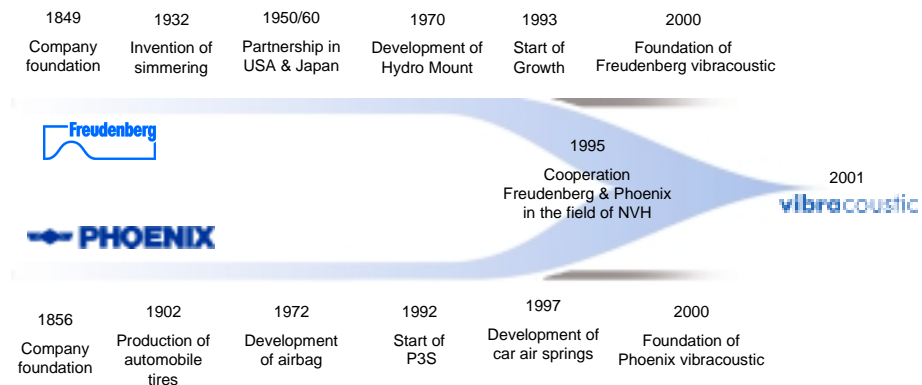


# Study about the Shimmy-Effect on a Mc Pherson front axle

ADAMS User Conference  
Rome , 15.-17. November 2000

Dipl.-Ing. Thorsten Roppelt  
Dipl.-Ing. Jürgen Beuth

## From Tradition to the Future



■ Two companies with tradition create a new era

## Globality World Wide Network



**vibracoustic** North America  
154 Mio \$ Turnover 1999  
ca. 770 Employees  
3 Manufacturing facilities  
1 Development centre



**vibracoustic** Europe  
330 Mio € Turnover 1999  
ca. 2000 Employees  
12 Manufacturing facilities  
2 Development centres



**vibracoustic** Japan  
12.390 Mio Yen Turnover 1999  
ca. 430 Employees  
2 Manufacturing facilities  
1 Development centre



**vibracoustic** do Brazil  
206 Mio. BRL Turnover 1999  
107 Employees  
1 Manufacturing facility



**vibracoustic** India  
(Sigma Phoenix)  
4,2 Mio € Turnover 1999  
ca. 150 Employees  
1 Manufacturing facility



**vibracoustic** Korea  
(Pyung Hwa)  
48.000 Mio Won Turnover 1999  
ca. 500 Employees  
1 Manufacturing facility  
1 Development centre



