Steering Vehicle with Force-based Impedance Control for Inertia Reduction

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***Abstract*— This paper presents the inertia control on a steering rack vehicle using interaction control approach through force-based impedance control. Overdriven factor in a vehicle motion especially on a cornering track, is one of the issues that need to be tackled for safety and energy efficiency. Hence, in the attempt to cope with the issue, this study proposes to implement a dynamic control technique that considers the interaction between the vehicle and its terrain by using indirectly shaping inertia forces. The proposed force-based impedance control is derived by considering the forces developed by the rack steering vehicle and shaping the vehicle velocities as its kinodynamic inputs. The implementation of the proposed dynamic control, emphasis is given to the vertical and horizontal axes of the vehicle body, during which inertia could happen as its velocity is at its lowest. This proposed dynamic control strategy is verified by simulating on the steering system model with road terrain and aerodynamic frictions as disturbances. The simulation results shows that the proposed control system is able to reduce the inertia forces via shaping the velocity inputs to the vehicle, even though road terrain and aerodynamic frictions are present in the cornering tracks.**

Keywords*— *Rack Steering Vehicle, Inertia Control, Force-based Impedance Control, Cornering Track

Vehicle (HGV) when taking a corner. For this vehicle the maneuver flight control scheme was proposed to reduce the adverse effect caused by over slip of the wheeled mobile robot in order to control the stability of the wheeled mobile robot [5]. Receding Horizon Model Predictive Path Follower (RHMPPF) then was introduced by Rajagopalan *et. al.* to improve the path following by the wheeled vehicle that referred to WMR system. This method specifically to overcome the slip incident during vehicle cornering through predictive slip correction using proposed RHMPPF [6].

Center of Gravity (CoG) of the vehicle system also can be used as criteria in solving the inertia factor as proposed by Huang and Wang [7]. In their works they had combined a real-time CoG position estimator using a combination of Adaptive Kalman Filter and Extended Kalman Filter (AKF-EKF) approach, to reduce the overforce of lightweight WMR. The backstepping control method to balance the side effects of wheeled-vehicle, notably the sideslip angles also becoming one the approach for vehicle's inertia control in which an observation was used to estimate the sliding. This control method can be used to achieve difficult manoeuvres in small environments such as a parallel parking or sharp turn in cornering [8].