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Virtual Physics

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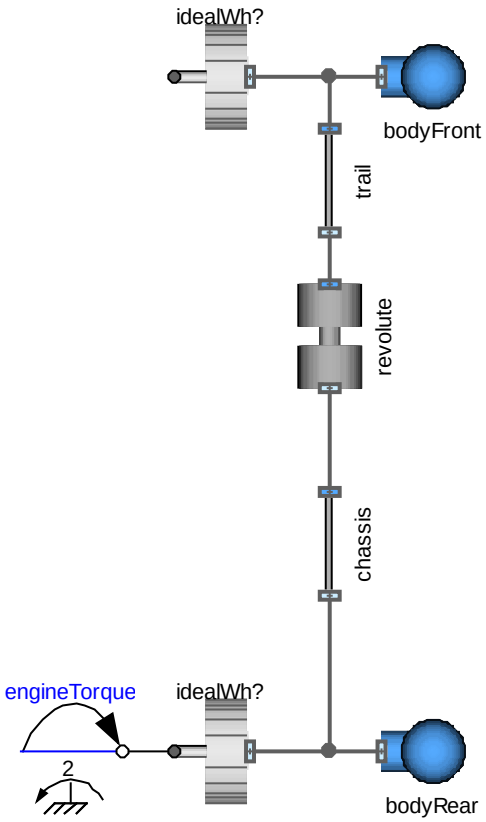
Exercise 8: Modeling of a Two-Track Model



Task A: Develop a two-track model of a car

Starting from the single-track version (picture above), develop a two-track model of car. A two-track model contains all four wheels of the car.

First, we have to replace the ideal rolling wheels with dry-friction or slip-based versions. Also the wheels now have their own inertia for the rolling axis. **Explain**: Why is it not possible to apply the ideal rolling wheels in a two-track model?

Then we can extend the single-track model to a two-track model. You may start with the rear part, modeling a tricycle as intermediate step. Both rear wheels share the same driving axis. The engine torque is acting on this axis. You need to plug in your differential (see Exercise 4) in order to transmit the power of the engine.

Finally, you can model the two front wheels. The steering angle of the two wheels shall always be equal (although this is not ideal for tight cornering maneuvers). There is a single inertia for the whole steering mechanics.

Below you find all important parameters:

Model Parameters

Wheel base (distance between front and rear wheel):	2.2m
Width (Distance between left and right wheel) :	1.5m
Trail	5cm
Weight in the geometric center of the car:	1.6t
Inertia at the geometric center of the car	1270kgm^2
Inertia of the Steering	15kgm^2
Inertia of the wheels	3kgm^2
Normal load on the wheels	4000N
Stiction Coefficient:	0.8
Friction Coefficient:	0.4
Sliding Velocity	0.15m/s
Adhesion Velocity	0.05m/s
Driving Torque:	80Nm

Test your model and play around with it!

Task B: Develop suitable components for a car.

When you have created and tested your car model, take a close look at it. It is likely that it contains many components in on a single flat modeling layer. A more hierarchical modeling of the vehicle might be favorable.

Thus, develop a suitable decomposition of your two-track model. For instance, create sub-models for the rear-axis, the front-axis (including steering) and the chassis as well as the engine. Provide a meaningful parameterization for your components.