Control of a Driveline with a Slipping Clutch

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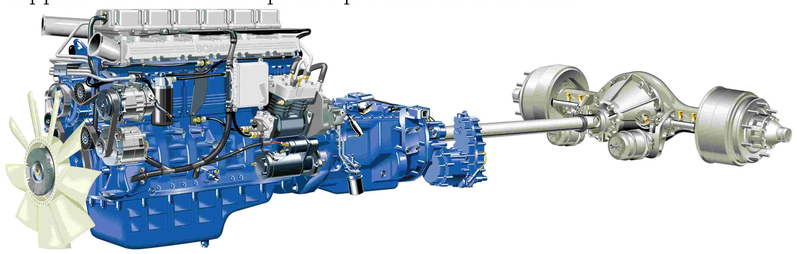
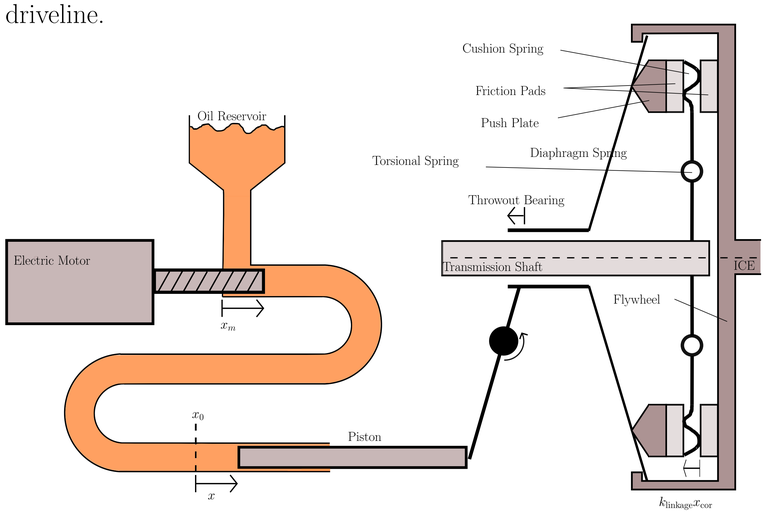
Integrated Powertrain Control

The behavior of a vehicle is not only controlled by the engine. There are several actuators available in a vehicles driveline (automatic clutch, Automated Manual Transmission (AMT),...) that can be used to affect the vehicle drivebility. By using these different actuators in an integrated manner with common control targets, performance and comfort benefits can be achieved. Scania acts as industrial partner in this project and supplies hardware and specific problem formulations.



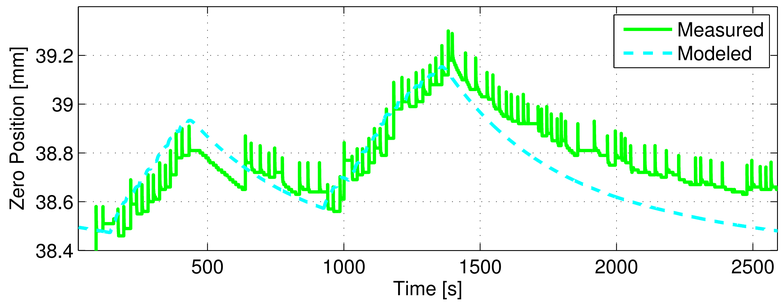
Control of a Driveline with a Slipping Clutch

The use of an automatic actuator for the clutch gives new opportunities for controlling the engine and driveline. Several applications would benefit from advanced clutch control. For example start and stop strategies for heavy trucks can be employed and in addition clutch control can be utilized in AMTs to reduce the time for gear changes, which is a crucial parameter for preventing stall in heavy trucks during hill climbing. Furthermore it is possible to use clutch control to damp oscillations in the driveline.

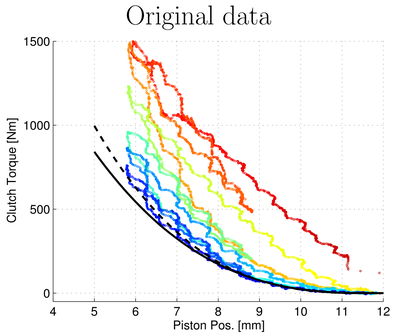


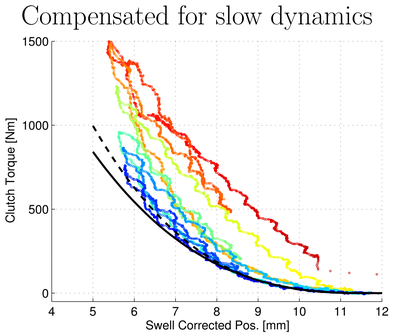
An important first step is to gain the fundamental knowledge about the important characteristics of a driveline with a slipping clutch. This has been done through modeling.

