WABS

Wahrnehmungsbasierte Bewegungssimulation (Perception Based Motion Simulation)

funded by the Federal Ministry of Education and Research , Germany (Bundesministerium für Bildung und Forschung)

This project aims to bring the impression of simulated motion as close to reality as possible by implementing psychophysical laws of perception into the control framework of simulators. Human motion perception models are experimentally tested in driving and flying scenarios using our MPI CyberMotion Simulator in order to enable a new generation of highly effective motion simulators.

Motion perception research in virtual control environments

Decades of development in simulation technology have produced a variety of high-fidelity simulators that are capable of excellent motion rendering within wide operational ranges. Yet, very often simulator users experience dizziness and discomfort even with the most advanced motion systems. One of the main reasons for this well-known problem is the mismatch between the rendered motion and its actual perception by the simulator user.

The WABS project aims to develop control systems for motion simulators that are able to create a more realistic impression of motion by generating motion that is perceptually correct rather than physically correct.

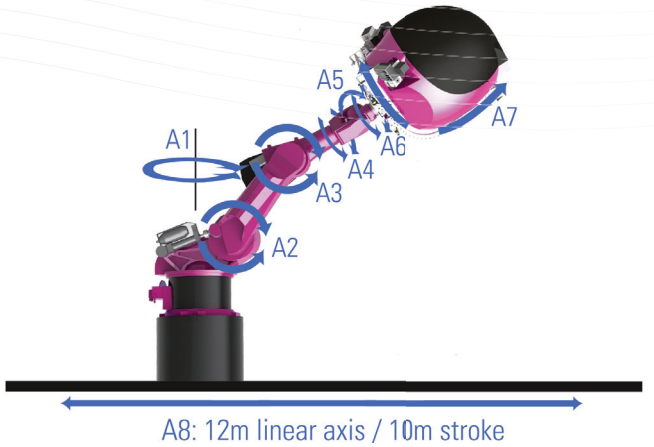
This new approach exploits the most up-to-date knowledge of human motion perception models to implement real-time, platform-independent control algorithms for a more convincing motion rendering.

www.validierungsfoerderung.de/vorhaben/wabs

Advantages

of the MPI CyberMotion Simulator

- Large motion space with 8 degrees of freedom (anthropomorphic robot arm with 6 degrees of freedom, additional drive for new closed gondola = axis 7, additional 12m linear axis with 10m stroke = axis 8)
- Motorized cabin with large-field stereo projection
- Upside-down motion profiles possible
- Low system latency
- Unlimited rotation of the first axis for sustained centrifugal accelerations
- 7th axis enhances motion envelope and rotation range



The MPI CyberMotion Simulator with its 8 independent axes.

The CyberMotion Simulator is continuously undergoing modifications and improvements (both hardware and software). Therefore, the information provided here is subject to change *(September, 2012)*.

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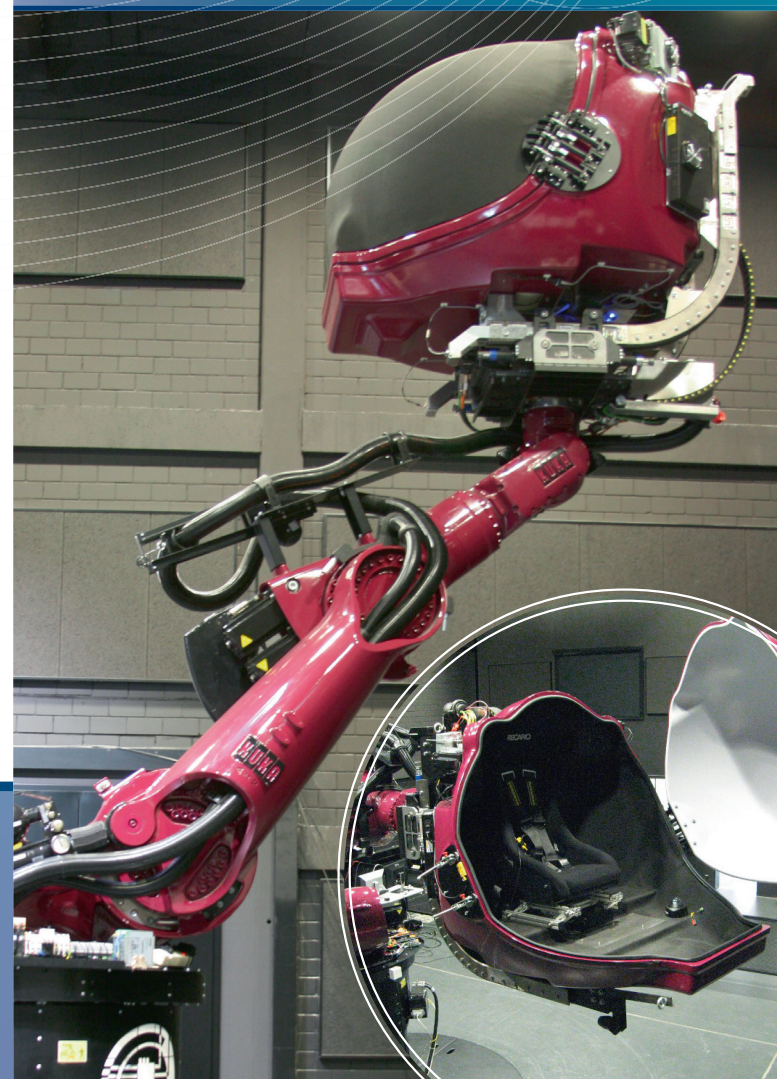
The CyberMotion Simulator: a novel tool for interactive vehicle simulation



