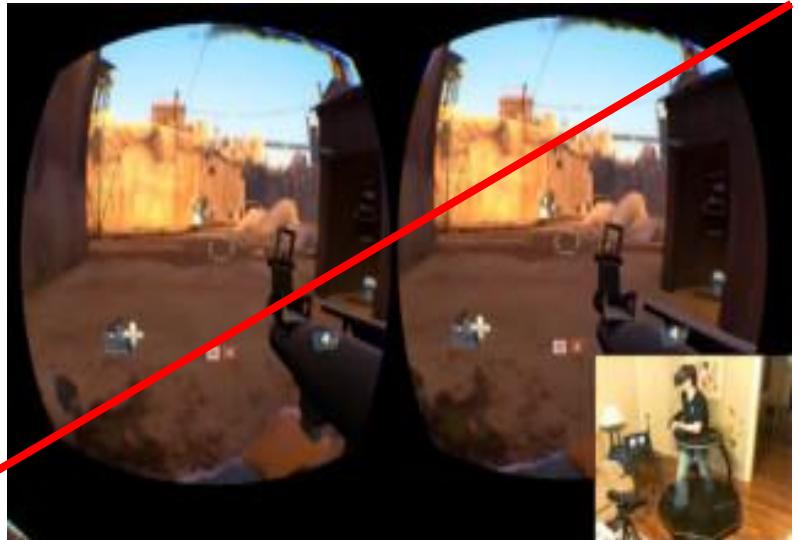




# Motivation for Virtual Reality

- Flight and drive simulators
- Computer games
- Product development: Virtual Prototyping
- Factory planning
- Architecture
- Cultural heritage
- Data analysis in Computational Engineering Science
- Medical simulation
- Psychiatric therapy
- VR as the better user interface
- VR as a goal in its own right

# Virtual Reality Games: Only a Side Effect of this Course!

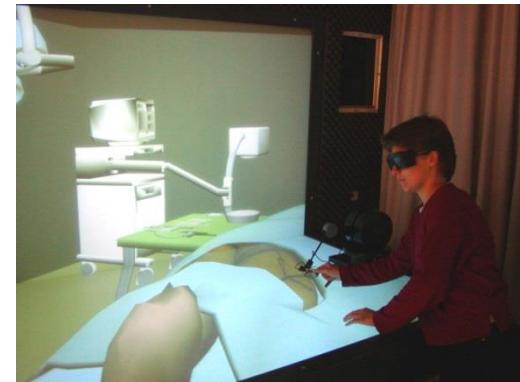


VR Coaster, Europa Park, Germany



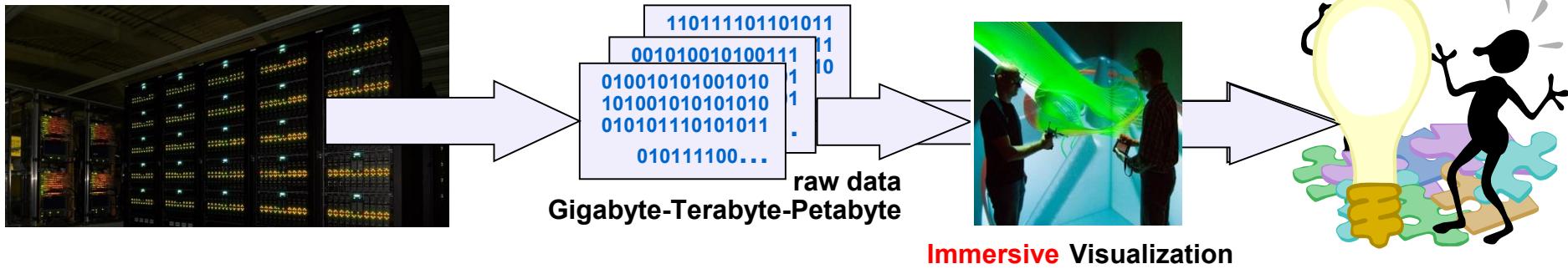
# VR Projects @ VR Group

- |                          |        |
|--------------------------|--------|
| • Basic Research         | ~ 20 % |
| • Production Technology  | ~ 20 % |
| • Simulation Science     | ~ 40 % |
| • Medicine & Psychology  | ~ 10 % |
| • Architecture & Culture | ~ 5 %  |
| • Education & Training   | ~ 5 %  |