**vibracoustic** China  
(Co-operation)  
2,3 Mio € Turnover 1999  
ca. 120 Employees  
1 Manufacturing facility



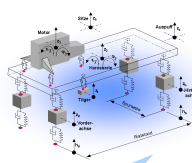
## System Integration



Simulation



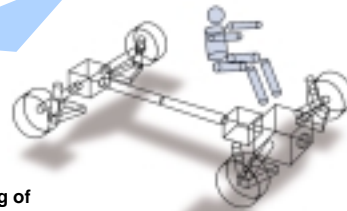
Calculation



Anechoic chamber with chassis dynamometer

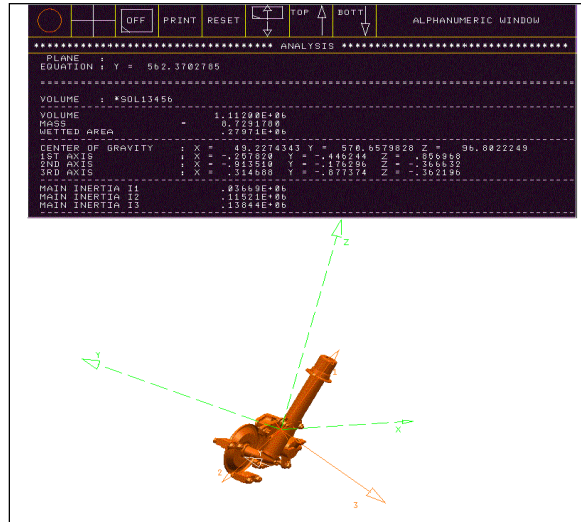


4 axis actuator road load input

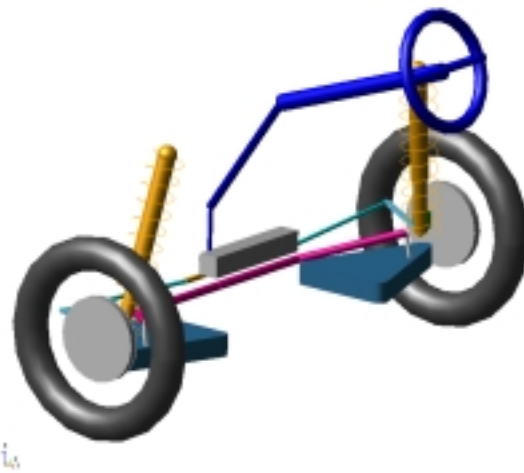


- System partner for calculation, simulation and testing of components, modules, systems & complete vehicles

