# Assignment 2 – Vehicle dynamics

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### Introduction

In this report, we are going to analyse the implementation and simulation of a rear-wheel-drive electric passenger car in MATLAB and Simulink. The target of the work is to develop a model of a vehicle motion and carry out tests of different cases, related to the main elements that are involved in the longitudinal dynamics (acceleration, friction braking, energy consumption, regenerative braking)

As a case study vehicle was given in the assignment, a set of parameters was already provided Fig/table and, whenever required, reasonable assumptions were made in order to obtain a complete and consistent description of the vehicle.

### Description of the model

The overall model consists of multiple subsystems, each one of them modelling different aspects of the vehicle.

#### Wheels

4 independent wheels, which share a common referenced model *wheel\_model.slx*, take as inputs the vertical load, friction coefficient, velocity of the vehicle and applied motor and braking (due to dissipative brakes) torques.

According to the Pacejka 96 tyre model, forces are computed and, in our case study, only the longitudinal component is used in next steps.

A second subsystem, regarding wheel dynamics, applies the moment balance equation, which considers torque given from the motor, friction brakes, rolling resistance and longitudinal force, in order to compute the angular acceleration and speed.

Tyre longitudinal slip is computed as a function of the vehicle speed and the obtained angular speed, it can fed either directly to the Pacejka function or to a subsystem which models tyre relaxation and computes a delayed slip ratio based on a mass-damper first order dynamics similarity, based on values set in the script.

ABS??

#### Longitudinal dynamics

Acceleration and speed at the center of gravity are computed based on the force balance equation, which considers the total longitudinal force, aerodynamic drag, gravity (due to possible inclination, but always set to 0 in our examination) and rolling forces.

As some of the formulas hold only for non-negative speeds, a saturation block is used.

#### Power losses

The model relies on a *parameters.m* file which contains both given and assumed parameters.