

Web-based Teleoperation of Laboratory Experiments

Christof Röhrig, Andreas Bischoff, <http://prt.fernuni-hagen.de/>

Within the project “Real Systems in the virtual Lab” three teleoperated laboratory experiments were developed [1]. In 2000, these experiments were firstly used by our students. Students control the experiments exclusively with their standard Web browser, no additional software is needed. A live video stream for viewing the experiment and an optional audio stream helps to provide a laboratory feeling. In 2001 additional features like VRML-visualisation, Augmented Reality and a Multiuser Virtual Reality interface to the experimentation plant were added. The experiment is now useable by a group of students at a given time, all users are represented by so called avatars (representation of a real person in virtual reality). A real collaboration like in local experimentation is possible.

The remote user views the virtual representation (the avatar) of the experiment (a vehicle) in her/his VRML-browser window. An alternative way of displaying 3D-information of user-avatars is a combination of video and 3D-data, the so called Augmented Reality. In this case a VRML-representation of all the present avatars in a corresponding view to the real camera-system is generated on server-side and mixed into the live-videostream by a genlock device (a video mixing device). All those virtual and video representations are provided to give the user the impression of being physically present at the experiment, and to allow real collaboration of a group of students. The remote experimentation without the live-video-stream, but including the virtual reality collaborative environment, is still usable under worst case conditions, like a 9600 Baud GSM-mobile-phone-connection.

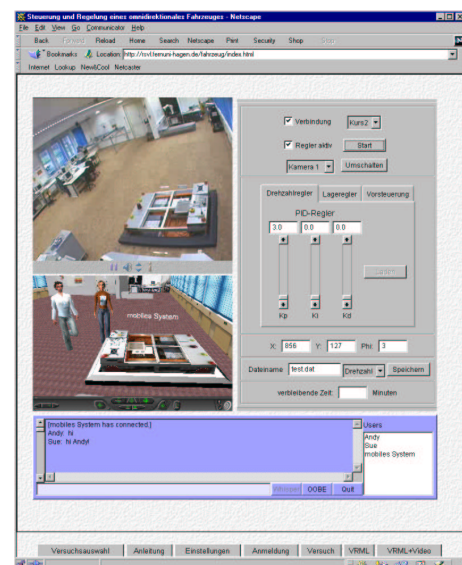


Figure 1: Integrated experimentation environment

- [1] <http://prt.fernuni-hagen.de/rsvl/>
- [2] Hoyer, H.; Jochheim, A.; Röhrig, C.; Bischoff A.: Multiuser Environment for a Teleoperated Laboratory, 1st IFAC CONFERENCE ON TELEMATICS APPLICATIONS IN AUTOMATION AND ROBOTICS, TA2001, Weingarten, July 2001,
- [3] Röhrig, C.; Bischoff A.: Remote Experimentation in a Collaborative Virtual Environment, ICDE 2001, Düsseldorf, Germany, April 2001
- [4] Bischoff A.; Röhrig, C: Reale Systeme im virtuellen Labor, kevih-Workshop Referenzmodelle netzbasierten Lehrens und Lernens - virtuelle Komponenten der Präsenzlehre, Tübingen, December 2001
- [5] Bischoff A.; Röhrig, C: MULTIUSER ENVIRONMENT FOR REMOTE EXPERIMENTATION IN CONTROL EDUCATION; INTERNET BASED CONTROL EDUCATION 2001, BCE'01; Madrid, December 2001