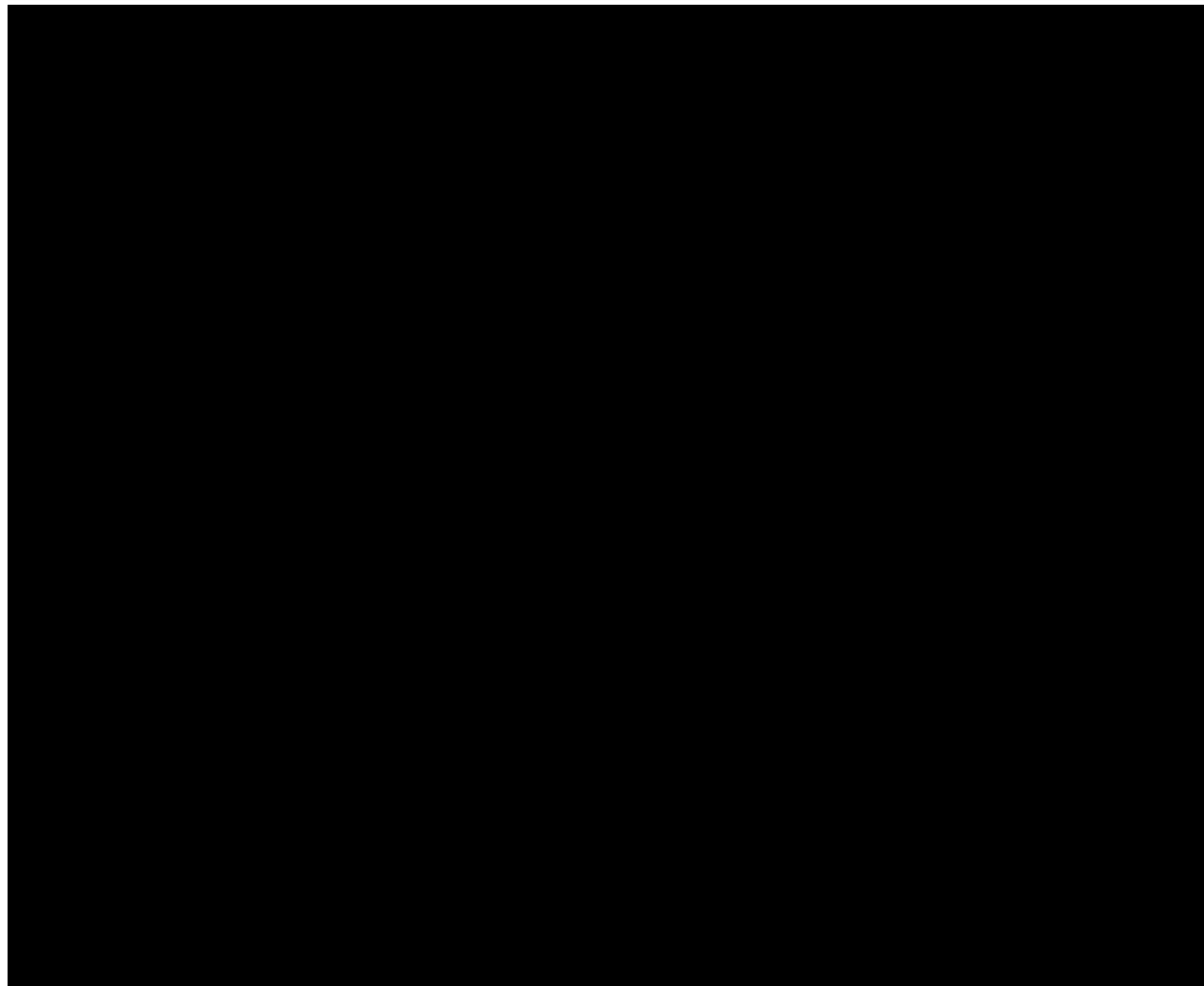
# Immersive Visualization



- R. Hamming (1962):  
„The purpose of Computing is insight, not numbers!“
- Humans are visual creatures: „A picture paints a 1000 words“
  - *Scientific visualization is a primary tool for data analysis*
- Raw data is rapidly increasing: Finer grids, 3-D, time-variant
- Explorative versus confirmative analysis
  - *Interact with simulation data in 3D space*

