

Dynamic Camera Usage in Mobile Teleoperation System for Buzz Wire Task

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Abstract—Visual feedback is the most important form of perception within teleoperation, therefore there is a need for a solution that allows for increased potential information gain that a camera can provide, this can be obtained by having a camera that is able to move its position relatively to the base robot. Therefore, this paper focuses on the use of a drone to act as dynamic camera in teleoperation scenarios. The drone control is performed via the use of hand tracking through a wearable motion capture suit and is built upon an existing teleoperation control framework. The usability of the dynamic camera is demonstrated through the use of a simulated drone to act as a dynamic camera in a simulated buzz wire task.

Index Terms—legged manipulator, quadruped robot, teleoperation, dynamic camera

I. INTRODUCTION

Teleoperation has been a rather useful application of robotics, in that robots can operate in scenarios that are too demanding or unsuitable for humans. However, for a teleoperated robot to be effective, the feedback from the robotic system must also be of high quality. Visual feedback is the main source of information for teleoperators controlling a robot and when operating in distant environments, the location of the camera is typically limited to the teleoperated robot. This allows for the robot to complete simple tasks, however, when delicate tasks such as moving hazardous objects or surgical scenarios, the placement of the camera can make teleoperation much more difficult. Traditionally, cameras have always been physically connected to the teleoperated robot, however, due to this limitation, there is a risk of other objects located on the robot such as robotic arms blocking the vision of the camera and impeding the teleoperation process. A mobile dynamic camera has the potential to avoid issues like these and also give the teleoperator a greater sense of depth and perception when considering a manipulation environment.

When teleoperated robots use only a single camera mounted on the robot, perception is more difficult for the teleoperator [1]. Manipulation difficulties can be avoided through use of object-orientated manipulation, however, this requires prior knowledge about the object being manipulated [2].

Cameras which span 360 degrees are a new innovation that have seen use on many teleoperated systems, however, as the

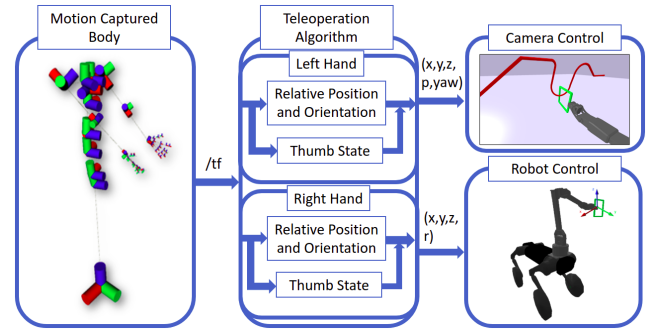


Fig. 1. An system overview of the control framework within the simulated task.

camera itself is typically located in a fixed position on the robot, it is not possible for a teleoperator look beyond objects obstructing the cameras vision without moving the robot itself [3].

In this paper, a simulated drone based dynamic camera controlled via the use of hand tracking in a motion capture system is combined with a mobile manipulator system that is teleoperated in a simulated environment to complete a buzz wire task.

II. SYSTEM OVERVIEW

For our teleoperated system, we use the Unitree's Aliengo quadruped robot, with additional actuated wheels on the feet, to provide linear movement, and a mounted ViperX 300, a 5 degree-of-freedom (DoF) robotic arm produced by Trossen Robotics, located on the top of the robot. Wheels allow the quadruped to perform linear movement without generating additional oscillations from actions such as stepping, which would be detrimental in this task. This also allows the quadruped to freely use its legs to adjust it's base height, effectively increasing the workspace of the robotic arm. Control of this robotic system is performed via sending position and orientation references to the end-effector of the robotic arm. These references are then coupled with the rest of the robot using a whole-body controller [4].

The dynamic camera system is built upon an existing teleoperation system [5] which uses a wearable inertia-based suit to control robotic systems through hand movements and finger-based triggers. In this scenario, the left hand is responsible for controlling linear movement and orientation of the dynamic camera, using the thumb as a trigger to switch between linear movement and orientation control. The right hand controls the

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