Air drag: Fd

eq. 1

Rolling drag: Fr

The force F2 that is needed to move car

eq. 2

Eq. that sums up all forces that interact on the car

eq. 3

We combine eq. 1 and eq. 2 into eq. 3. We estimate that the rolling resistance to be negligible, hence we get eq. 4.

eq. 4

The vehicle engine transmits the power to the wheels from this equation

eq. 5

We insert eq. 5 into eq. 4

eq. 6



Figure

Now let have a look at the vehicle electric motor. The torque is a linear proportional to the current and is motor torque constant.

eq. 7

We can derive eq. 6

eq. 8

The angular velocity is defined as a linear voltage difference, proportional to the angular velocity of the armature shaft and

eq. 9

By using Kirchoff’s laws in figure 1, the following equation can be derived

eq. 10

From eq. 9 the torque of the electric engine have been found and can be inserted into eq. 6

eq. 11

Before eq. 11 is Laplace transformed all the constants will be substitute

And we have:

eq. 12

Laplace transformed eq. 12

Parameter definition

mass of the vehicle

wheel inertia

radius of the wheel

electrical resistance in the motor

angular velocity constant

torque constant