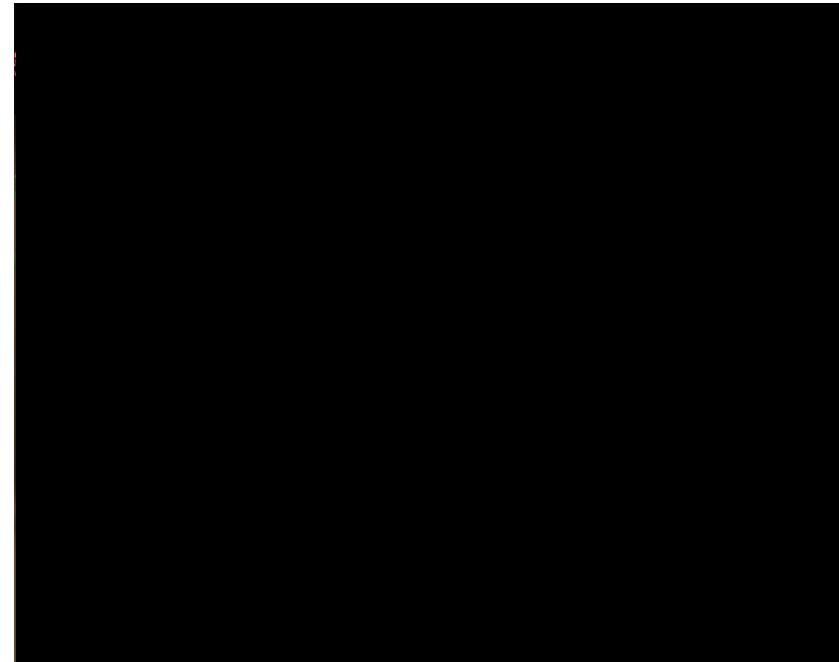
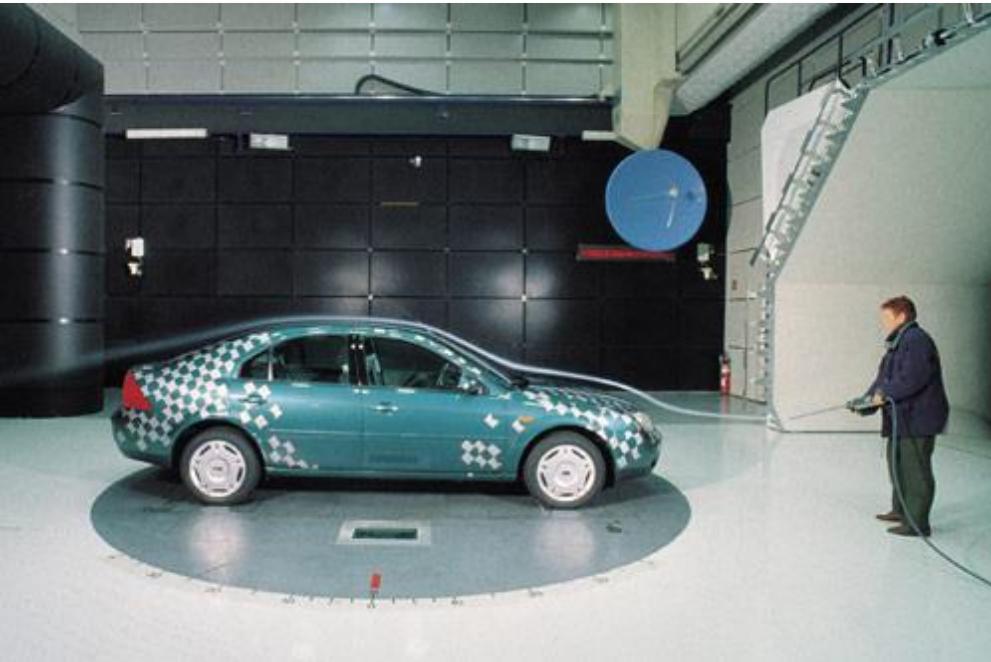
# Video from the late 90's: Counter Propfan

VR Group,  
DLR

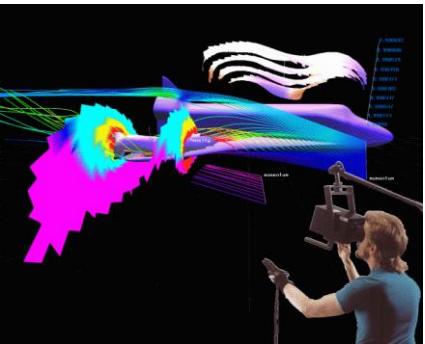


→ [YouTube](#)

# The „Virtual Windtunnel“ Revisited



→ [YouTube](#)



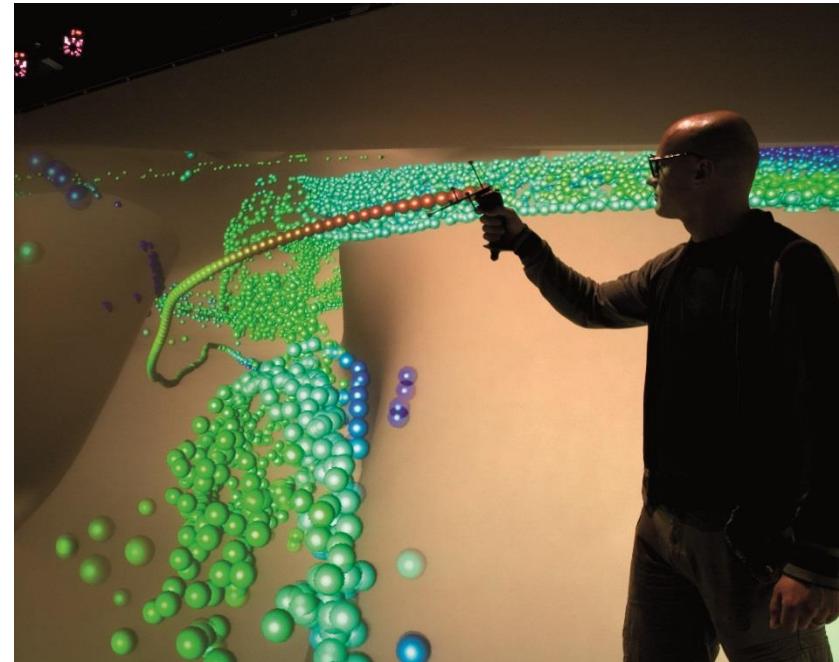
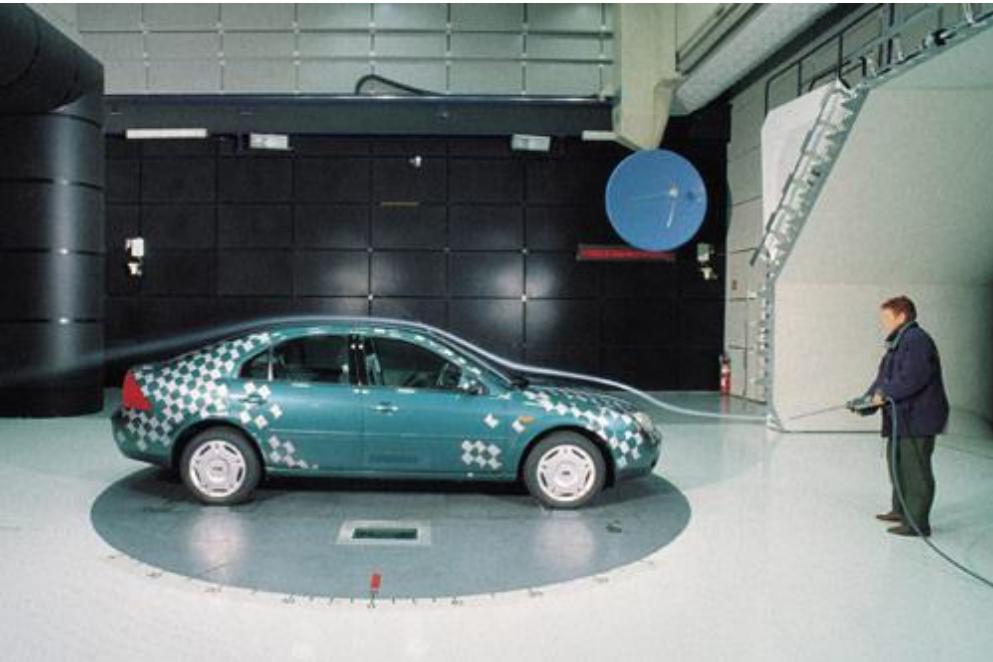
Steve Bryson &  
Creon Levit, 1991  
NASA

