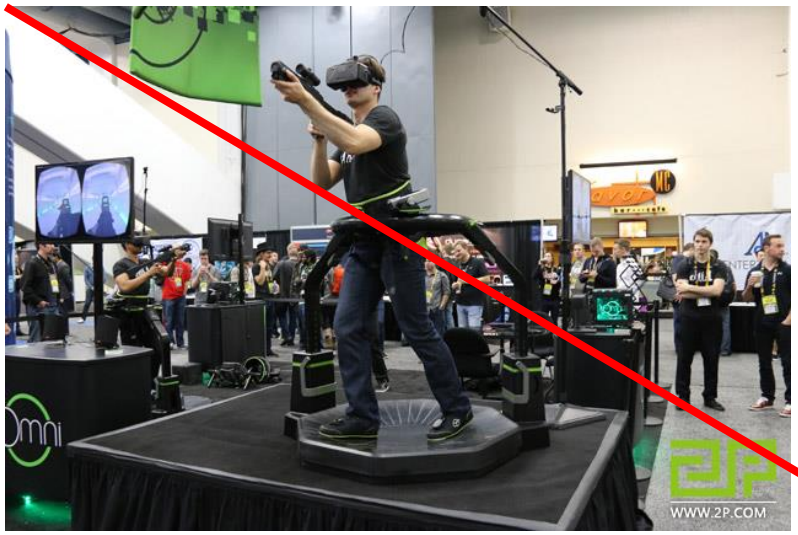
Course on Virtual Reality

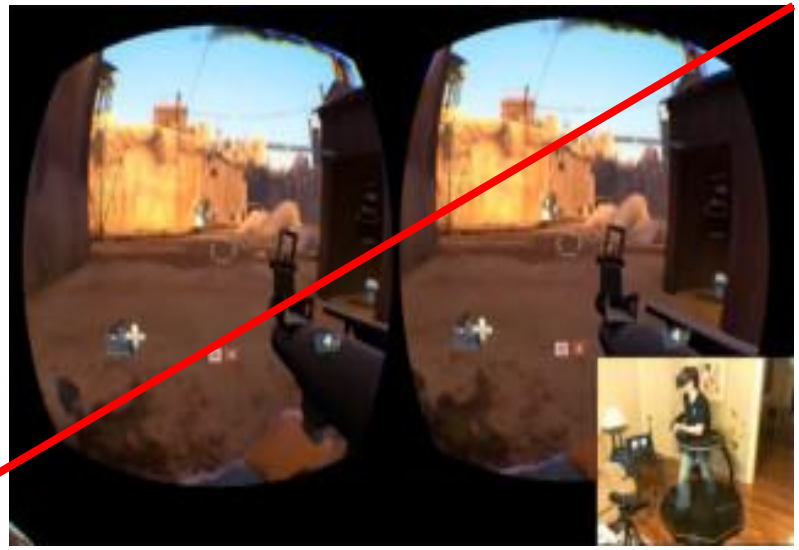
Applications in Science & Industry

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
- Psychatric therapy
- VR as the better user interface
- VR as a goal in it’s own right

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

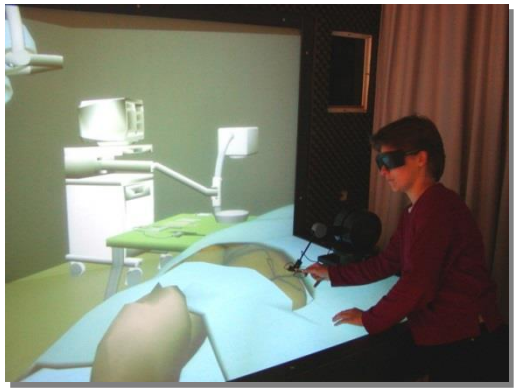




VR Coaster, Europa Park, Germany

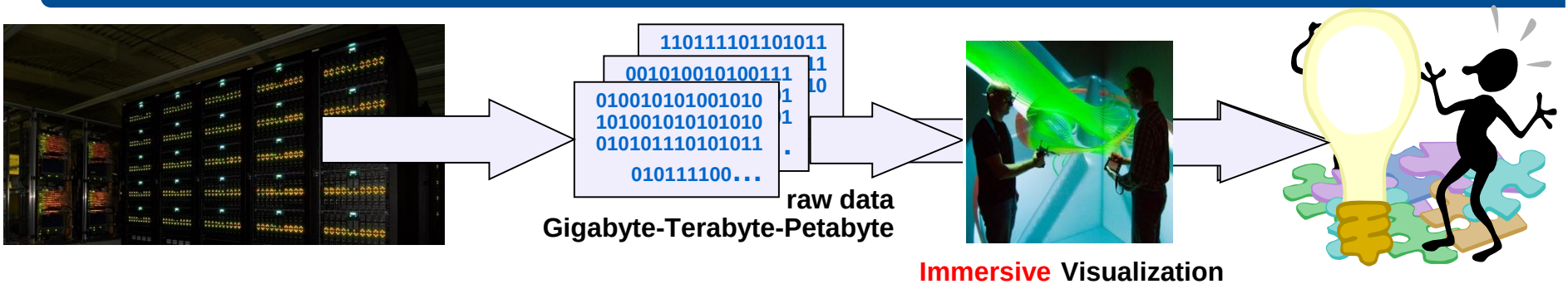
VR Projects @ VR Group

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



Virtual Reality in Simulation Science

Immersive Visualization



- R. Hamming (1962):
  „The purpose of Computing is insight, not numbers!“
- Humans are visual creatures: „An picture paints a 1000 words“

