Dynamic Predictive Energy Management

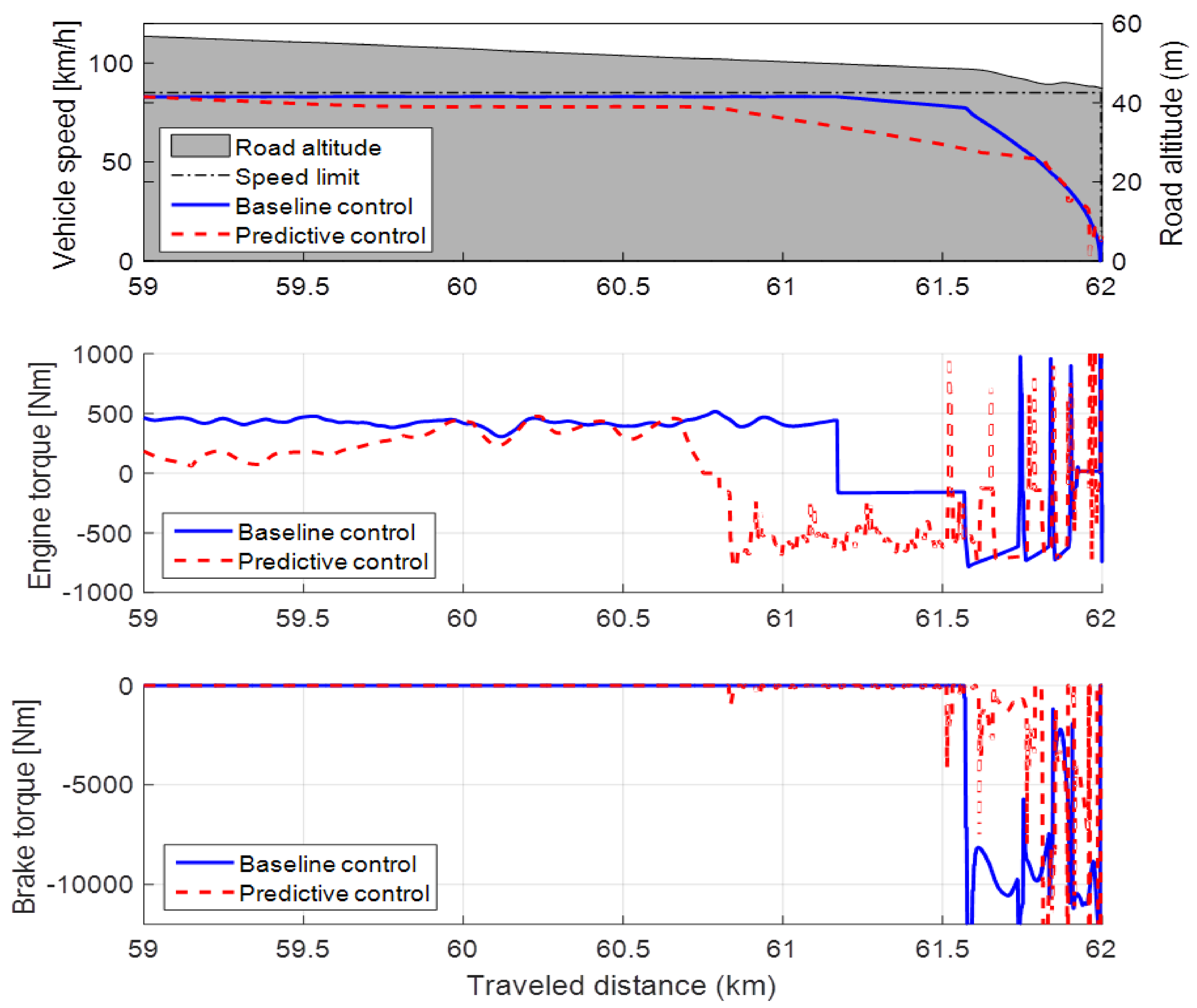
Challenges and solutions:

State of art today uses eHorizon with slope data for optimal gear shifting. However, addition of traffic disturbs the predictions as well as increases the torque transients due to increased intermittent braking events. This leads to increased fuel consumption both in conventional powertrain as well as for hybrid electric powertrains.
The solution to this is to incorporate the knowledge of the traffic flow a head of the vehicle into the predictions. This is done by adding the dynamic vehicle speed of the traffic a head in conjunction to take integrated the adaptive cruise control into the predictive energy and power management. The latter to handle the impact for traffic close to the vehicle
The combination of local and predictive optimization. The prediction may use different length scales considering vehicle dynamics, battery capacity, elevation of road and predicted traffic conditions.
The challenge in this context is to incorporate the eHorizon data with slopes and dynamic traffic speed into a predictive energy management control strategy.

IMPERIUM's contributions:

In IMPERIUM, a predictive energy and power management control strategy is implemented using the dynamic eHorizon data. This is then verified both in vehicle and in simulations. This control strategy uses the eHorizon data to optimize the vehicle speed profile over a control horizon as well as the co-state for a hybrid powertrain to minimize the fuel consumption.
An integrated engine and EATS supervisory controller and hybridization requires a predictive controller that is global, knows the current operating conditions of the vehicle and its powertrain components can only enhance the fuel saving.
In IMPERIUM this is further boosted using predictive controllers that have dynamic information such as traffic conditions. The Engine and EATS supervisory controller manages not to exceed the tailpipe NOx mass-flow constraint during almost the entire cycle, with the only exception of the initial heating phase. Additionally, the controller tries to prevent the crossing of the maximum SCR inlet temperature avoiding the fastening of the intake throttle valve, starting when the prediction estimates an overrun to take place at the end of the prediction horizon.

Impact / what's next:



The outcome of IMPERIUM is highly valued. The three years of development of these control strategies have leverage the knowledge substantially. The developed control strategies will be transferred into pre-product development. The intention is to further mature the control strategies and integrate them into the products.

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