## DFG Project, Partners:

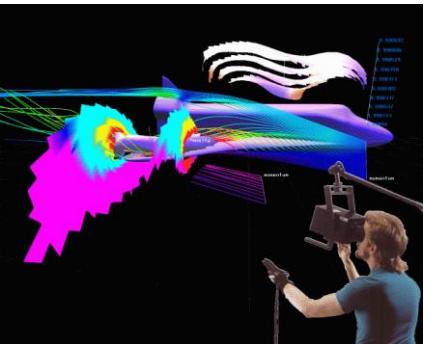
- RWTH Aerodynamisches Institut, Prof. Schröder
  - RWTH VR Group
  - Klinikum Aachen, Radiologie, Prof. Wein
  - Uniklinik Köln, IMSIE, Prof. Mösges
- [C&G 2005, MMVR 2007, EGPGV 2011, EGPGV 2015, ...]

# The „Virtual Windtunnel“

For PDF version



→ [YouTube](#)

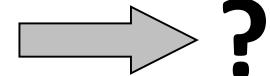
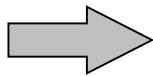


Steve Bryson &  
Creon Levit, 1991  
NASA

**DFG Project, Partners:**

- RWTH Aerodynamisches Institut, Prof. Schröder
  - RWTH VR Group
  - Klinikum Aachen, Radiologie, Prof. Wein
  - Uniklinik Köln, IMSIE, Prof. Mösges
- [C&G 2005, MMVR 2007, EGPGV 2011, EGPGV 2015, ...]

# Ventricular Assist Devices



→ [YouTube](#)

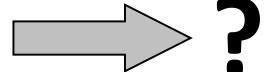
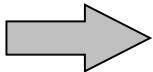
→ [YouTube](#)

→ [YouTube](#)

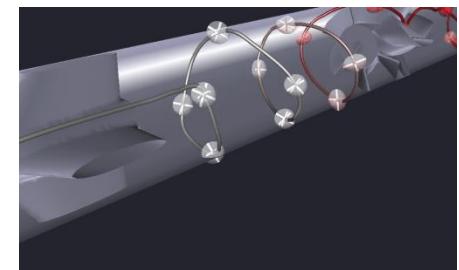
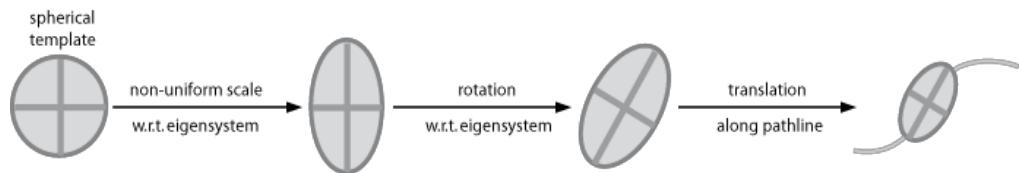
# Ventricular Assist Devices



For PDF version

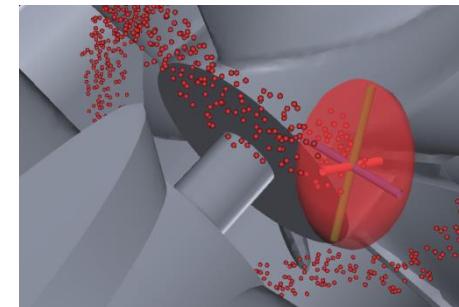


- Blood is “damaged” (hemolysis)
- Hemolysis estimated along pathlines
- Tensor-based model as developed by CATS
- **Visualization metaphor:** Map deformation to glyphs.