Clutch Model



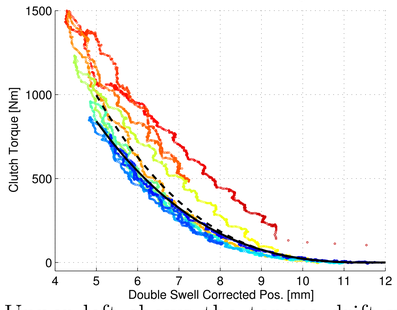
When the clutch is closed the expansion of the iron cast parts can be measured with the sensor on the piston.

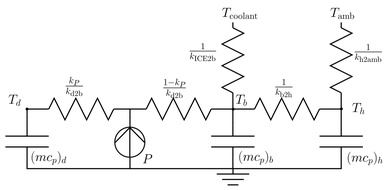




Comp. for fast and slow dynamics

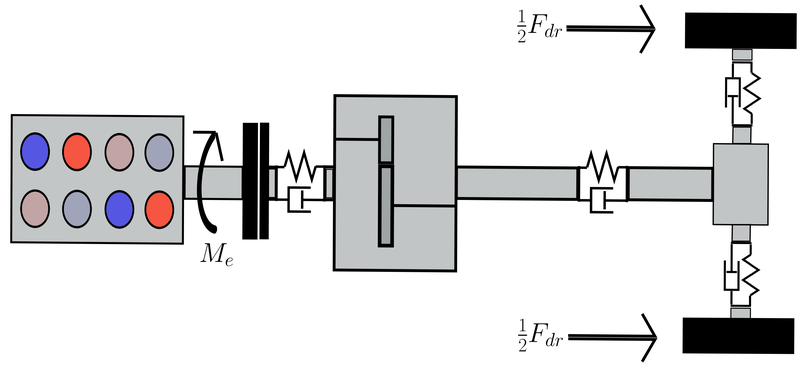
Thermal model



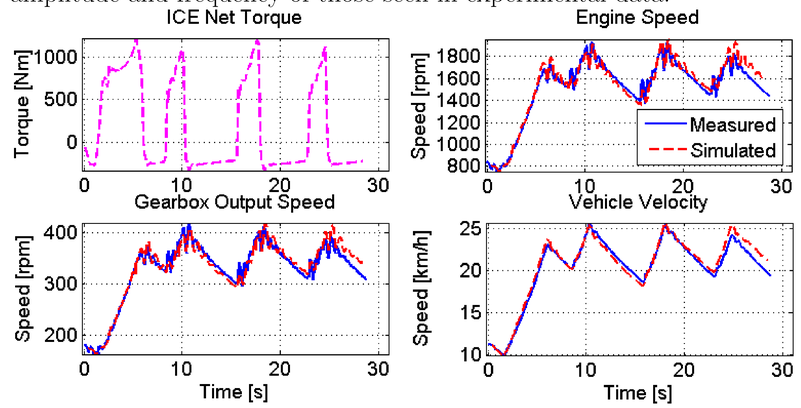


Upper left shows the torque drift when temperature increases. Upper right shows a slight improvement when the position is compensated for the slow zero position dynamics. Lower left is when fast dynamics have been added. Lower right show the temperature model that has been used in order to compensate for the expansion.

Driveline Model



Measurement from a Scania truck compared with open-loop simulation of the model. Driveline oscillations are modeled and capture both the amplitude and frequency of those seen in experimental data.



Future Work

The next step is to use these models in order to develop observers and controller for the powertrain.

Publications

Myklebust, A. and Eriksson, L. (2012a). Road slope analysis and filtering for driveline shuffle simulation. In *2012 IFAC Workshop on Engine and Powertrain Control, Simulation and Modeling*.

Myklebust, A. and Eriksson, L. (2012b). Torque model with fast and slow temperature dynamics of a slipping dry clutch. In *2012 IEEE Vehicle Power and Propulsion Conference*.