starts
- Ditch drop,
- Idiot starts, max ptu torque.





Animations





Press Comments on 'The all new Discovery 3'



Since the launch of the new Discovery 3, there has been some very positive press comments complimentary to the ride performance of the vehicle;

“Hugely comfortable”; Jeremy Clarkson Sunday Times,

“superb refinement, comfort, driveability and MPV-style seven-seat practicality.”; What MPV & 4x4,

“The Discovery rides (cats eyes), minor scars and coarse surfaces better than just about anything else.” AutoCar