The MPI CyberMotion Simulator

The MPI CyberMotion Simulator was developed at the Max Planck Institute for Biological Cybernetics as a novel alternative to traditional motion simulators. It is based on a commercial robot arm originally designed for use in industries such as automobile assembly. The use of this anthropomorphic robot manipulator as a motion simulator offers many advantages over standard Stewart platforms with a hexapod motion system, for example higher dexterity, larger motion envelopes, sustained centrifugal accelerations, and the possibility to place subjects in extreme orientations (e.g. upside-down).

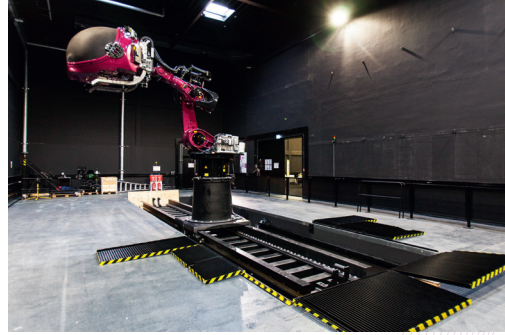
At the Max Planck Institute for Biological Cybernetics, the robot arm has been customized for use in basic research by outfitting it with a racing car seat that is equipped with a six point safety belt system and an enclosed cabin with a curved projection screen. The MPI CyberMotion Simulator can be programmed to move participants passively along predefined trajectories. It also allows participants to have complete active control over their movements through the use of various control devices (e.g. sidestick, helicopter cyclic stick, or steering wheel). In this mode of operation, the MPI CyberMotion Simulator can be used to simulate the behavior of virtual vehicles such as cars, airplanes, and helicopters.

Closed cabin with 3D projection system
Inset: fisheye view of a racing simulation

Simulator videos can be found at:
www.youtube.com/user/MPIVideosProject

A Simulator in the Service of Science

The following highlights three projects that investigate flying and driving simulation and make use of the unique abilities of the MPI CyberMotion Simulator:



The large motion range of the CyberMotion Simulator allows pilots to experience unusual attitudes in motion. Foto: Victor S. Brigola

myCopter

Enabling Technologies for Personal Aerial Transportation Systems

funded by the 7th Framework Programme of the European Union
(Transport/Aeronautics: Promising pioneering ideas in air transport)

Prevailing congestion problems with ground-based transportation and the anticipated growth of traffic in the coming decades present a major challenge in developing solutions for future personal transportation systems. As conventional modes of transport suffer several limitations, the goal of the EU-funded myCopter project is to initiate a paradigm shift and to pave the way for personal aerial vehicles (PAVs) to be used for daily work and leisure commutes. In myCopter, the vehicle itself is not yet the main focus of research. Rather, the project focuses on the impact of such a paradigm shift on society and what kind of technical infrastructure – also called personal air transport system (PATS) – is necessary to move personal transportation into the third dimension.

The project will investigate new automation technologies for obstacle avoidance, path planning and formation flying, which also have excellent potential for other aerospace applications. In addition, models of handling dynamics for potential PAVs will be designed and implemented on motion simulators and a manned helicopter. Finally, an investigation into the human capabilities of flying a PAV will be conducted, resulting in a user-centred design of a suitable human-machine interface.

In terms of the social impact, a team of experts will first ascertain and evaluate expectations and objections people might have, such as legal issues, safety concerns and ecological aspects. This will result in potential solutions to address these challenges and to ensure support for a PATS and its acceptance by society.

www.mycopter.eu

SUPRA

Simulation of UPset Recovery in Aviation

funded by the 7th Framework Programme of the European Union
(under the 2nd Transport and Aeronautics Call)

SUPRA is a collaborative research project that aims to enhance flight simulators beyond their current capabilities to allow for effective upset recovery training.

An aircraft upset can be defined as an airplane unintentionally exceeding the parameters normally experienced in standard situations. This may concern unusual attitudes (large pitch or bank attitudes) and also inappropriate airspeeds, resulting in stall of the airplane. Because the normal response of the airplane to pilot control input may be altered during an upset, it is important to train pilots to adopt alternate control strategies to sustain or regain controlled flight. To do this effectively in a flight simulator, the simulator should realistically reflect the aircraft behavior in upset conditions – requirements which current flight simulator technology is still incapable of fulfilling.

The collaborative research project SUPRA will investigate the simulator requirements necessary for upset recovery training. The models currently used in commercial flight simulation will have to be extended as part of the project. In addition, research in SUPRA will also concern simulator motion cueing required to support effective training of upset recovery manoeuvres. The motion cueing developments will be supported by experiments on pilots' motion perception in conditions similar to aircraft upset.

www.supra.aero

Three views showing configurations which cannot be achieved with traditional motion simulators.