Dynamic Analysis of Transmission System

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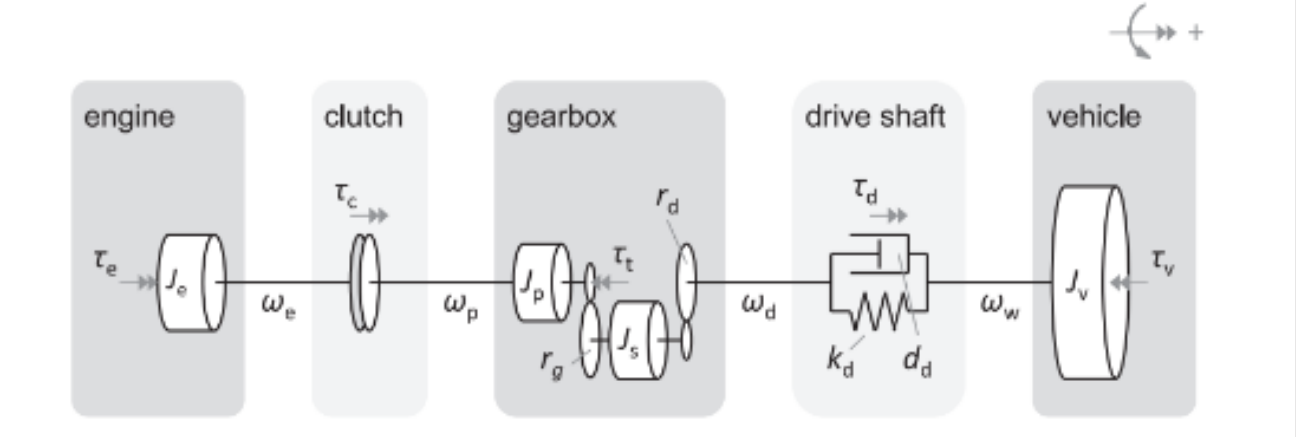
Drive Train

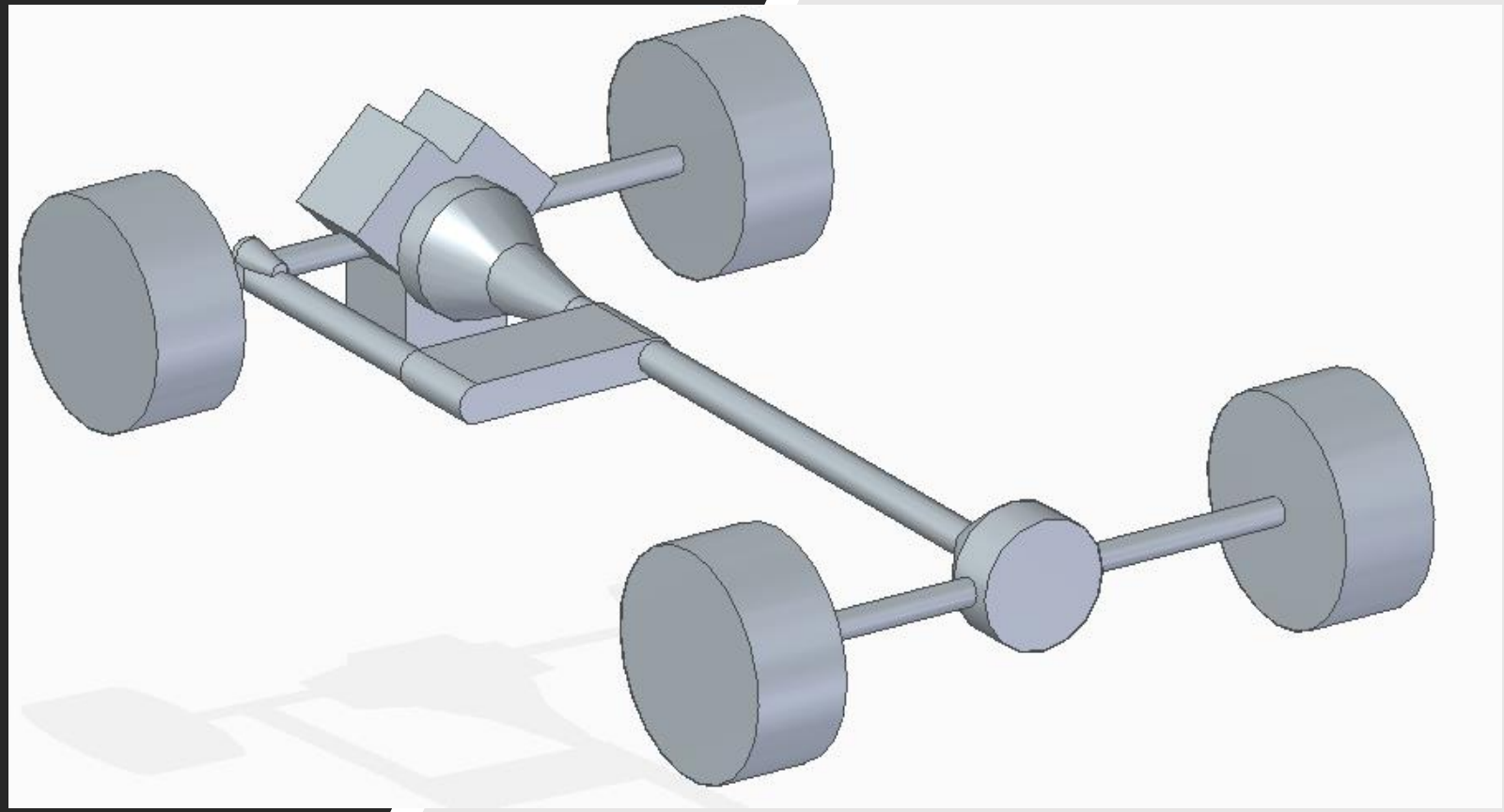
Components of Drive Train

- Engine
- Clutch
- Gear/Transmission System
- Propeller Shafts
- Final Drive
- Drive Shaft
- Wheel