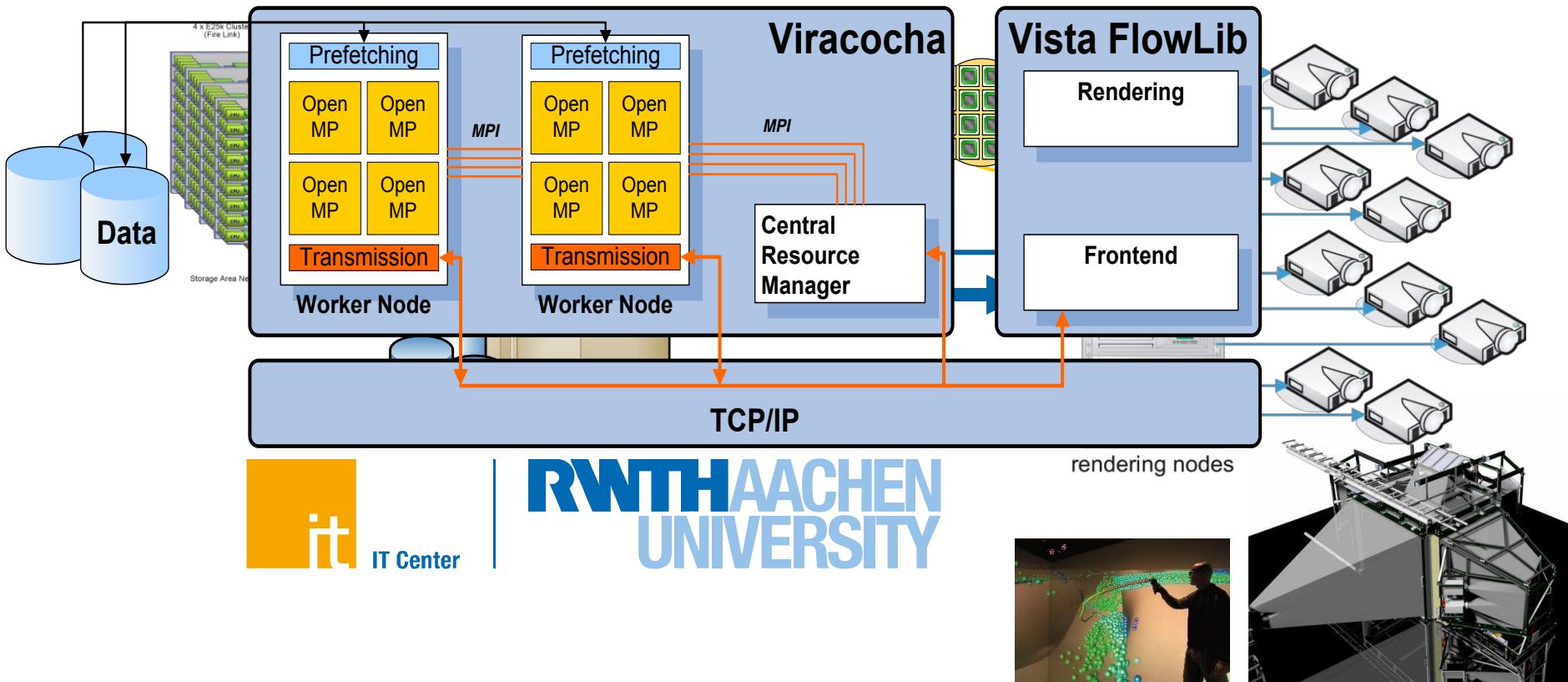
Collaboration in JARA|HPC, Partners:  
• RWTH CATS & AICES, Prof. Behr  
• RWTH VR Group  
[IEEE Vis 2008 Best Paper Award]

- [YouTube](#)
- [YouTube](#)
- [YouTube](#)



# A Parallel Framework for Immersive Vis

- Use HPC resources for simulation & post processing
- Flexibly map processes to compute resources
- Hierarchical parallelization, advanced scheduling



