

## Powertrain Simulation Plots

Included here are simulation plots generated using the powertrain model for three different scenarios:

In all scenarios, car is moving on a road with constant grade with the throttle at a constant position

**Scenario 1** : tps = 10%, grade = 0

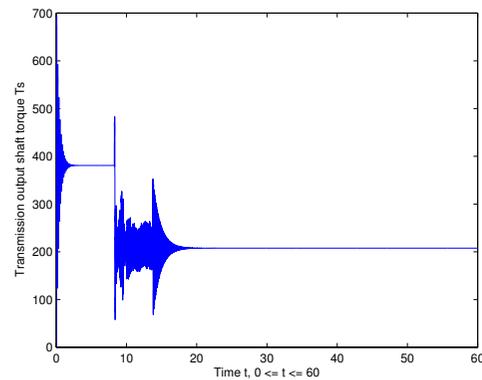
**Scenario 2** : tps = 50%, grade = 0.1 radians

**Scenario 3** : tps = 80%, grade = 0.2 radians

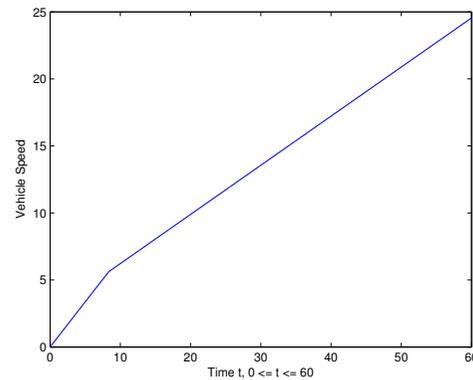
The last scenario is simulated twice: once with step size 0.001s, and then with step size 0.0005s. The first two scenarios are simulated with step size 0.001s.

# Powertrain Simulation Plots: $tps=10\%$ , $grade=0$

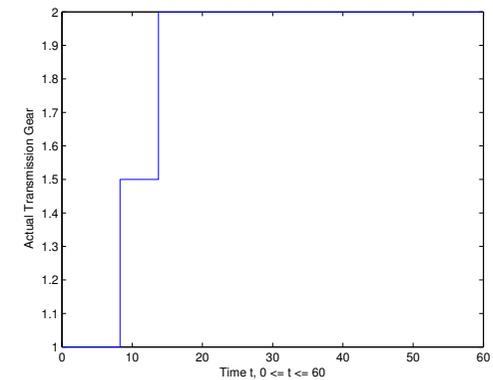
Transmission Torque



Vehicle Speed



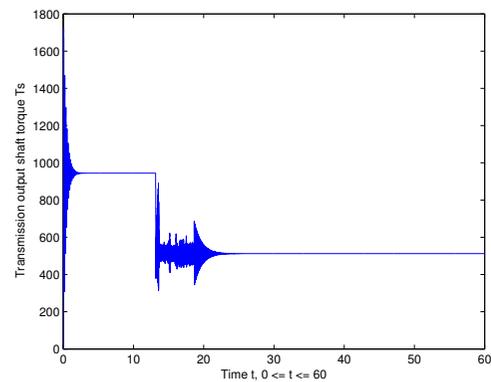
Gear



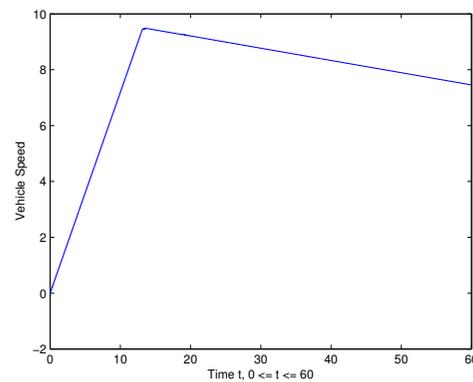
Gear change from 1st to 2nd at around 10s.