### CATIA-DATA

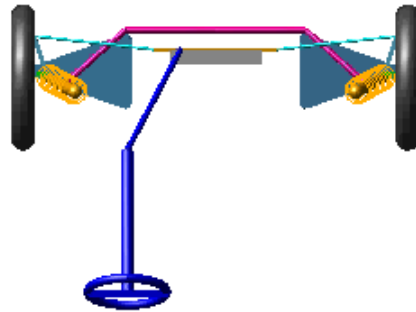


### Front axle model in ADAMS

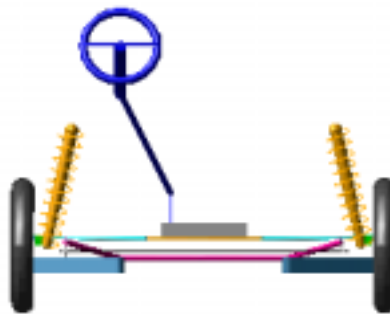




## *Steering*

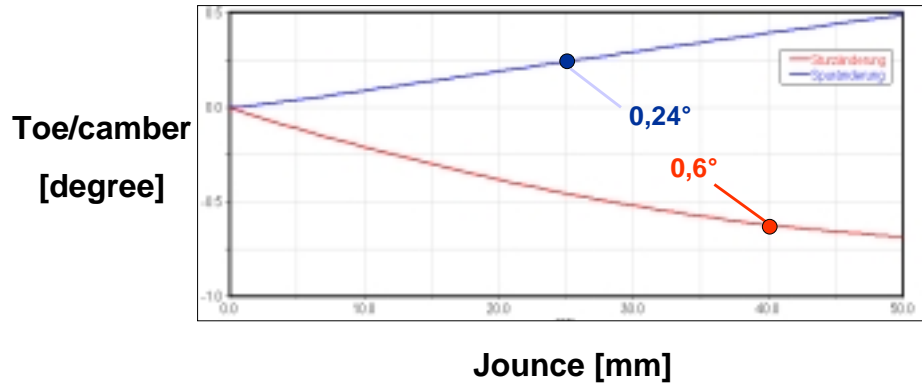


## *Jounce*



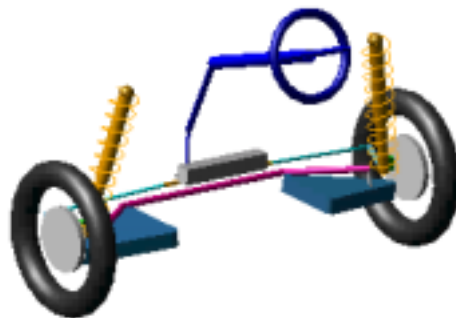


### Toe and camber



### Problem identification

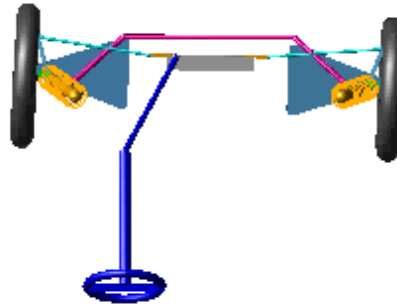
***Axle frequency 10,4 Hz***





Problem identification

***Natural frequency 17,41 Hz***



**Measurement**

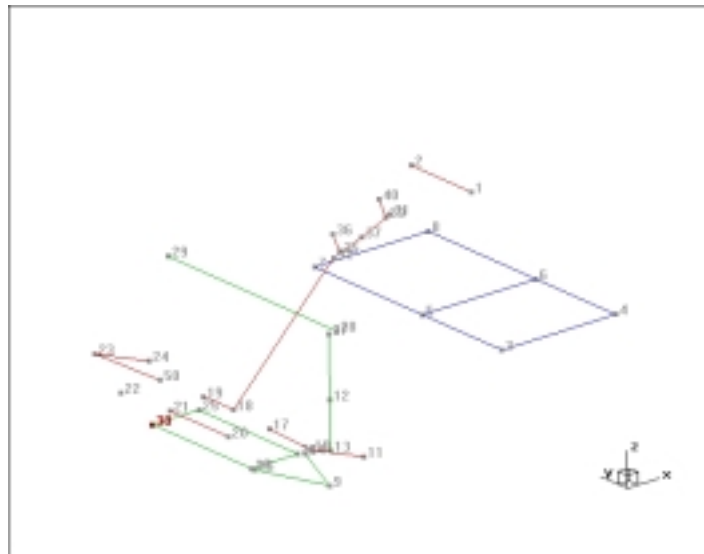


### Measured Data

- Acceleration for various constant driving velocities in the range between 40 and 140 km/h, measured on a vehicle test bench
- 3D-coordinates of acceleration measuring points
- Information for Visualization (connecting lines between different nodes)