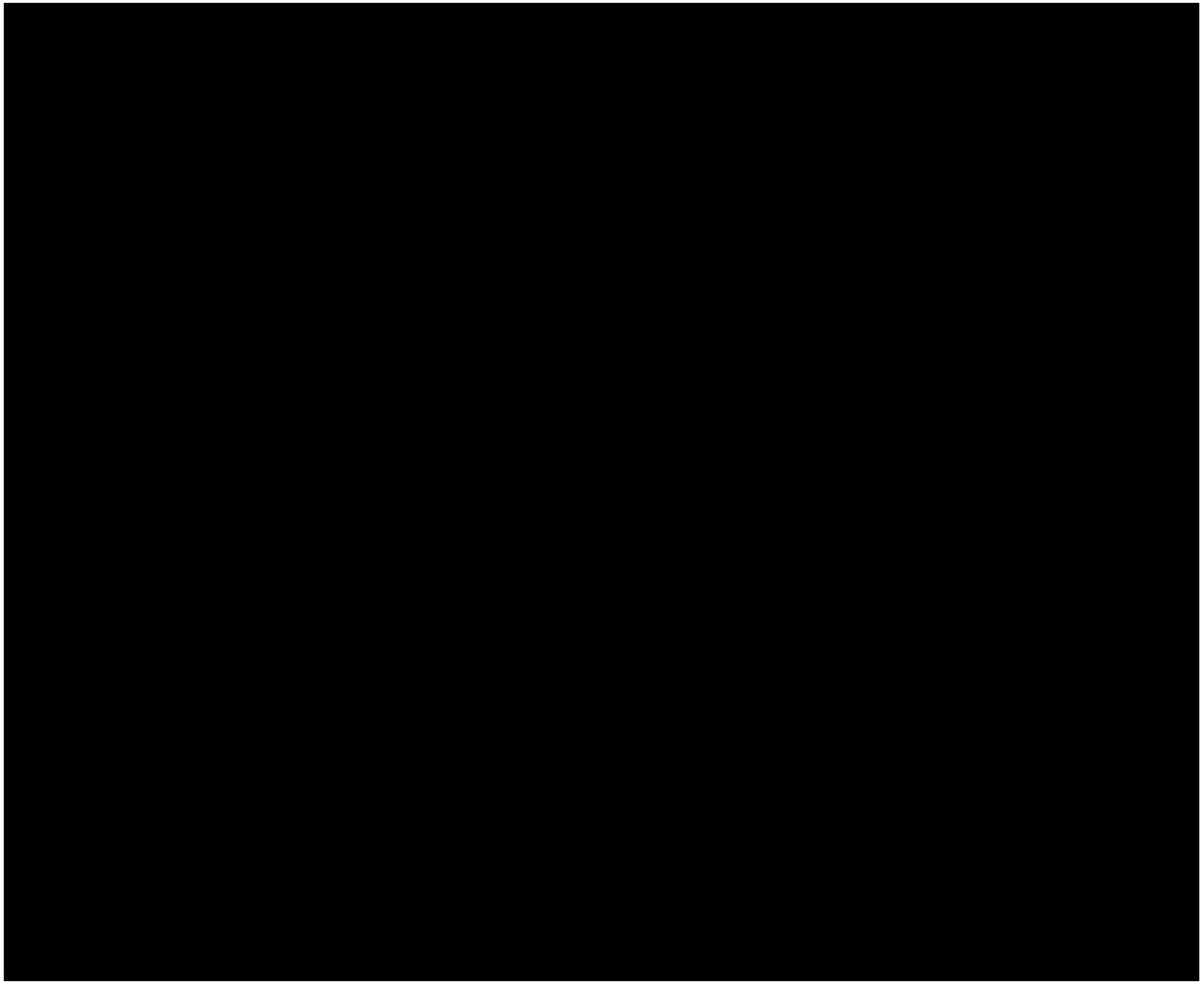
➢ *Scientific visualization is a primary tool for data analysis*

- Raw data is rapidly increasing: Finer grids, 3-D, time-variant
- Explorative versus confirmative analysis

➢ Interact with simulation data in 3D space

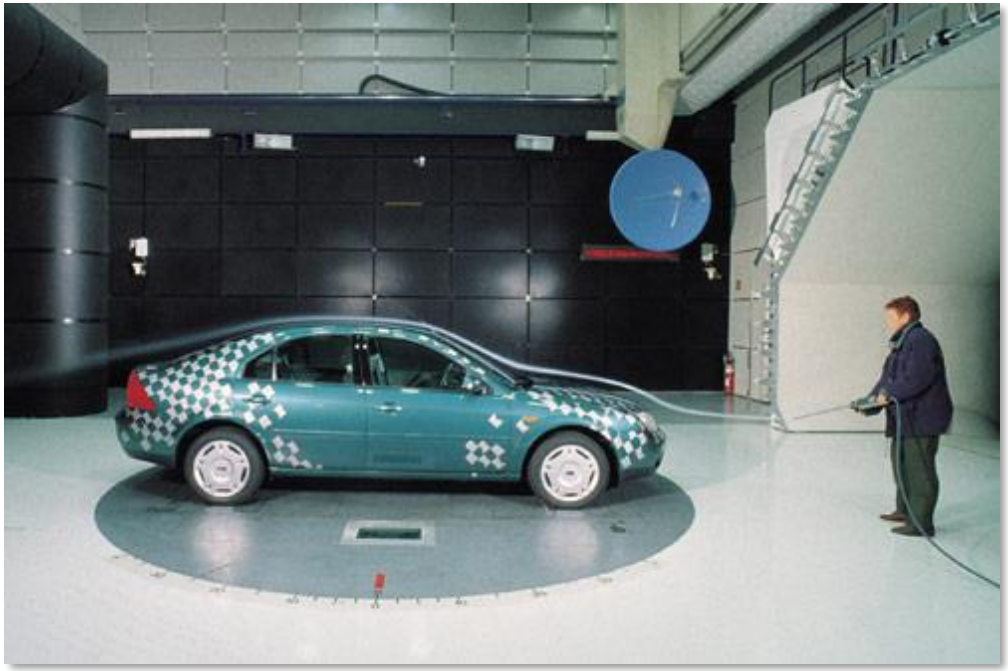
Video from the late 90’s: Counter Propfan