# Powertrain Simulation Plots: $tps=50\%$ , $grade=0.1$

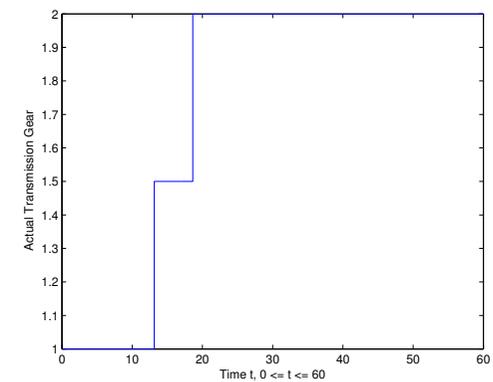
Transmission Torque



Vehicle Speed



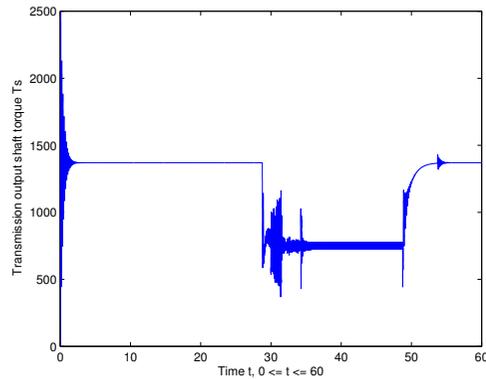
Gear



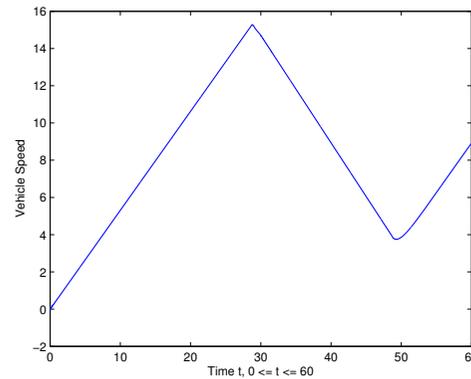
Gear change from 1st to 2nd at around 12s.

# Powertrain Simulation Plots: tps=80%, grade=0.2

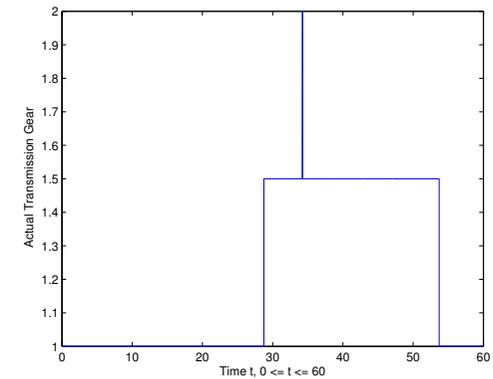
Transmission Torque



Vehicle Speed



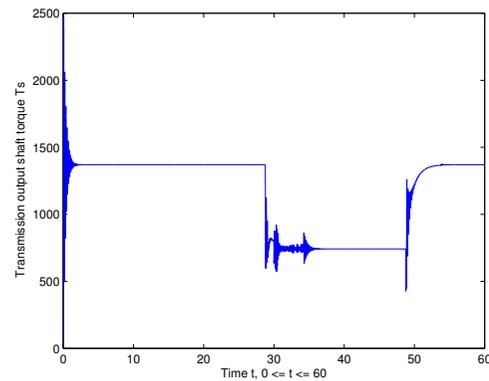
Gear



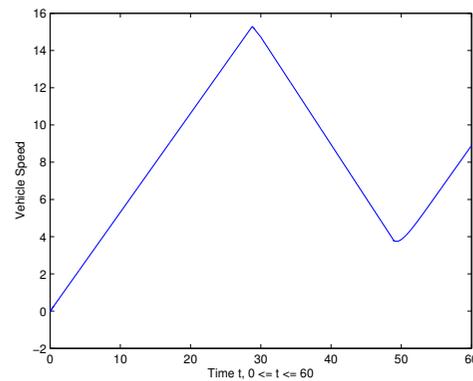
Gear change from 1st to 2nd at around 30s and an (incorrect) elongated back switch to 1st at 40–50s.

# Powertrain Simulation Plots: tps=80%,grade=0.2

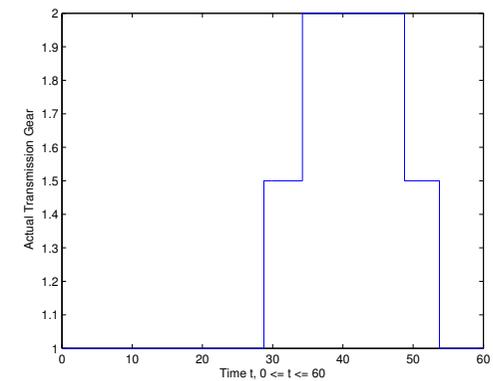
Transmission Torque



Vehicle Speed



Gear



Gear change from 1st to 2nd at around 30s and correctly switching back to 1st at 50+s.