**A virtual reality system for the simulation and manipulation of wireless communication networks**

**Submission ID: 155**

**Category: Application**

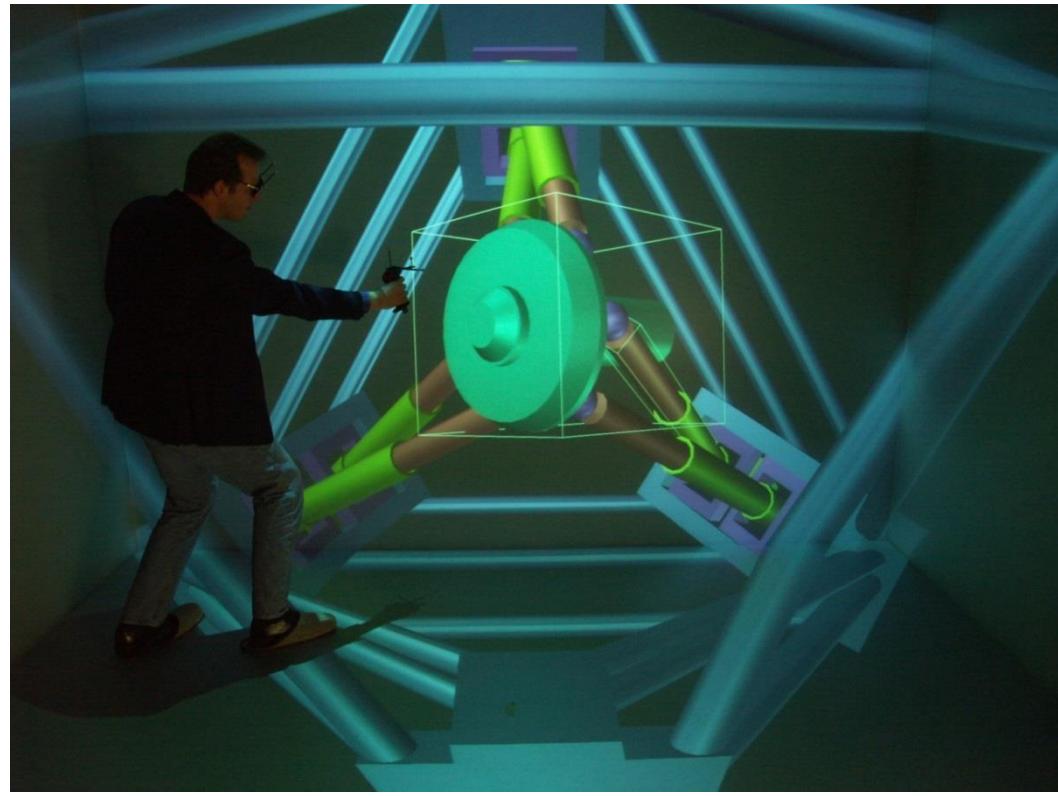
→ [YouTube](#)