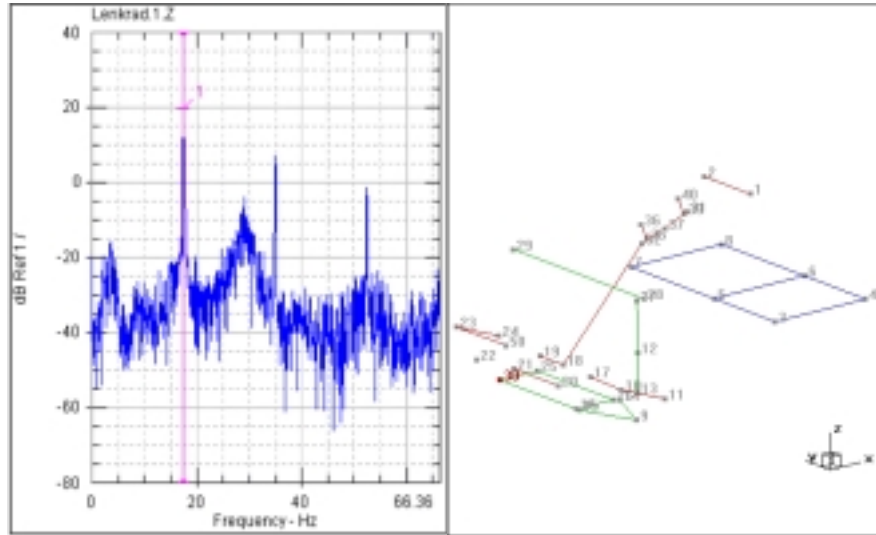


### Geometry

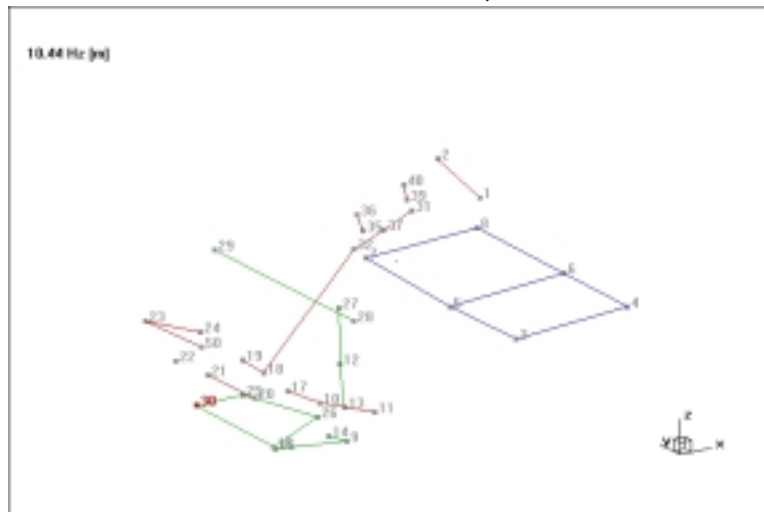




### Calculation of the vibration forms



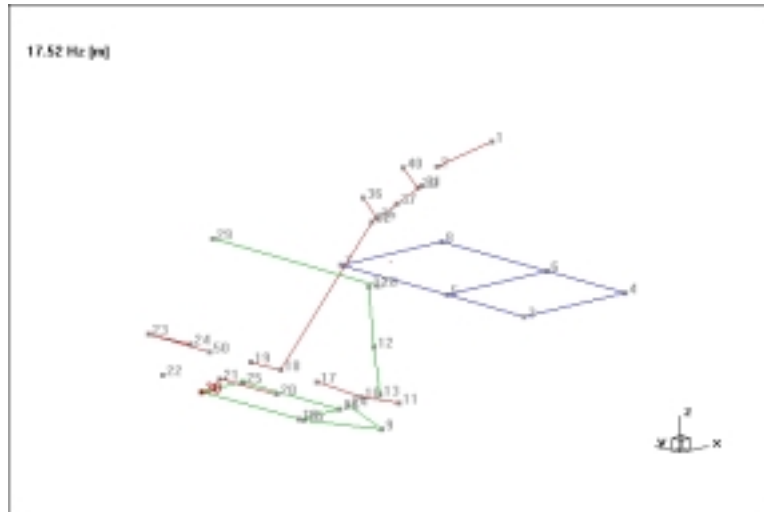
### vibration form at 10,4 Hz







vibration form at 17,5 Hz



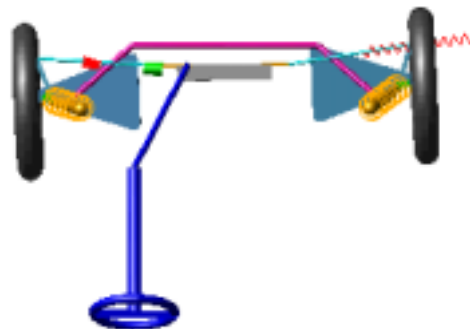
# Modification



Modifikation der Querlenkerbuchsen					
radial	axial	Torsion [Nm/mm]	Karlenk	Shimmy Eigenfrequenz [Hz]	
2857	350	1500	4000	17,4	entspricht Baubau mit 55 Score
3957	350	1500	4000	17,34	corresponds v = 115 km/h
4857	350	1500	4000	18,24	
5857	350	1500	4000	18,44	
6957	350	1500	4000	18,57	
2857	950	1500	4000	18,6	
2857	1340	1500	4000	18,89	
2857	1850	1500	4000	19	
2857	2360	1500	4000	19,1	
2857	2840	1500	4000	19,31	
2857	350	2500	4000	17,4	
2857	350	3000	4000	17,4	
2857	350	4000	4000	17,4	
2857	350	5000	4000	17,4	
2857	350	1500	3000	17,4	
2857	350	1500	4000	17,4	
2857	350	1500	4500	17,4	
2857	350	1500	5000	17,4	
2857	350	1500	6000	17,4	
6000	735	3150	6400	19,4	entspricht Baubau mit 70 Score

