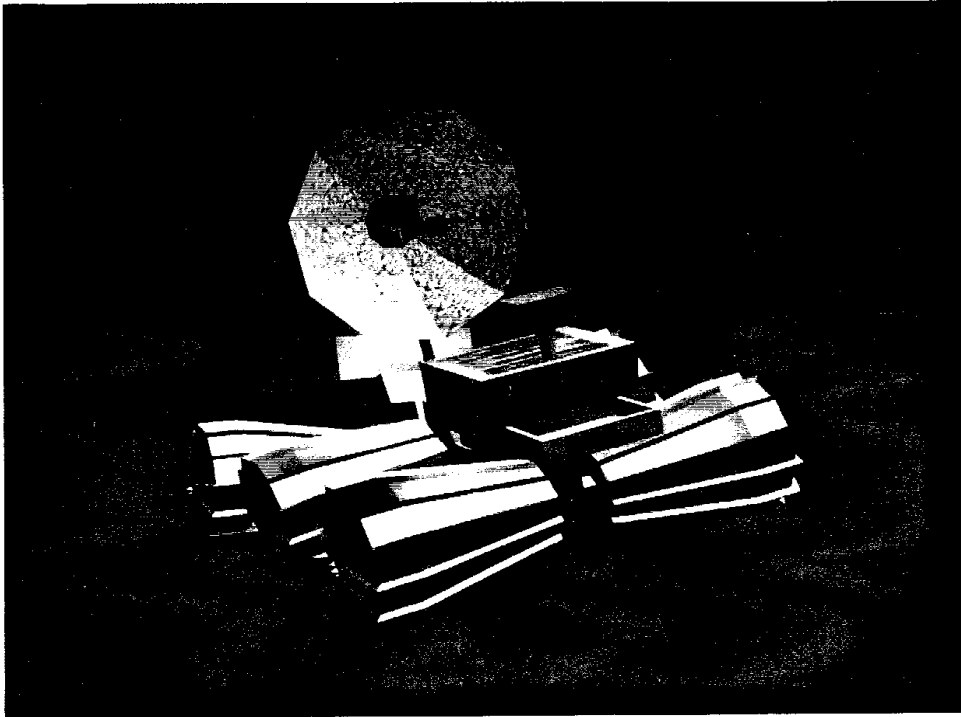


From TNO-FEL Brochure dated 1995

Dynamic Rover Simulation for Teleoperations in Planetary Surface Exploration



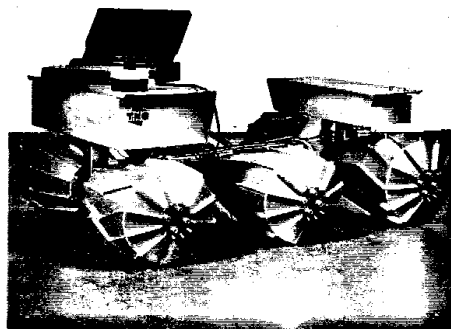
About TNO-Physics and Electronics Laboratory

The TNO-Physics and Electronics Laboratory (TNO-FEL) is a contract research organisation operating in the field of Command & Control and Simulation, and Communications and Information Technology. Expertise in the field of (distributed interactive) simulators is based on a thorough understanding of interactive multimedia, including Virtual Environments, distributed computing, computer-generated imagery, and information technology. TNO-FEL integrates domain specific simulation models, possibly originating from other TNO institutes, in their simulators when applicable.

Smart Teleoperations Workstation

Teleoperation is the technique to control a remote robot platform. Operators controlling telemanipulators usually perform their task by indirect manipulation, i.e., pushing of buttons and pulling of levers. In so-called "operator-in-the-loop" situations, the task of the operator is even more difficult to accomplish. This is especially true when there is a marked delay between a command, the resulting action,

and the (visual) feed back of the result of the action. The unstructured nature of the unknown remote environment further hinders the operator in safe control of the robot platform. In order to overcome the above-mentioned difficulties, a new generation of telerobotics control systems is subject of study and prototype development at TNO-FEL: Smart Teleoperations Workstations.



Advanced Simulation Techniques at TNO-FEL

Advanced Simulation Techniques (AST) at TNO-FEL bring together the fields of computer vision, sensor-based environment modelling, telecommunications, command and control, virtual environment techniques, robotics, dynamics modelling, and human-machine interfacing. The TNO-FEL Smart Teleoperations Workstation (STW) is to a large extent based on the emerging technology known as Virtual Reality, or Virtual Environments (VEs). The situational awareness of the operator can, in principle, be enhanced significantly. Placing the operator in a virtual environment, modelled after the actual rover workspace, allows for a more efficient, effective and safer control of the remote mobile platform and robot extensions. Interactive tools for dynamics and kinematics simulation, planning, modelling, and robot conditioning provide the operator with means to specify the rover's actions in the virtual environment. Tools for direct control purposes in the actual environment are under way. Commands derived from the simulation can be sent to the rover for execution, after which the process of simulation and manipulation can be repeated until mission targets have been reached.

Teleoperations platform

To be able to verify the concept of performing teleoperated task making use of the dynamic rover simulation workstation, TNO has constructed a teleoperations platform, capable of traversing terrain types resembling planetary surface characteristics. The rover is fully teleoperated and can be equipped with all kinds of sensors and actuators to perform various teleoperation experiments. The project is a joined activity between four TNO institutes. TNO Physics and Electronics Laboratory has developed the teleoperations workstation in which the dynamic simulator of the rover, implemented by the TNO Road-Vehicles Research Institute, is integrated. By the latter institute also the construction of the rover has been done. The TNO Institute of Applied Physics was responsible for the control part of the rover. Finally, TNO Building and Construction Research Institute has integrated a laser positioning system, CAPSY, to be able to monitor the behaviour of the rover during operation.

TNO-FEL: Your partner in R&D

A wide experience in real-time simulation, computer-generated imagery, world modelling and database building, and distributed computing enables TNO-FEL to render R&D services to industries and governments in this exciting field.

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