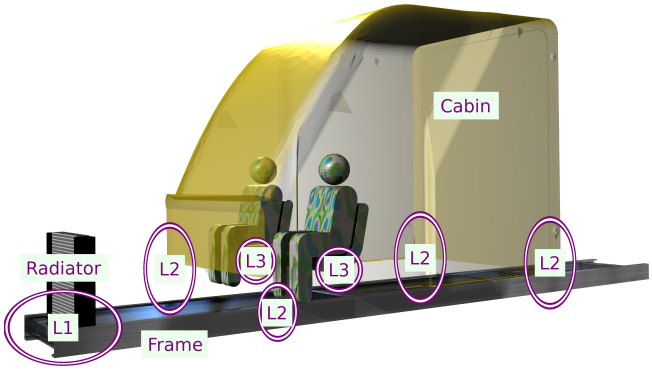
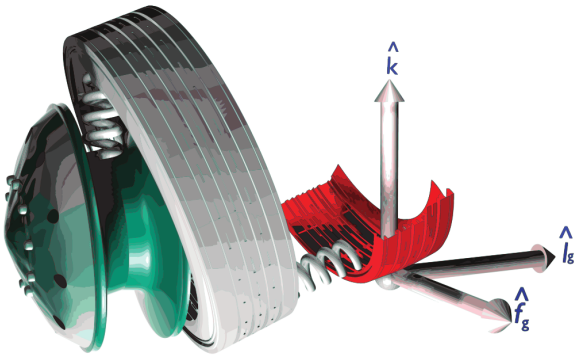
STUDYING TIRES, ROADS, AND CYCLOIDAL ROTORS WITH MULTIBODY DYNAMICS

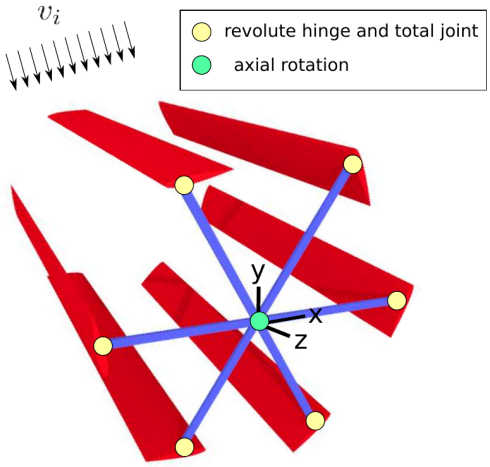
THE MBDYN OPEN-SOURCE MULTIBODY TOOL DEVELOPED AT POLIMI HAS BEEN USED TO SUCCESSFULLY ANALYZE THE DYNAMICS OF TIRES, THE INFLUENCE OF THE ROAD DEGRADATION ON THE BEHAVIOR OF LARGE TRUCKS, AND THE EFFICIENCY AND STABILITY OF CYCLOIDAL ROTORS.



A model of a **semi-trailer truck** was built and then calibrated and validated by an on-road experimental campaign of coastdown tests. The model was used within an extensive profile study that linked specific profiles to their impact on energy consumption, vehicle wear, driver and passenger health, and safety. It allowed to identify trends in the relationships between 19 different profile evaluation criteria and the impacts aforementioned. The model accurateness was also assessed by comparing the relationships obtained to those published in the literature.

The rigid ring **tire** model used within that truck model takes as input the longitudinal profile of the road. It is intended to evaluate the transient behavior of the tire rolling on a deteriorated road profile. It is tailored for applications at low camber angles, limited steering and velocity changes, and continuous contact with the road. It is expected to be accurate under excitation frequencies up to 100 Hz and road deformation up to 20% and it is integrated implicitly except for the road profile. The model has been calibrated and validated against a trusted finite element analysis of Michelin XZA-3 tires mounted on a wheel and axle assembly going over rectangular cleats.





Cycloidal rotors consist of an arrangement of blades that rotate and pitch about a central drum. The blades are aligned with the drum axis. By pitching harmonically they create a net propulsive force which can propel an aircraft. Thus, the aeroelastic response of a cycloidal rotor has been studied using MBDyn. The efficiency and the stability of the cycloidal rotor in various configurations was studied. The model is validated using a set of data obtained from experiments conducted by three different parties. The use of cycloidal rotors as a replacement for the tail rotor of a helicopter has also been considered. Preliminary analysis suggests that they can potentially cut down the propulsive energy demand of a helicopter at high velocities.

Louis Gagnon does research on the dynamic modeling of vehicles and energy efficiency. He obtained his Bachelor of Engineering at McGill University and his MSc and PhD of Engineering at Laval University. He has published many articles on the dynamics and aerodynamics of vehicles. Louis presented various engineering projects in popular magazines, on television, and on the radio. During his studies at McGill, he joined the Electric Snowmobile Team, and at Laval, the Supermileage team. He coordinated the planting of fruit trees on Laval's campus and he was awarded the G.H. Duggan Medal by the Canadian Society for Mechanical Engineering. Finally, Louis is currently at the end of a postdoc at Politecnico di Milano working on an energy efficient cycloidal rotor concept.