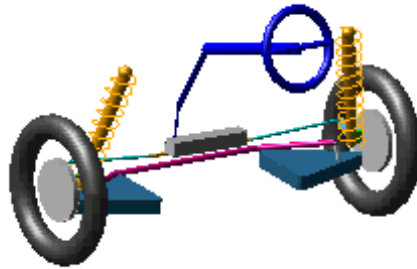


**Natural frequency 17,5 Hz**  
with vibration absorber

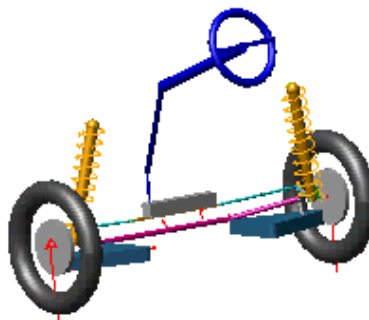




***Natural frequency 17,5 Hz***  
***with elastic steering linkage connection***

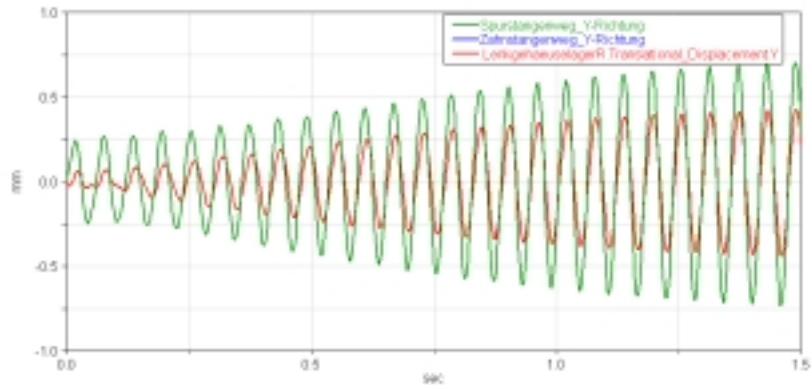


**Dynamic Analysis**  
**excitation on Steering wheel**



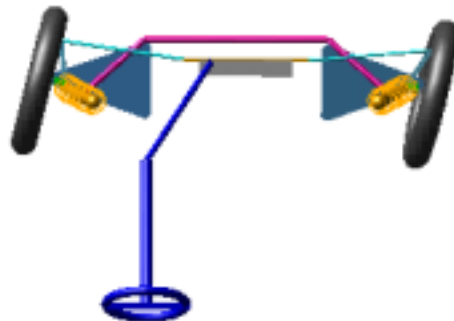


Tie rod / gear rack / steering-gear mount y-direction



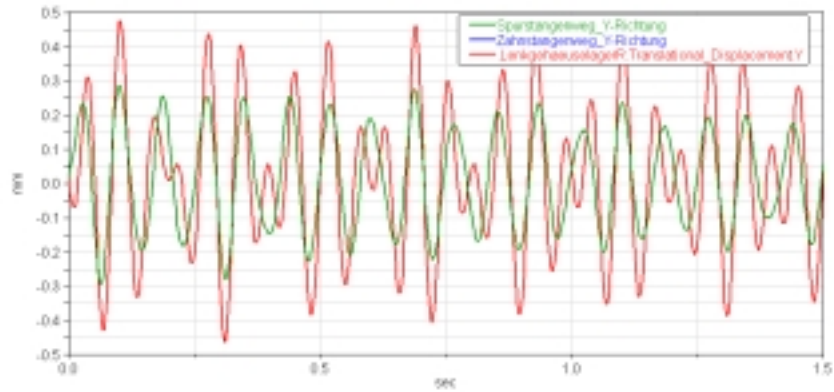
10 times reduced stiffnessrate of steering-gear mounts in y-direction

