

https://dspace.org/

Off-road handling of a mini baja vehicle

Winnaar, Kyle Thomas

2017
https://hdl.handle.net/10539/24615
Winnaar, Kyle Thomas, (2018) Off-road handling of a mini baja vehicle, University of the Witwatersrand, Johannesburg, https://hdl.handle.net/10539/24615

Downloaded from a DSpace repository. https://dspace.org/

Abstract

The primary focus of vehicle dynamics studies have been the handling capabilities and suspension design of a vehicle to achieve the optimal road holding capability and ride comfort level. Numerous studies have focussed on the design, modelling and optimisation for on-road vehicle suspensions, but the study of vehicle dynamics on off-road surfaces is still relatively new. The objectives of this dissertation were to characterise the steady-state cornering response for on-road and off-road surfaces, evaluate the open-loop vehicle response using the step-steering input manoeuvre, and evaluate the closed-loop vehicle response using the double lane change (DLC) manoeuvre of a mini baja vehicle. The mini baja vehicle was instrumented with an inertial measurement unit (IMU) to measure vehicle accelerations and yaw rate, a steering angle sensor, throttle and brake position sensors, and a wheel speed sensor to measure rear wheel angular velocity. A tarmac surface was used as a control test surface, while grass and dirt track surfaces offered decreasing tyre grip levels, resulting in larger sideslip. The handling on the tarmac surface was repeatable for all the cornering tests performed. On the grass and dirt track surface, tyre grip levels decreased, resulting in an increase in steering variability when exposed to transient cornering. On the grass surface, the tyres were able to generate sufficient lateral force to obtain understeer up to a maximum lateral acceleration of 0.6 g. Up to a maximum lateral acceleration of 0.35 g, the tyre grip level was still sufficient that the handling was stable on the grass and dirt track surfaces as compared to on the tarmac surface. On the dirt track surface, the tyre traction decreased at a lateral acceleration of 0.35 g and the vehicle exhibited oversteer at a maximum lateral acceleration of 0.39 g. The tyres were unable to develop sufficient lateral force on the dirt track surface for high lateral acceleration manoeuvres. When performing transient cornering, the ability of the tyres to develop a lateral force had the biggest influence on handling on surfaces which offered low tyre traction.