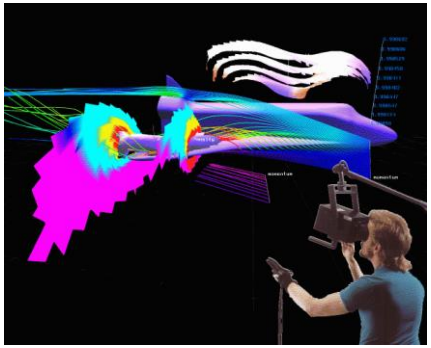
VR Group, DLR



→ YouTube

The „Virtual Windtunnel“ Revisited





→ YouTube

Steve Bryson &
Creon Levit, 1991
NASA

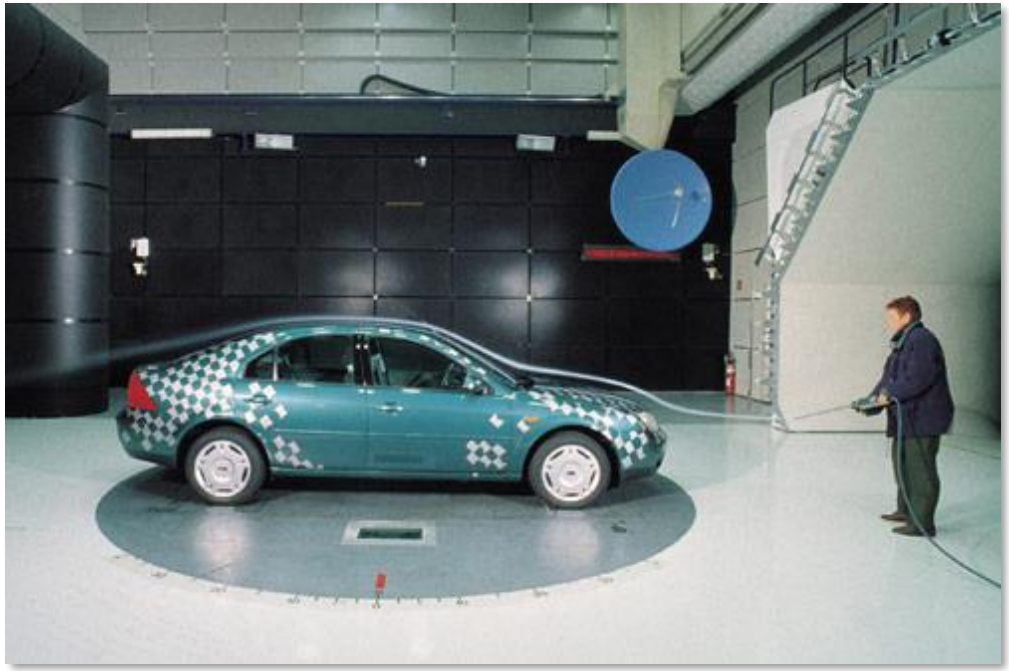
DFG Project, Partners:

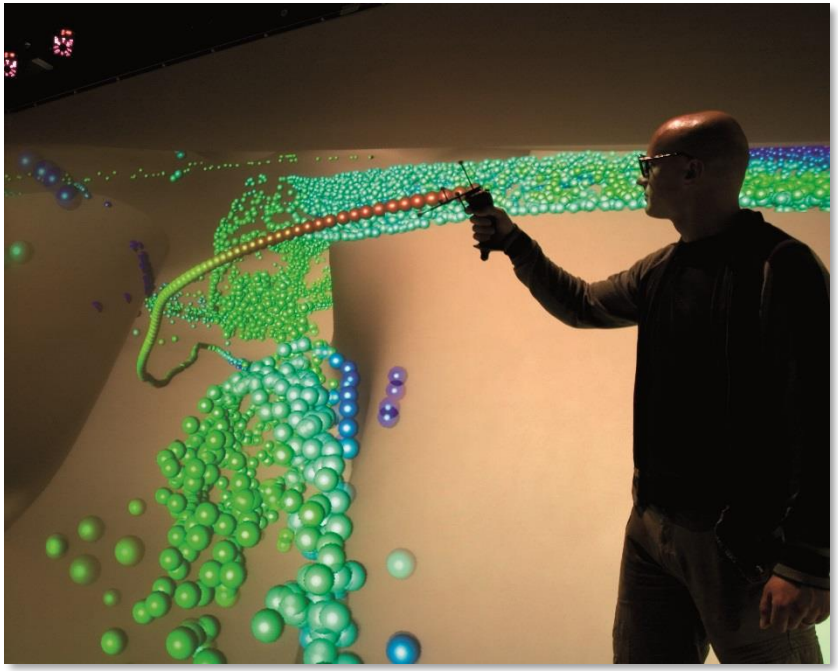
- RWTH Aerodynamisches Institut, Prof. Schröder
- RWTH VR Group
- Klinikum Aachen, Radiologie, Prof. Wein
- Unikinik Köln, IMSIE, Prof. Mösges