# **Virtual Reality in Production Technology**

- Machine Tool Prototyping
- Factory Planning

# Virtual Hexapod

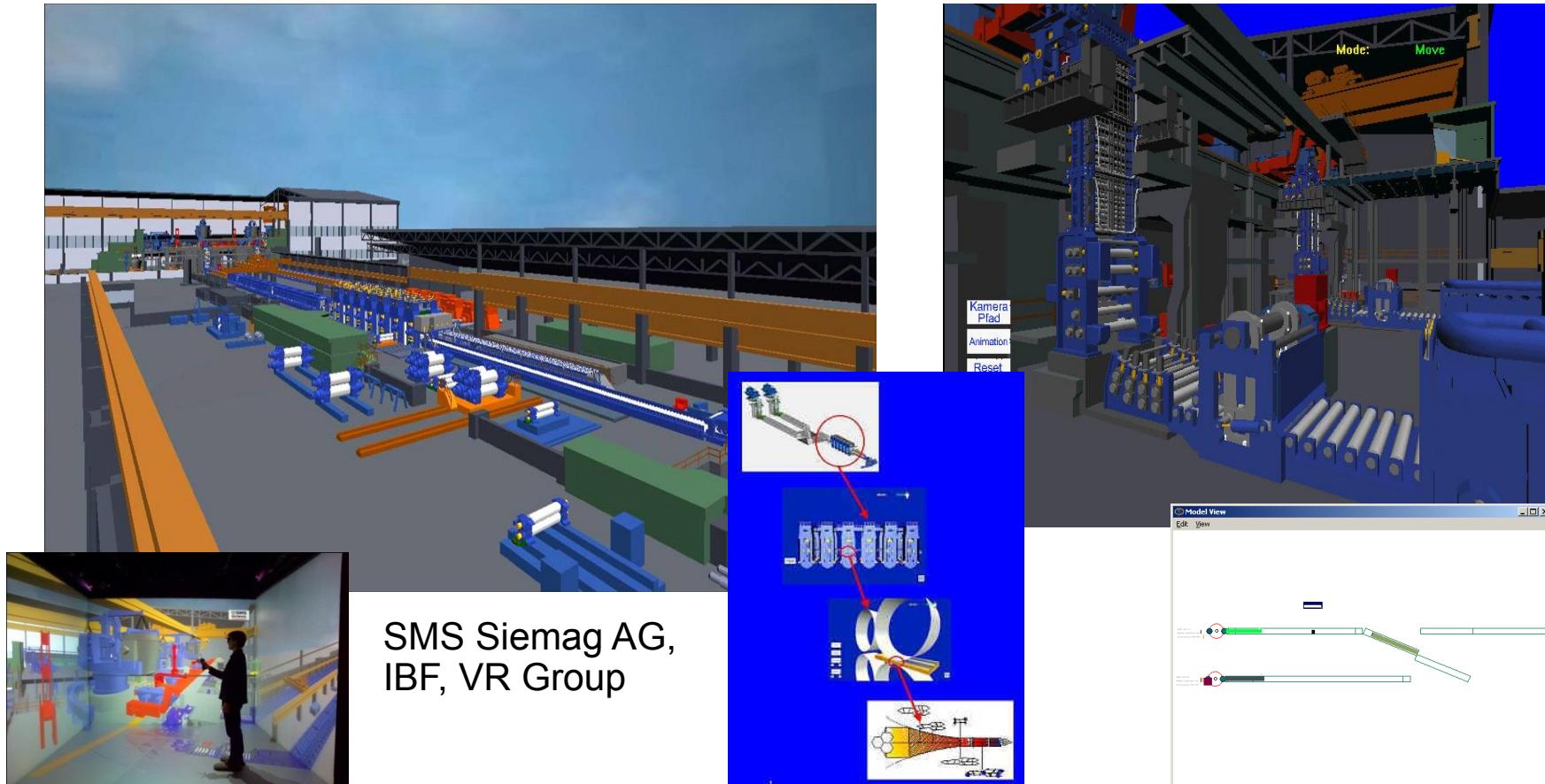
WZL, VR Group



# Video: Virtual Hexapod



# Virtual Plants



# Virtual Plants



SMS Siemag AG,  
VR Group

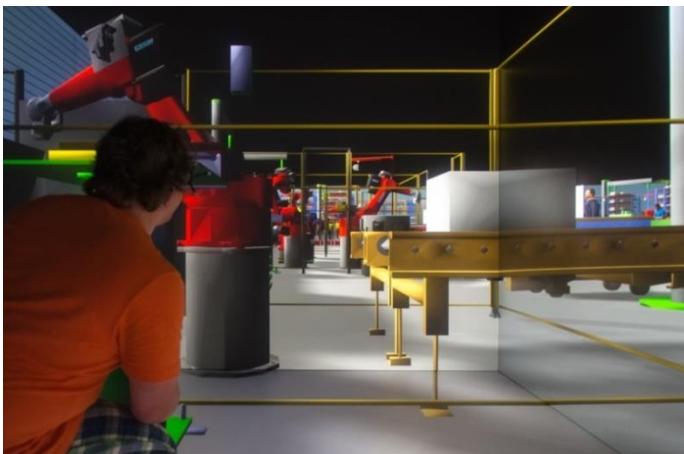
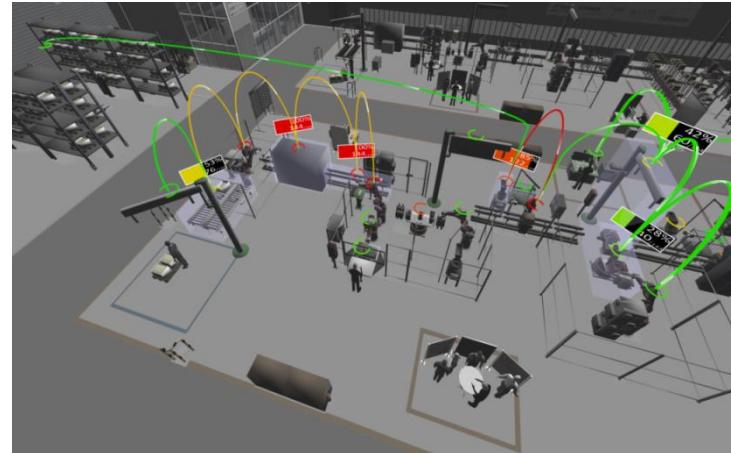
## Factory Layout Planning



**WZL**

**NLD**  
Nonlinear Dynamics of  
Laser Processing

**Fraunhofer**  
ILT



# flapAssist: VR-based Factory Planning

- Integrate factory planning and machine optimization
- Combine geometry data, simulation data, material flow, and more

**DFG Cluster of Excellence, Partners:**

- RWTH IMA/ZLW/IFU, Prof. Jeschke
- RWTH VR Group
- Fraunhofer ILT, Prof. Schulz
- RWTH WZL

[3DCVE 2014, SEARIS 2015, IEEE VR 2016, ... ]

## flapAssist

### VR-based Factory Layout Planning Support

Developed during the Cluster of Excellence  
"Integrative Production Technology for High-wage Countries"

Sebastian Pick, Sascha Gebhardt, Torsten W. Kuhlen  
Visual Computing Institute, RWTH Aachen University, Germany

→ YouTube



Contact: pick@vr.rwth-aachen.de

# Virtual Reality in Behavioral Studies



Convey Belt Study

ERS Seed Fund Project "Peers at Work"

Partners:

- RWTH Experimentelle Wirtschaftsforschung,  
Prof. Gürerk
- RWTH VR Group  
[MPRA 2016]

→ [YouTube](#)

Basic Funding

Partners:

- RWTH VR Group  
[3DUI 2016 Honorable Mention]

Collision Avoidance  
in the Presence of a Virtual Agent  
in Small-Scale Virtual Environments

Andrea Bönsch, Benjamin Weyers, Jonathan Wendt, Sebastian Freitag, Torsten W. Kuhlen

Visual Computing Institute, RWTH Aachen University, Germany  
JARA – High-Performance Computing

