Diploma Thesis Proposal

Intuitive context-free glove-based control for remote teleoperation via a virtual environment

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1 Abstract

The operation of remotely operated or semi-autonomous robotic systems by a human operator today is a difficult task to perform. Traditionally, a robotic system is controlled via a graphical user interface with complex menus, tabs and other hierarchies to provide the operator with all necessary sensor data and control functions. However, this requires the user to often shift his attention away from the robotic system to navigate through often complex menus in order to activate a program function or adjust an important parameter. However, these defocussations always causes a delay between the robot's action and the operator's reaction, additionally causing the operator not to pay attention on the robots' doing while being busy navigating the user interface. This may result in orders being issued late, or, in a worst case, even in loss of control of the situation, regardless whether the robot is controlled with a direct line of sight or being piloted from a distance.
These problems do not only apply to virtually "safe" environments such as simulation environments or laboratories. With prospect of future space missions as currently planned by NASA and ESA, teleoperation is an important part of manned space missions, including the control of manipulators or remotely operated exploration rovers. Although they provide the necessary protection from (amongst others) mini-asteroids, temperature and radiation, todays space suits also mean heavy encumbrance to their user, making accurate and precise interaction very difficult and cumbersome. Therefore, the development of a suit-integrated data glove based control for remote operation of semi-autonomous systems have already been suggested in 2003 [1].
Thus, the development of an intuitive glove-based gesture control system is an important step to improve the development and deployment of remotely controlled or semi-autonomous systems.

2 Objectives

The shift of attention between the robotic system and its control interface can be countered by utilizing a virtual environment in order to merge all relevant sensory feedbacks such as the robots state, its surroundings (as far as known to the robot) and also its controls into a single, interactive entity.

This diploma thesis aims to develop an intuitive dataglove-based gesture control system for easy and context-free control of the SpaceClimber robotic system utilizing the DFKI CAVE as a virtual environment.

To allow for a smooth and natural interaction in and with the virtual environment, a gesture recognition system will be implemented using the CyberGlove Systems CyberTouch© data glove in combination together with the InterSense© tracking system. A virtual model of the SpaceClimber robot will provide visual feedback of the real robots state and mutually allow for system configuration by interacting with the model in a context-free manner. For example, grasping the body and moving it up/downwards can be used to set the robots body-above-ground height, while grasping the entire robot and moving it to a different location could issue a movement command, much like setting a waypoint.
Further, the system is not only restricted to easily adjust the robots runtime parameters or issue semi-autonomous control commands, but to control the robot in a more direct way. For example, if the robot is stuck in a difficult situation, the operator could manually control and move each of the robot's legs individually in the virtual environment, which would then be transmitted to the real robot.

The diploma thesis will be concluded by evaluating the new control concept against traditional control methods to validate improvements in both usability of the system and controllability of the robot.

References

[1] Pennsylvania State University Mars Society, editor. *Integrated Astronaut Control System for EVA*. Pennsylvania State University Mars Society, 2003.