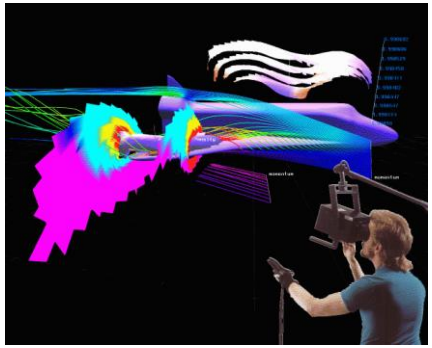
[C&G 2005, MMVR 2007, EGPGV 2011, EGPGV 2015, …]

The „Virtual Windtunnel“

For PDF version







Steve Bryson &
Creon Levit, 1991
NASA

→ YouTube

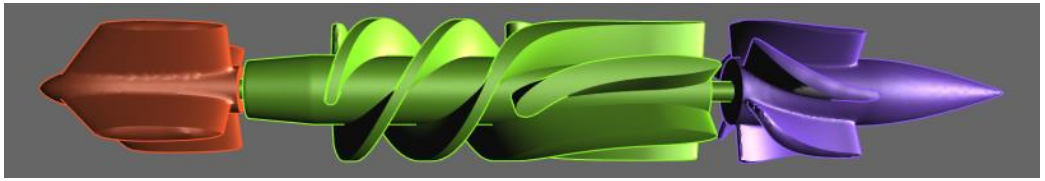
DFG Project, Partners:

- RWTH Aerodynamisches Institut, Prof. Schröder
- RWTH VR Group
- Klinikum Aachen, Radiologie, Prof. Wein
- Unikinik Köln, IMSIE, Prof. Mösges

[C&G 2005, MMVR 2007, EGPGV 2011, EGPGV 2015, …]

Ventricular Assist Devices

RBCs



VAD rotating @ up to 12,000 rpm

→ YouTube

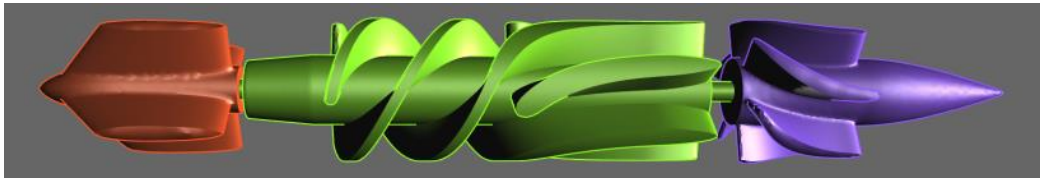
→ YouTube

→ YouTube

Ventricular Assist Devices

For PDF version

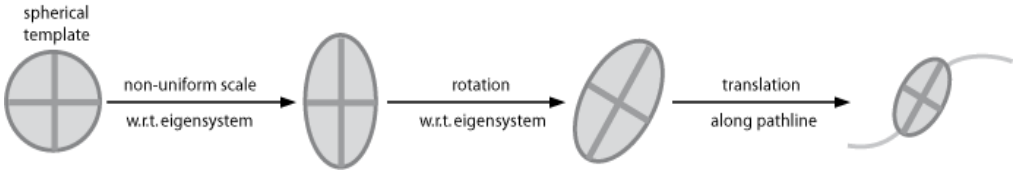
RBCs

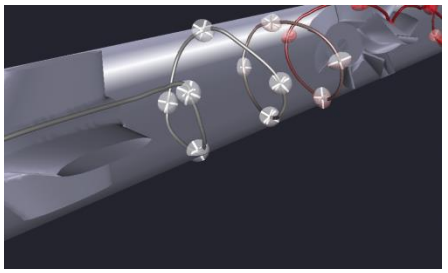


VAD rotating @ up to 12,000 rpm

?

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





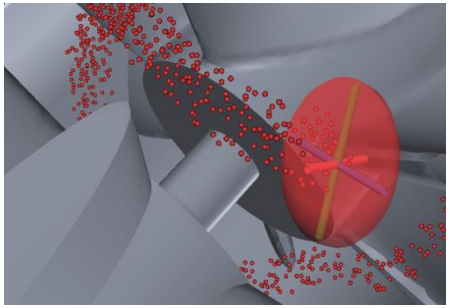
Collaboration in JARA|HPC,Partners:
- RWTH CATS & AICES, Prof. Behr
- RWTH VR Group

[IEEE Vis 2008 Best Paper Award]

