

A) Longitudinal acceleration compensation control through electric powertrain torque modulation (2 or 3 students)

Road irregularities induce vertical and longitudinal vibrations of the sprung and unsprung masses, which affect vehicle comfort. While the vertical dynamics and related compensation techniques are extensively covered by the suspension control literature, the longitudinal dynamics on uneven road surfaces are less frequently addressed, and are significantly influenced by the tires and suspension systems. Electric powertrains, e.g., on-board and in-wheel powertrains, in conjunction with pre-emptive control based on the information on the road profile ahead, have some potential for effective compensation. The target of this project is to explore AI or distributed control solutions for reducing the longitudinal acceleration oscillations caused by road irregularities. The resulting algorithm/s will be implemented in a simulation environment, e.g., Matlab/Simulink, and then tested on a real vehicle, i.e., the ZEBRA (picture below), fully equipped with the most advanced sensors for vehicle control assessment and control units for algorithms deployment (dSPACE MicroAutobox III). Moreover, a further thesis proposal concerns the possibility of testing control algorithms already developed on a Range Rover Evoque in collaboration with Tenneco Automotive, Sint-Truiden, Belgium.



Fig. 1. The ZEBRA vehicle of the University of Surrey.

Required skills:

- MATLAB & Simulink programming
- Python
- Knowledge of control engineering (e.g., gained from university courses)
- AI (highly desirable but not essential as it will be learnt during the project)
- Proactivity

References:

- 1) V. Vidal et al., "On Pre-Emptive In-Wheel Motor Control for Reducing the Longitudinal Acceleration Oscillations Caused by Road Irregularities," in IEEE Transactions on Vehicular Technology, vol. 71, no. 9, pp. 9322-9337, Sept. 2022, doi: 10.1109/TVT.2022.3172172.

Additional information:

The student responsible for the control algorithm development task can work remotely for the entire duration of the project. However, the students responsible for the experimental tests task are required to be on-site for the visiting period at the University of Surrey (UK) or at the Tenneco Automotive Center (Belgium).