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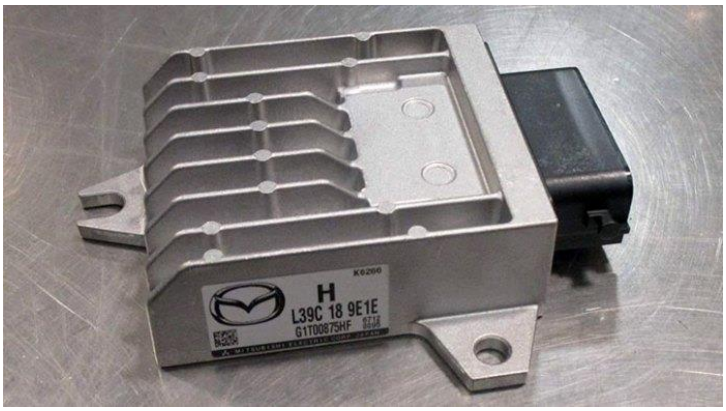
Introduction

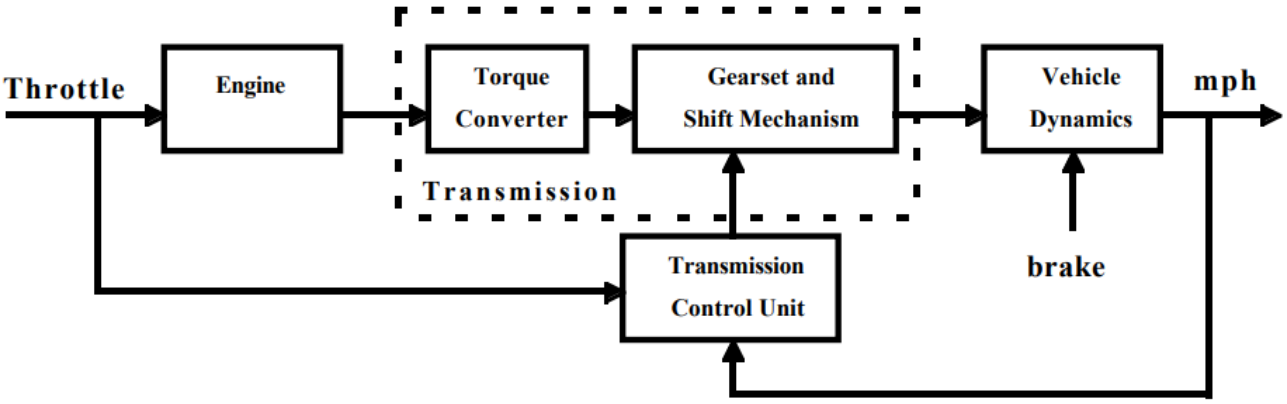
What is Automatic Transmission Control?

A part of the Electronic Control Unit (ECU), the Transmission Control Unit covers everything related to the transmission of a vehicle. It ensures smooth gear shifts and optimal fuel economy and performance. Below we will discuss how does it work and major input and output sensors it uses. Models can be used to automate this process of Transmission switches.



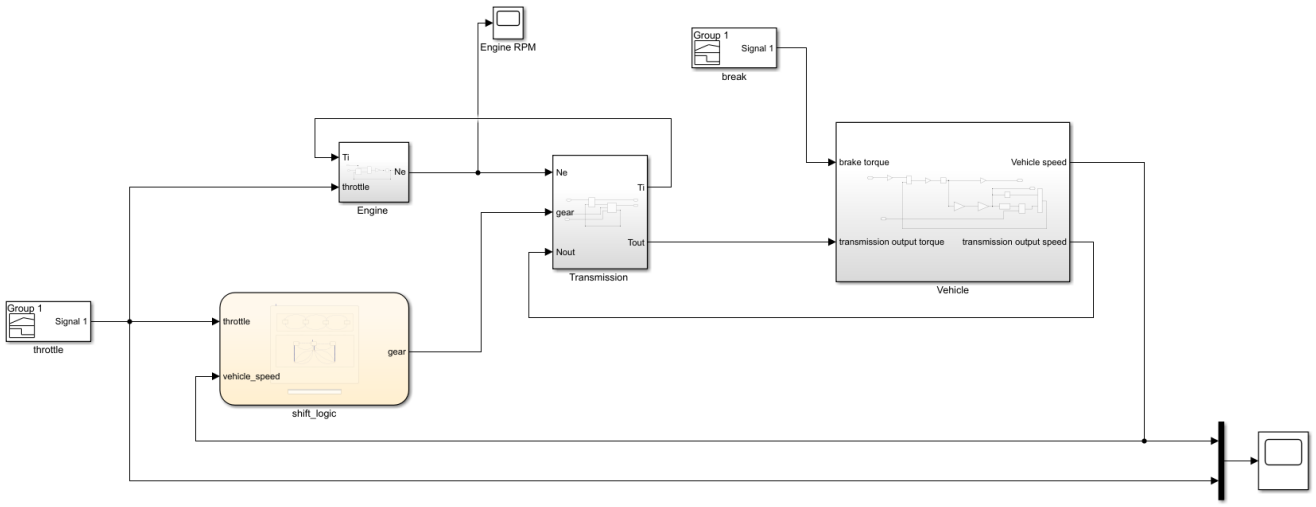
What have I done here?