→ YouTube

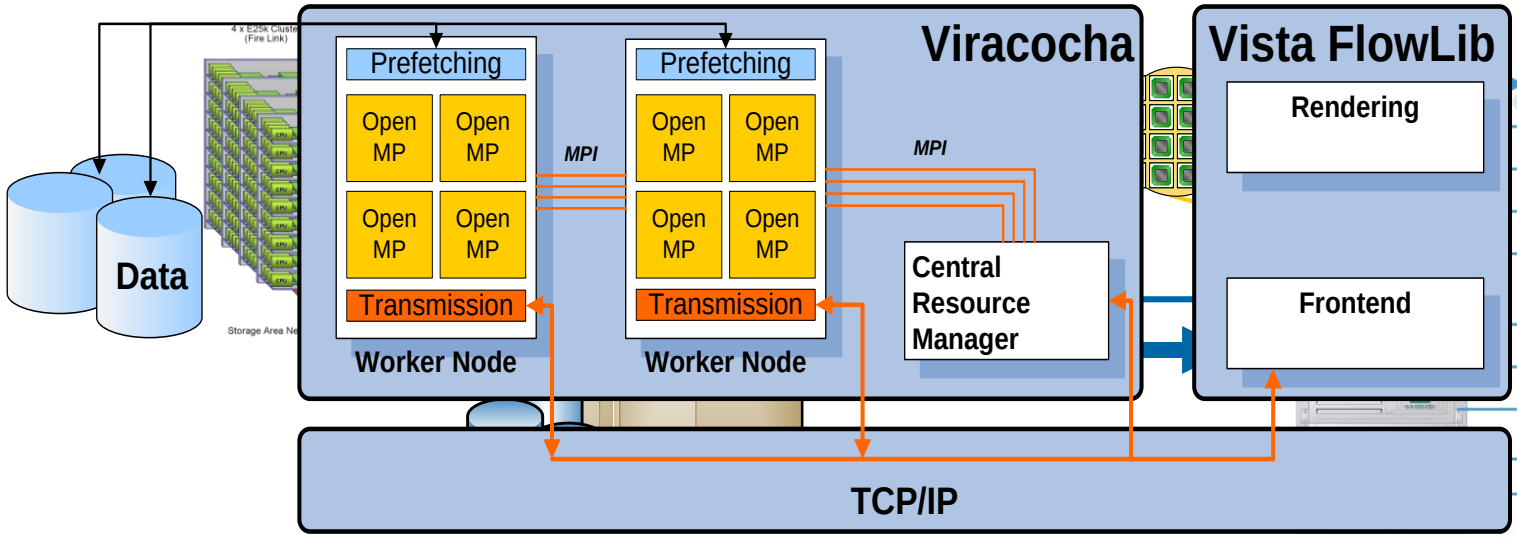
→ YouTube

→ YouTube



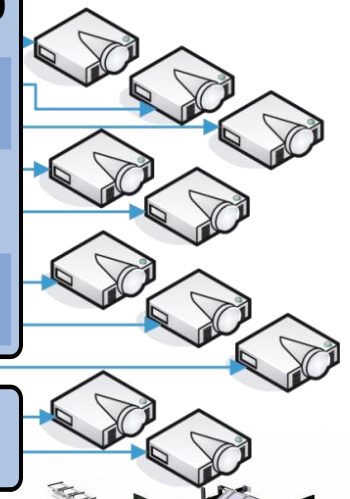
A Parallel Framework for Immersive Vis

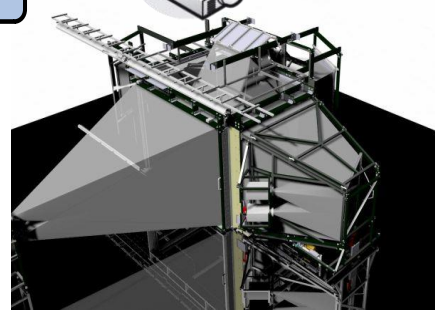
- Use HPC resources for simulation & post processing
- Flexibly map processes to compute resources
- Hierarchical parallelization, advanced scheduling



