

Development of an Electronic Differential Drive Platform for Off-Road Unmanned Vehicle Under Rapid Changing of Road Friction

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This research project represents the development of an electronic differential drive platform for off-road unmanned vehicles to improve their mobility under rapidly changing road friction conditions. The platform we have proposed utilises a Disturbance Observer (DOB) and a Reaction Torque Observer (RTOB) to deal with sudden and repeated changes in road friction and slope changes. To evaluate the effectiveness, we conducted simulations through MATLAB-Simulink and ROS-Gazebo. The Simulink simulation involved testing the wheels' speed changes on inclined and uneven surfaces. The ROS-Gazebo simulation provided a more realistic environment, creating off-road conditions. The ROS simulation involved navigating the robot through off-road terrain with varying friction conditions, and the same Simulink block diagram can be used in the ROS simulation. The ROS-Gazebo simulation made it easier to illustrate the effectiveness of the proposed platform in real-world situations. The DOB controller was employed to estimate and mitigate the disturbance caused by the changes in friction or slope by providing counteractive feedback response to those disturbances. The RTOB detected the resistance or torque encountered by the wheels. Its primary function was to monitor and estimate the reaction torque or rotational forces acting on the vehicle's wheels or drivetrain. Overall, the simulations in both Simulink and ROS-Gazebo demonstrated the effectiveness of these two controllers in maintaining stability and robust control while navigating uneven or challenging terrains. In summary, our research findings have the potential to enhance the sustainability of cities through the development of more robust and efficient unmanned vehicles for off-road applications.

Keywords: DOB, RTOB, ROS, Gazebo, Simulink

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