Simulink is used to model an automotive drivetrain. Stateflow enhances the Simulink model with its representation of the transmission control logic. Simulink provides a powerful environment for the modeling and simulation of dynamic systems and processes. In many systems, though, supervisory functions like changing modes or invoking new gain schedules must respond to events that may occur and conditions that develop over time. As a result, the environment requires a language capable of managing these multiple modes and developing conditions. In the following example, Stateflow demonstrates its strength in this capacity by performing the function of gear selection in an automatic transmission. This function is combined with the drivetrain dynamics in a natural and intuitive manner by incorporating a Stateflow block in the Simulink block diagram.



Simulink Model Based Design

Main Block Diagram



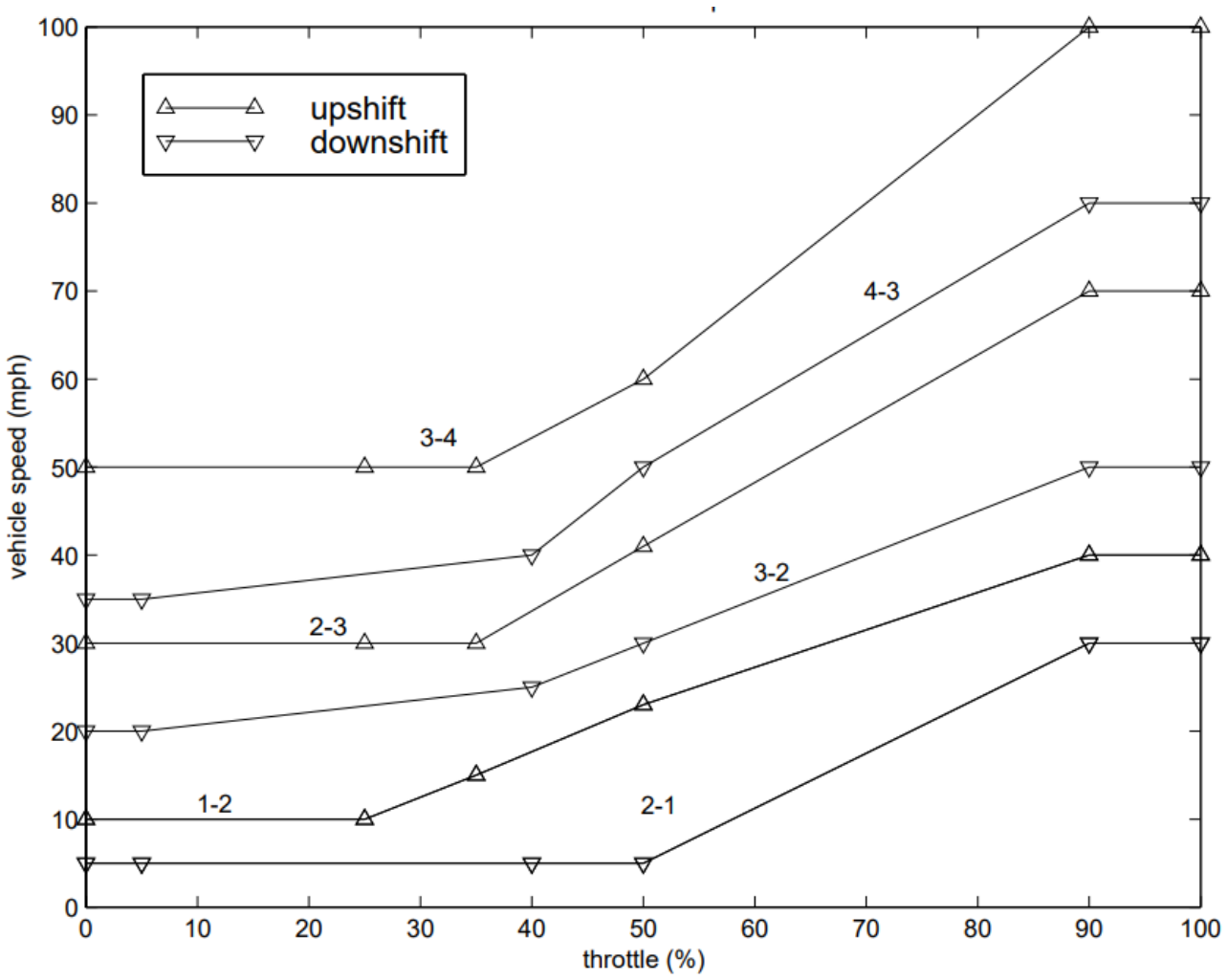
Description:

- The Engine subsystem consists of a two-dimensional table that interpolates engine torque vs. throttle and engine speed. The model subtracts the impeller torque, divides the difference by the inertia and then numerically integrates the quotient to compute the engine speed.
- The torque converter and the block which implements the various gear ratios make up the transmission subsystem.
- The torque converter is a masked subsystem, under which the model computes the relationships of Equation 7.2. The parameters entered into the subsystem are a vector of speed ratios (Nin/Ne) and vectors of K-factor (f2) and torque ratio (f3) corresponding to the speed ratio data. Figure 7.6 shows the subsystem implementation.

- The transmission ratio block determines the ratio RTR (gear), shown in Table 7.1 and computes the transmission output torque and input speed, as indicated in Equation 7.3. The ratios used progress from low to another underdrive ratio, one-to-one and overdrive.

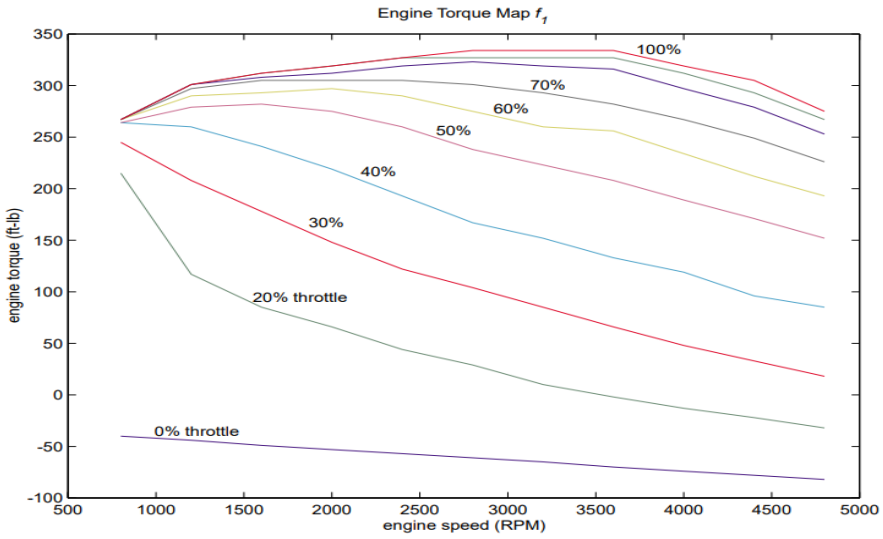
gear	R_{TR}
1	2.393
2	1.450
3	1.000
4	0.677

Shift Schedule:

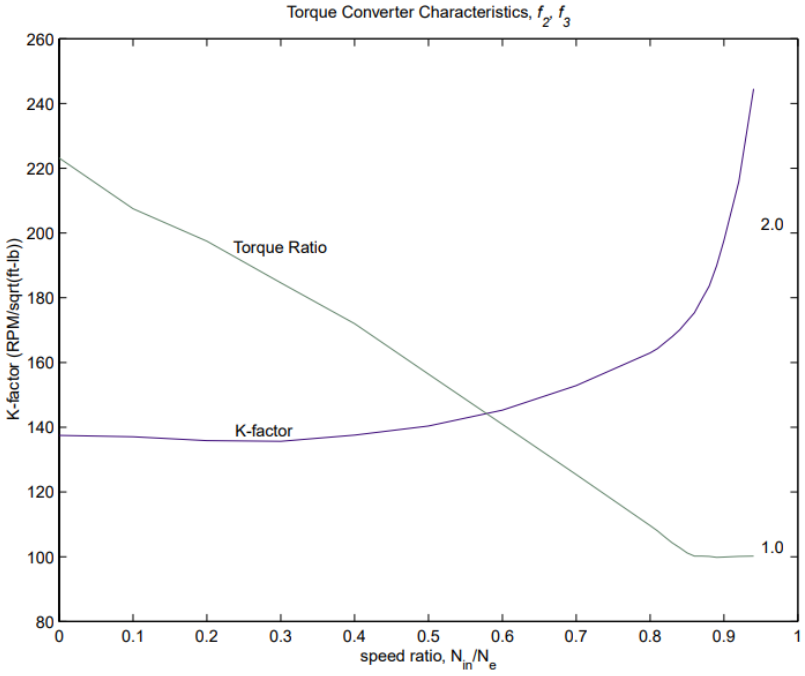


Output:

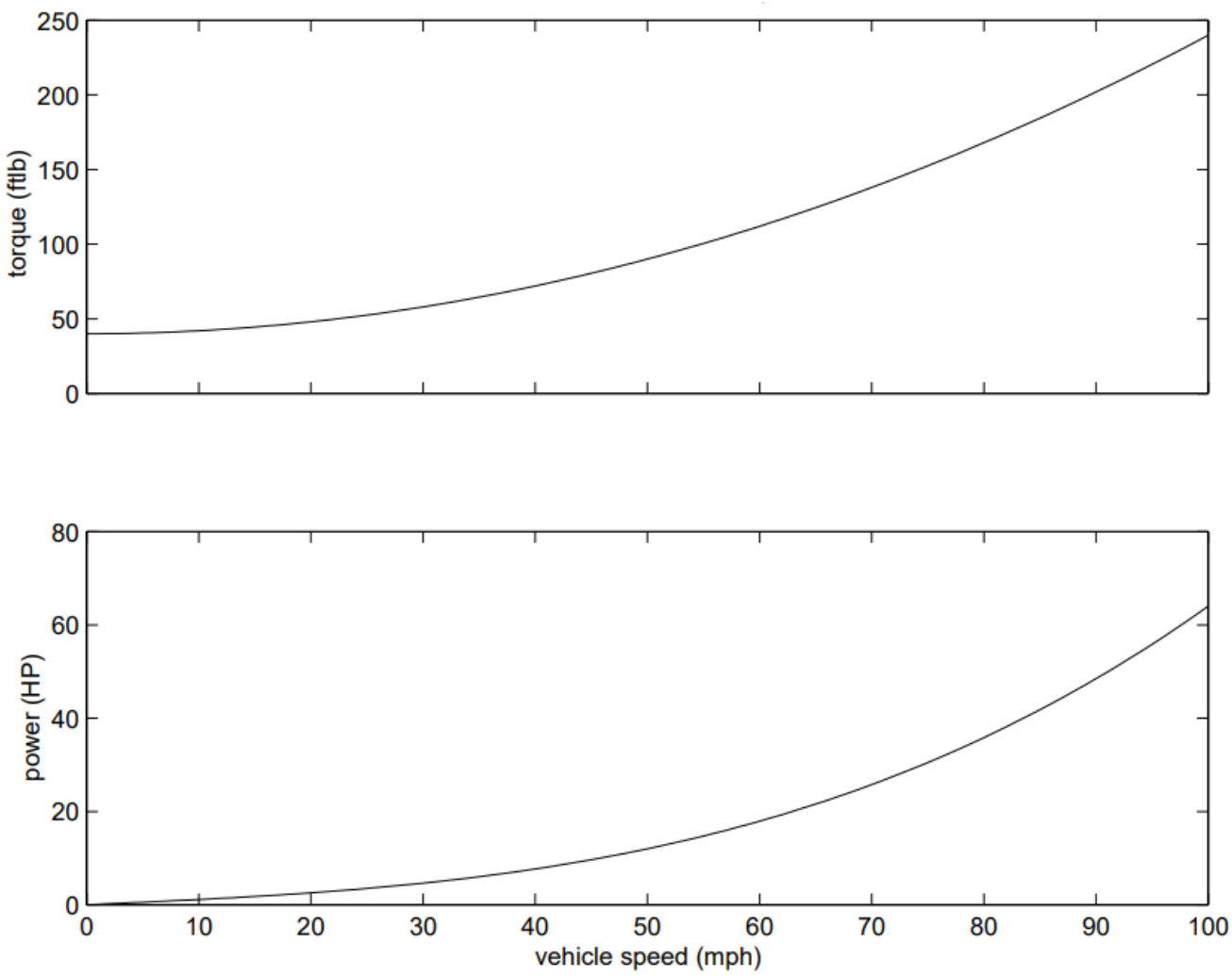
Engine map:



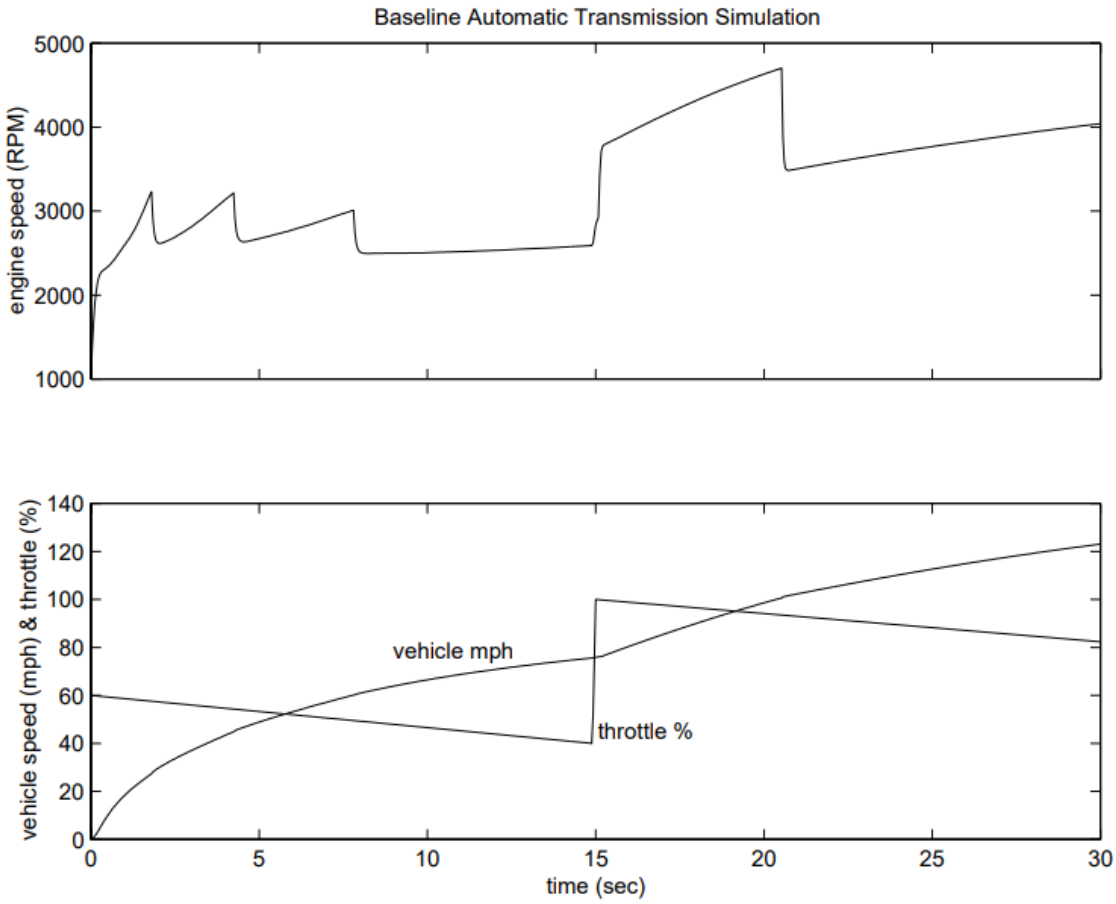
Torque converter Characteristics



Vehicle road Load or Drag Torque



Initial simulation time history:



Conclusion

We can easily enhance this basic system in a modular manner, for example, by replacing the engine or transmission with a more complex model. We can thus build up large systems within this structure via step-wise refinement. The seamless integration of Stateflow control logic with Simulink signal processing enables the construction of a model which is both efficient and visually intuitive..

References

https://www.youtube.com/watch?v=J-JOn5xaZbQ&ab_channel=MATLAB

http://www.mechengdesign.co.uk/PlannedWeb/mech331/caracc5.htm

https://www.researchgate.net/figure/Engine-2-D-lookup-table_fig2_315867215

https://www.claytex.com/tech-blog/torque-converters-the-clutches-of-automatic-transmissions/

https://www.youtube.com/watch?v=239iVQIiTA8&ab_channel=SimulinkTutorial

https://gomechanic.in/blog/tcu-transmission-control-unit-explained/