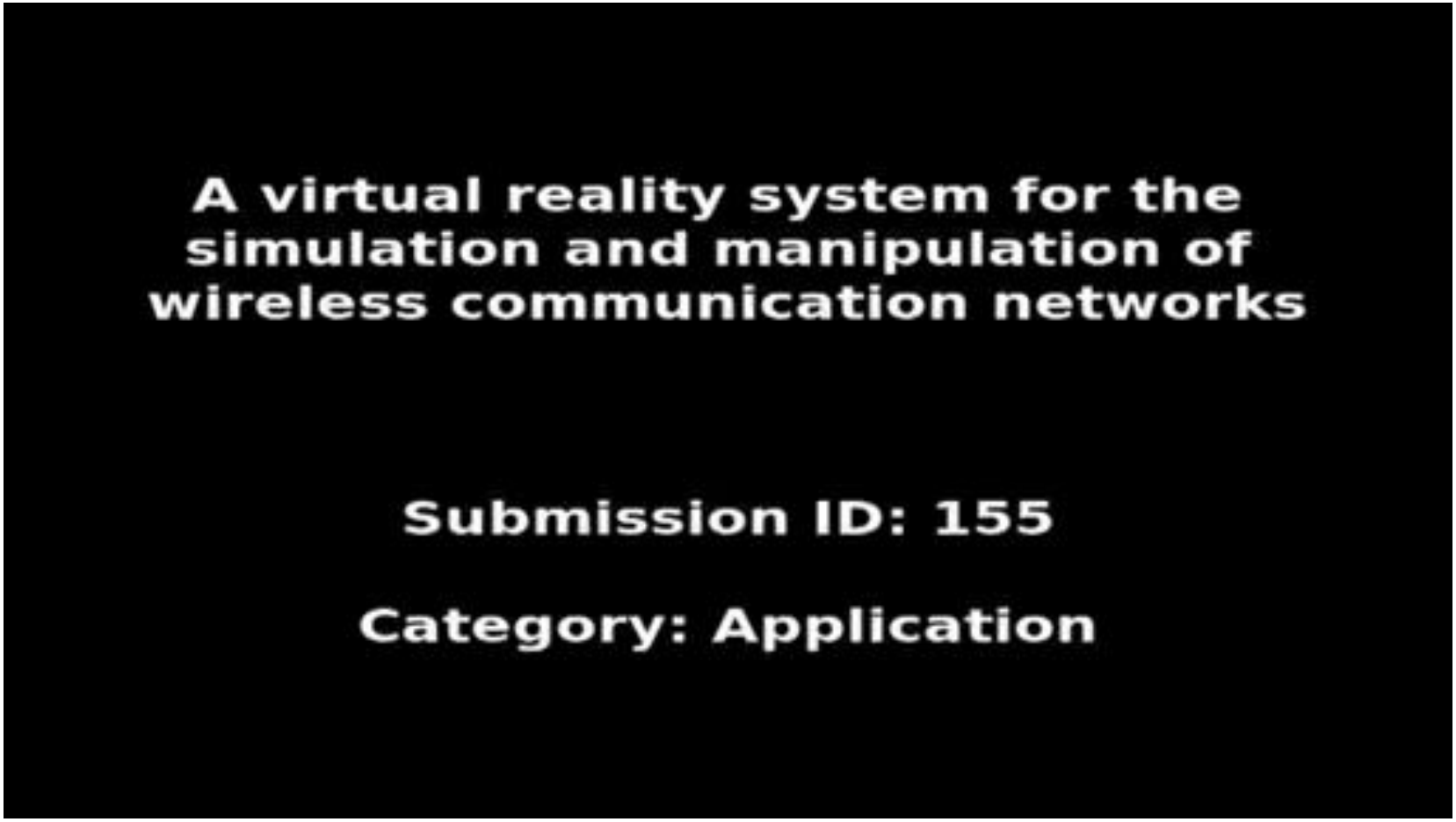
IT Center

RWTH AACHEN UNIVERSITY





GPU-based Realtime Simulations



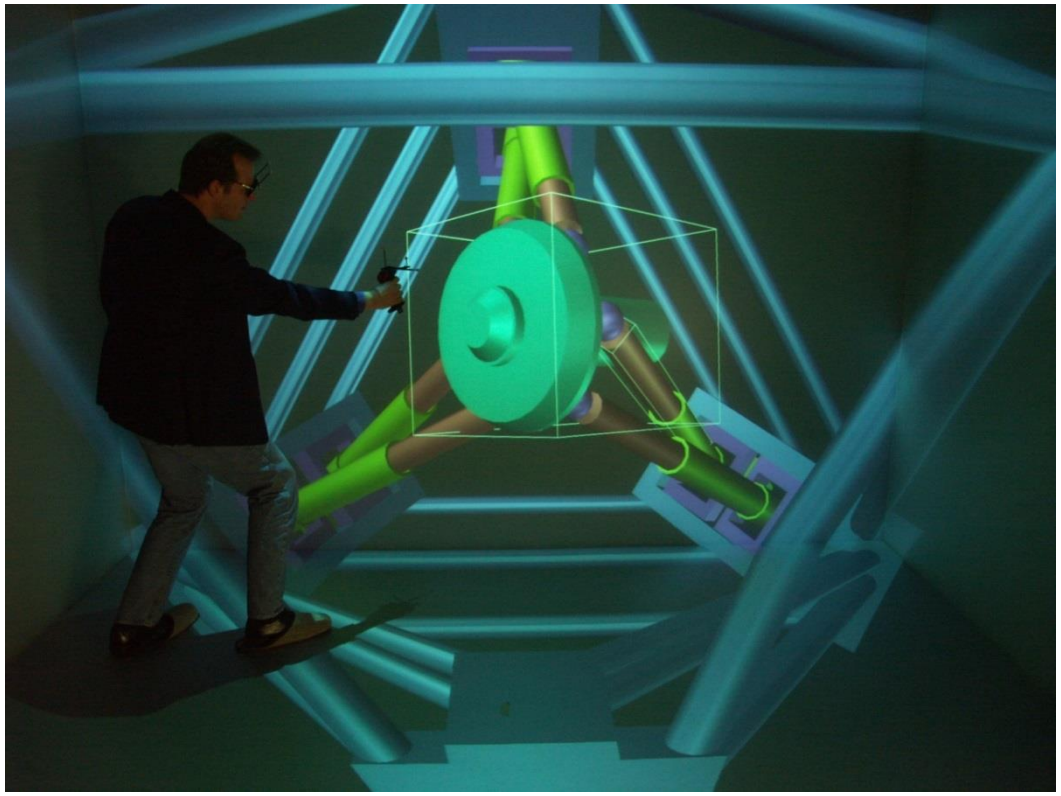
→ YouTube

Virtual Reality in Production Technology

- Machine Tool Prototyping
- Factory Planning

Virtual Hexapod

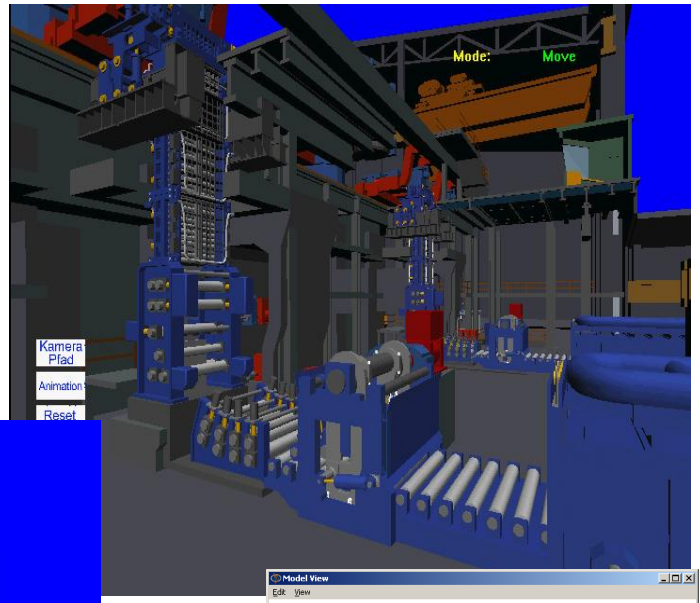
WZL, VR Group

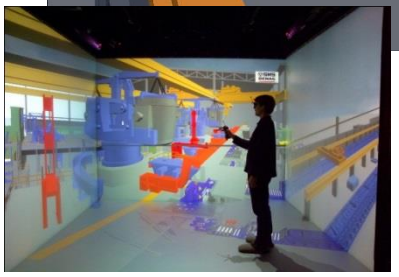


Video: Virtual Hexapod

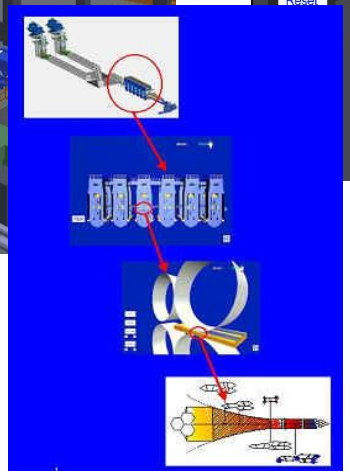
→ YouTube

