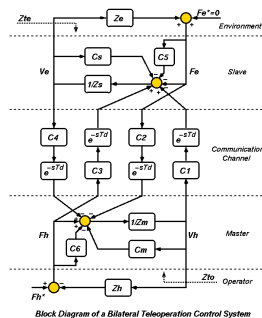# Teleoperation 3
Chairs: Robert Anderson, Junku Yuh

Analysis and Evaluation of Stability and Performance Robustness for Teleoperation Control Architectures
K. Hashtrudi-Zaad and S. E. Salcudean
University of British Columbia

- Operator/Environment uncertainties and time-delays compromise stability and performance.
- Robustness analysis using Llewellyn's criterion and impedances minima/Z-width's.
- Tradeoffs for control architectures presented.
- Design guidelines given.

Block Diagram of a Bilateral Teleoperation Control System

Design of a Teleoperation Controller for an Underwater Manipulator
Dong-Soo Kwon[1], Jee-Hwan Ryu[1], Pan-Mook Lee[2] and Seok-Won Hong[2]
[1]Korea Advanced Institute of Science and Technology and [2]Korea Research Institute of Ships and Ocean Engineering

- Teleoperation of an underwater manipulator is harder then other teleoperations
- To achieve a transparency, adaptive sliding mode control and disturbance observer are used for the slave and the master, respectively
- We got an excellent results for free motion, continuous contact motion and intermittent contact motion simulations
- A teleoperation controller for an underwater manipulator is proposed.
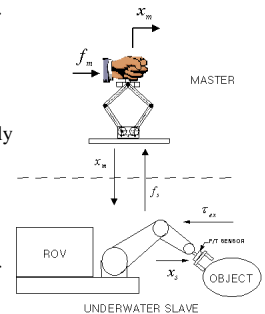
Force Reflection for Time-Delayed Teleoperation of Space Robots
L. F. Penin, K. Matsumoto and Sachiko Wakabayashi
National Aerospace Laboratory, Japan

- How to use force reflection to improve time-delayed teleoperation?
- Use force-reflecting hand controllers as displaying tools with and without a model.
- Experiments conducted teleoperating the robot onboard ETS-7 satellite.
- First extensive application of force reflection on a real space robot.

Overview camera
Robot arm
Satellite
FR Joystick
Teleoperation Station
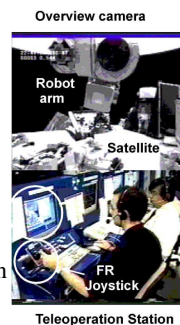
Network-Based Force-Reflecting Teleoperation
A. Sano, H. Fujimoto and T. Takai
Nagoya Institute of Technology

- This study aims to develop a practical force-reflecting teleoperator through the Internet.
- The design of controllers incorporating adjustment to the time delay could be realized in the framework of gain scheduling.
- Pushing the wall, inserting the video cassette, and holding the raw egg, have been performed with haptic senses.
- The proposed control strategy is well suited to the network-based teleoperation.

Photo-Realistic Scene Prediction of Partially Unknown Environments for the Compensation of Time Delays in Telepresence Applications
M. Barth, T. Burkert, C. Eberst, N. O. Stoffler and G. Farber
Technische Universitat Munchen

- Delays in the visual Feedback of a Teleoperation System
- Model from Camera Images, photo-realism by Texture Mapping
- Scene Reconstruction and Prediction in structured Environments
- Photo-realistic Prediction can be achieved
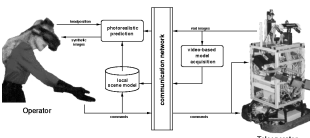
Remote Coordinated Controls in Multiple Telerobot Cooperation
N. Y. Chong[3], T. Kotoku[1], K. Ohba[1], K. Komoriya[1], N. Matsuhira[2] and K. Tanie[1]
[1]Mechanical Engineering Laboratory (MEL), [2]Toshiba Corp. and [3]NEDO

- Multi-Operator-Multi-Robot tele-collaboration with time delay.
- Coordinated control with predictive graphic simulators.
- Larger master instructions and less task completion time.
- Development of local coordinated controls in MOMR teleoperation.