

Summary

This report describes a method and the accompanying program to predict the driving characteristics of an electric scooter without the need to build a prototype.

“Driving characteristic” is a very general and undefined term. To evaluate a particular design of an electric scooter on these driving characteristics, quantifiable parameters have to be identified. Three commonly encountered scenarios are considered: Driving straight ahead, cornering and driving at very low speed. Each scenario has different aspects which influence the handling of the vehicle.

The parameters which are used to evaluate designs are the total mass of the scooter, the vertical position of the centre of mass, the amount of over- or understeer and the self-stabilizing ability of the design. The amount over- or understeer is determined by the wheel load, a front loaded scooter will tend to oversteer while a rear loaded design will understeer. The self-stabilizing ability is expressed in eigenvalues of the equations of motion.

The design is evaluated on three aspects; comfort, manoeuvrability and safety. A low total mass and centre of mass has a positive influence on all aspects. The ideal weight distribution for manoeuvrability is an equal wheel load on both wheels, assuming using equal tyres on front and rear wheel. Because understeer is very dangerous for single-track vehicles, a slightly understeering scooter is safer. A stable scooter will be more comfortable as less effort is required to keep the desired heading. As the stable scooter will tend to remain upright is harder to lean into a corner and therefore less manoeuvrable.

The accompanying program can be used to calculate these evaluation parameters from an input consisting of the simplified geometry or the more complex input including moments of inertia of each component.

Examples are given which show an agreement of the expected results with the evaluation parameters determined by the method.

While it will remain difficult to predict behaviour and feel of a scooter, this methods will give the designer a tool with which he will be able to compare a design to benchmark designs or models which are already built.