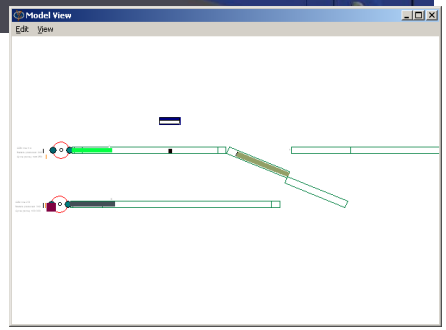
Virtual Plants





SMS Siemag AG,
IBF, VR Group

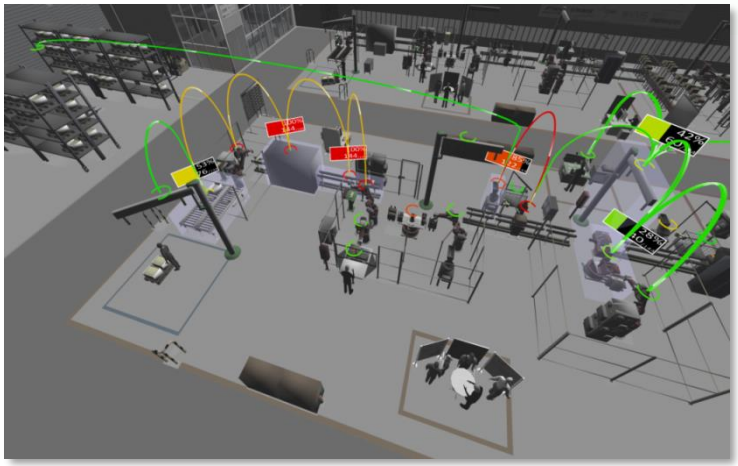




Virtual Plants

SMS Siemag AG, VR Group

Factory Layout Planning



flapAssist: VR-based Factory Planning

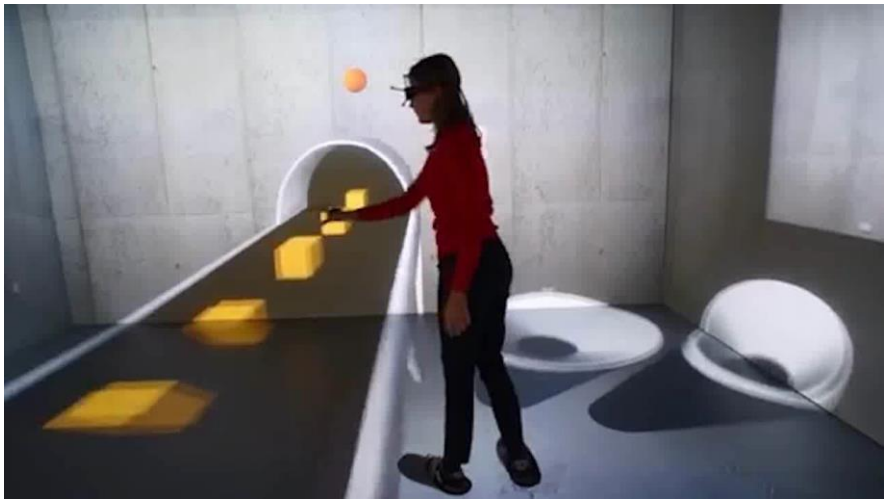
- Integrate factory planning and machine optimization
- Combine geometry data, simulation data, material flow, and more

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, …]