Natural frequency 12,13 Hz





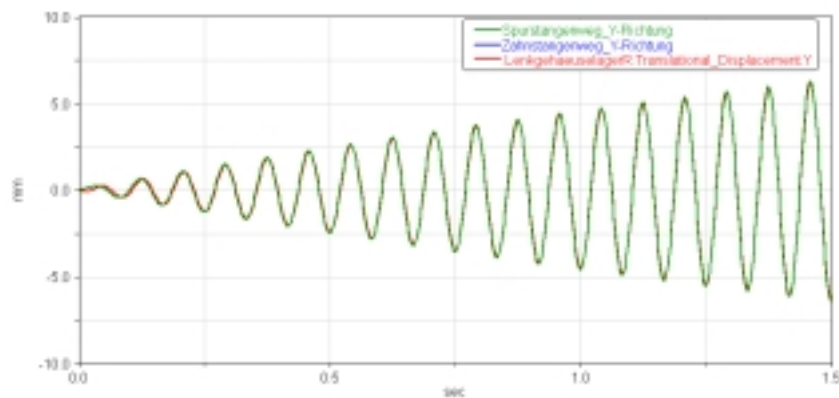
Tie rod / gear rack / steering-gear mount y-direction



10 times reduced stiffnessrate of steering-gear mounts in y-direction

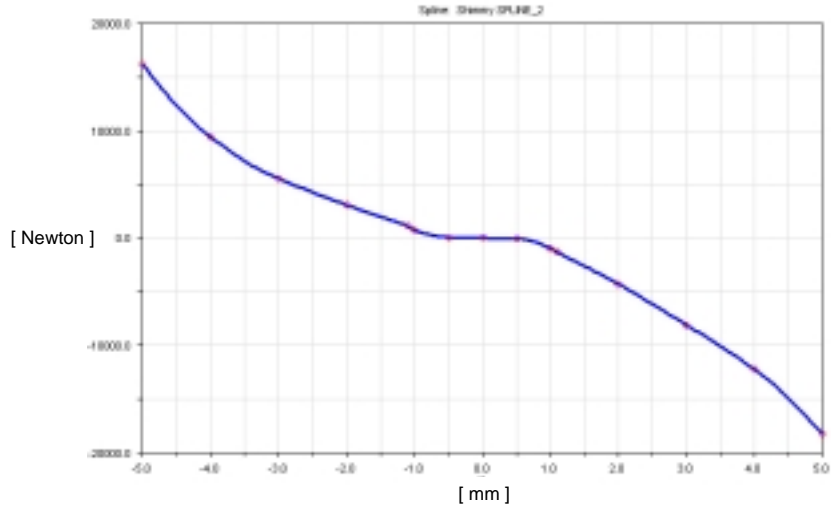


Tie rod / gear rack / steering-gear mount y-direction



10 times reduced stiffnessrate of steering-gear mounts in y-direction

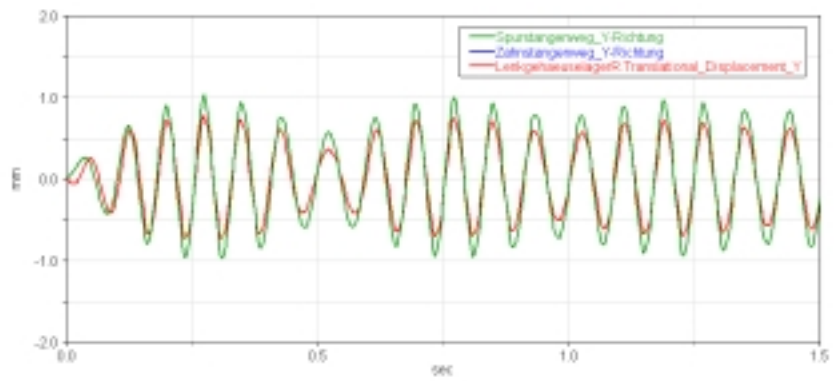
Stiffness characteristic of steering-gear mount in Y-direction



Excitation 12 Hz



Tie rod / gear rack / steering-gear mount y-direction



Steering-gear mount modified with spline\_2



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