 **RWTHAACHEN**  
UNIVERSITY

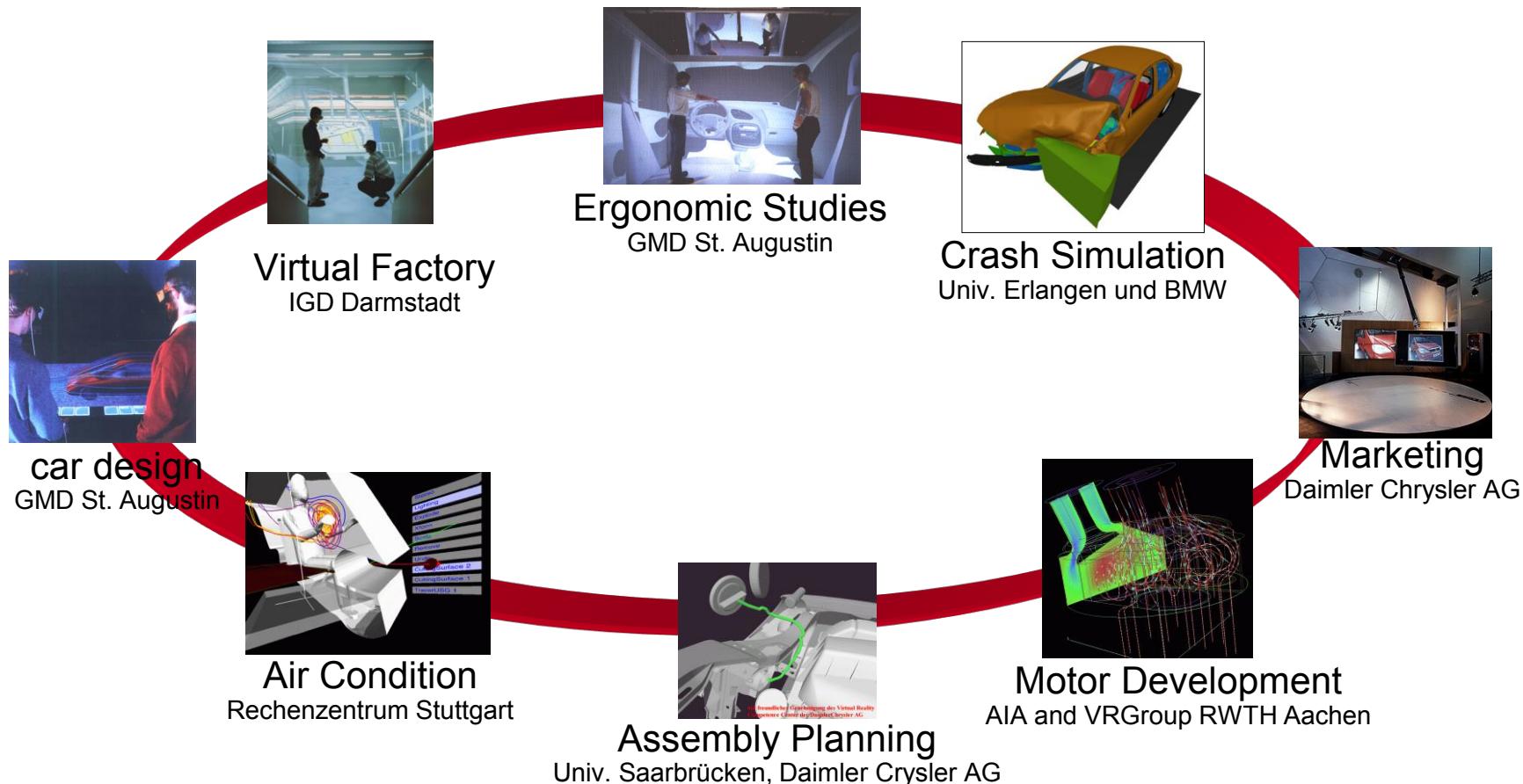
contact: boensch@vr.rwth-aachen.de

→ [YouTube](#)

# **Virtual Reality in Product Design**

## **Virtual Prototyping**

# VR in the Automotive Industry

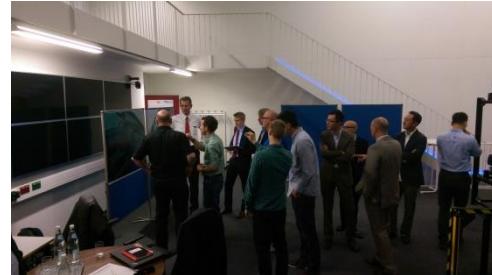


# Virtual Reality in Product Design



Auch e.GO nutzt die so entstehenden Synergien am Standort RWTH Aachen Campus - dem deutschen "Silicon Valley" - und begleiten das Thema virtuelle Realität von Beginn an mit unserem Unternehmen. Wir haben aixCAVE genutzt, um unser Fahrzeugdesign zu finalisieren. So konnten wir innerhalb von kürzester Zeit den Entwicklungsfortschritt holographisch so realistisch abbilden, dass der Bau eines zusätzlichen "Showcars" überflüssig geworden ist.

*Press Release, March 2016*



# Design & Ergonomics

Courtesy of ICIDO GmbH, Stuttgart



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IDO:ERGONOMICS

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# Assembly Simulation of Flexible Parts

Courtesy of ICIDO GmbH, Stuttgart



IC:IDO  
VR productive

IDO:FLEXIBLES

# Crash Simulation

IKA, VR Group



WZL, IAW