→ YouTube

Virtual Reality in Behavioral Studies



Convey Belt Study

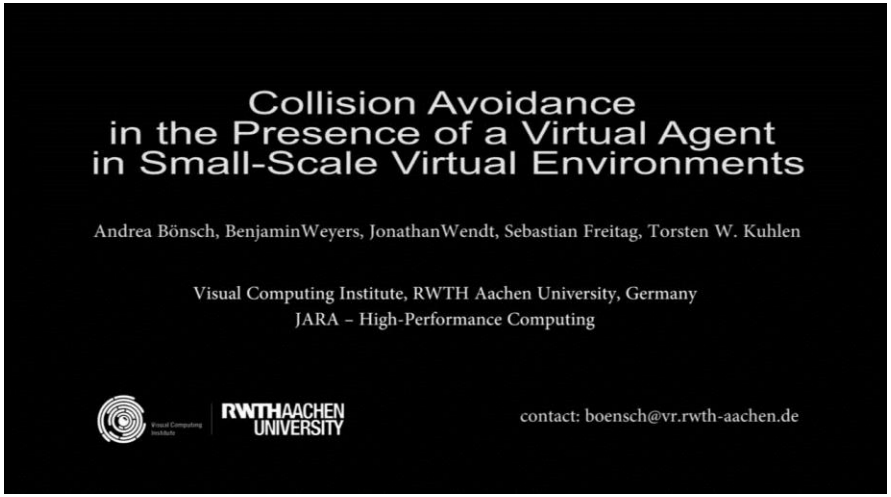
ERS Seed Fund Project “Peers at Work”

Partners:

- RWTH Experimentelle Wirtschaftsforschung, Prof. Gürerk
- RWTH VR Group

[MPRA 2016]

→ YouTube



Collision Avoidance Study

Basic Funding

Partners:

- RWTH VR Group

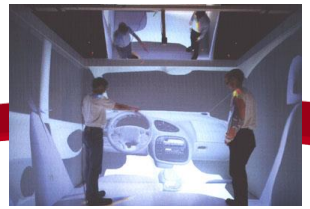
[3DUI 2016 Honorable Mention]

→ YouTube

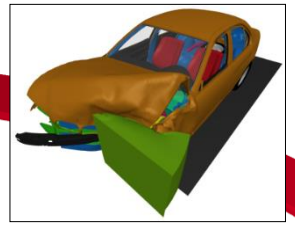
Virtual Reality in Product Design
Virtual Prototyping

VR in the Automotive Industry

Virtual Factory
IGD Darmstadt



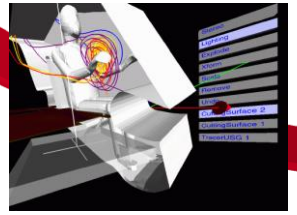
Ergonomic Studies
GMD St. Augustin



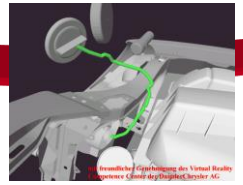
Crash Simulation
Univ. Erlangen und BMW

Marketing
Daimler Chrysler AG

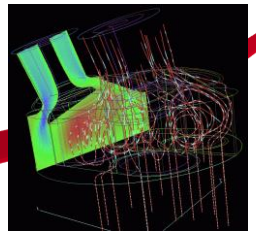
car design
GMD St. Augustin



Air Condition
Rechenzentrum Stuttgart



Assembly Planning
Univ. Saarbrücken, Daimler Crysler AG



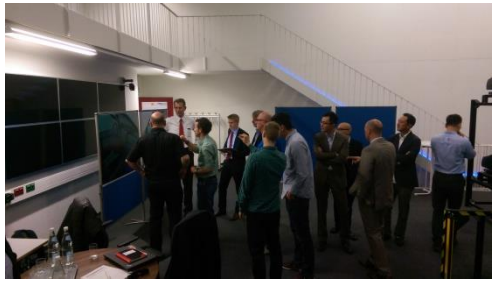
Motor Development
AIA and VRGroup RWTH Aachen

Virtual Reality in Product Design

e.GO

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

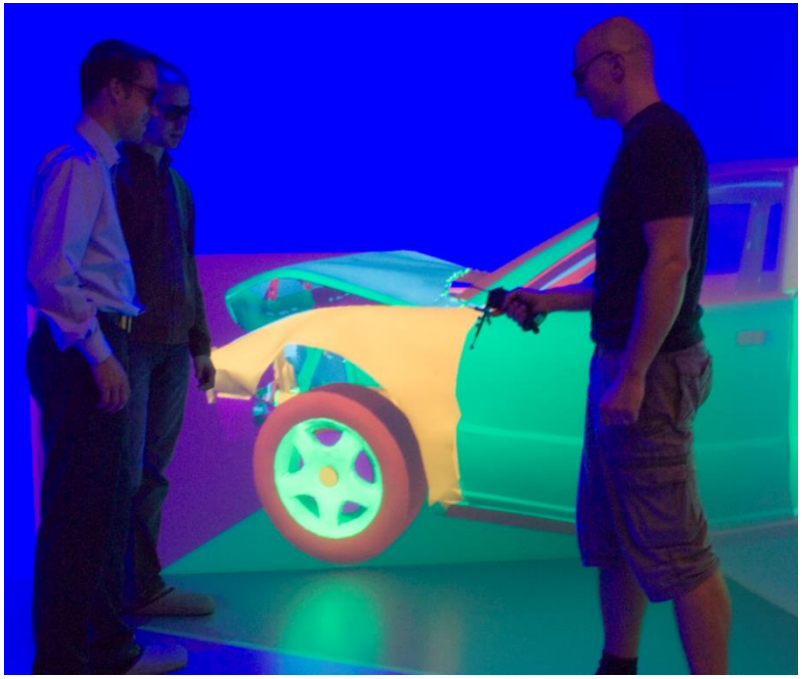
Assembly Simulation of Flexible Parts

Courtesy of ICIDO GmbH, Stuttgart

IDO:FLEXIBLES

Crash Simulation

IKA, VR Group



WZL, IAW