Key Characteristics: Optimal control problem integrating human behavior and operational constraints • Driver-vehicle-railway model for optimization problem •

New approach to design a human factor based eco-driving system for tram

This project proposes an original new way to design a so-called SECAAC (the French acronym for Human Factor based Self-Adaptive Eco-Driving System).

SECAAC is an Eco-Driving Advisory System (EDAS) which adapts the Eco-drive advice, given by a Head-Up Display, based on human factors. Currently, the driver cab is equipped with an EDAS which integrates a controller where an optimal control problem is computed. This optimisation problem is a multi-model approach where the kinematics, consumption of the vehicle and the environment are computed to reduce the vehicle consumption by calculating an optimal velocity profile. However, in tram transport, the driver remains in the control and supervisory loop, takes charge of several manual tasks and the delay of driving is short between two stations. As the eco-driving task consists in respecting a commanding speed, it can then be assimilated to a tracking task that can be perturbated by traffic flow, safety or security constraints or the degradation of the driver cognitive or physical state due to human factors as fatigue, distraction, and inattention.

Therefore, the new advice called SECAAC is proposed in order to adapt the set-point to such variations of the driver state. SECAAC includes a driver-vehicle model linked with the vehicle kinematic characteristics and a human model to identify real-time human parameters. Experiments on a railway simulator involving tram drivers demonstrated that SECAAC reduces consumption by about 14% and improves the tracking task performance in a mixed traffic density by about 17% compared to EDAS •