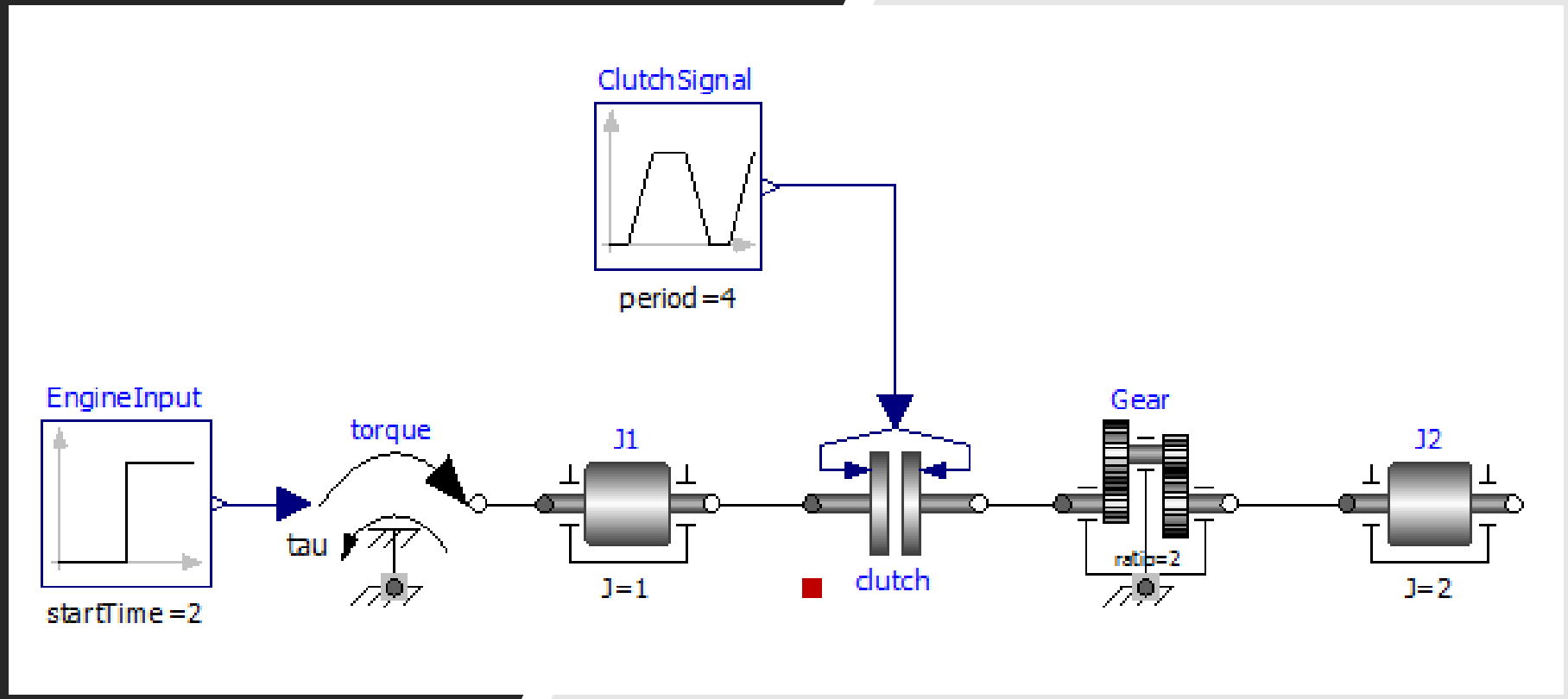
"It's a system to transfer engine torque to the wheel."

CAD MODEL



CAD MODEL

Model of Clutch in Modelica



Clutch (Equations)

$F_c = F_{c,max}\, u_c$, where $F_{c,max}$ (the maximum possible normal force F_c)

$$M_{c,k}\ (u_c,\ \omega_{rel}) = M_{c,k,max}\ (\omega_{rel})\ u_c$$

$$M_{c,k,max}\ (\omega_{rel}) = n\ \frac{r_o + r_i}{2}\ \mu_c\ (\omega_{rel})\ F_{c,max}$$

The equations that describes this are

$$J_e\ \dot{\omega}_{c,in} = M_e - M_c$$
$$J_v\ \dot{\omega}_{c,out} = M_c - M_v$$

The torque transferred through the clutch is

$$M_c\ (\omega_{rel}) = M_{c,k}\ (u_c,\ \omega_{rel})\ sgn\ (\omega_{rel})$$

where sgn is the signum function. The equations above are valid when $\omega_{rel} \neq 0$.

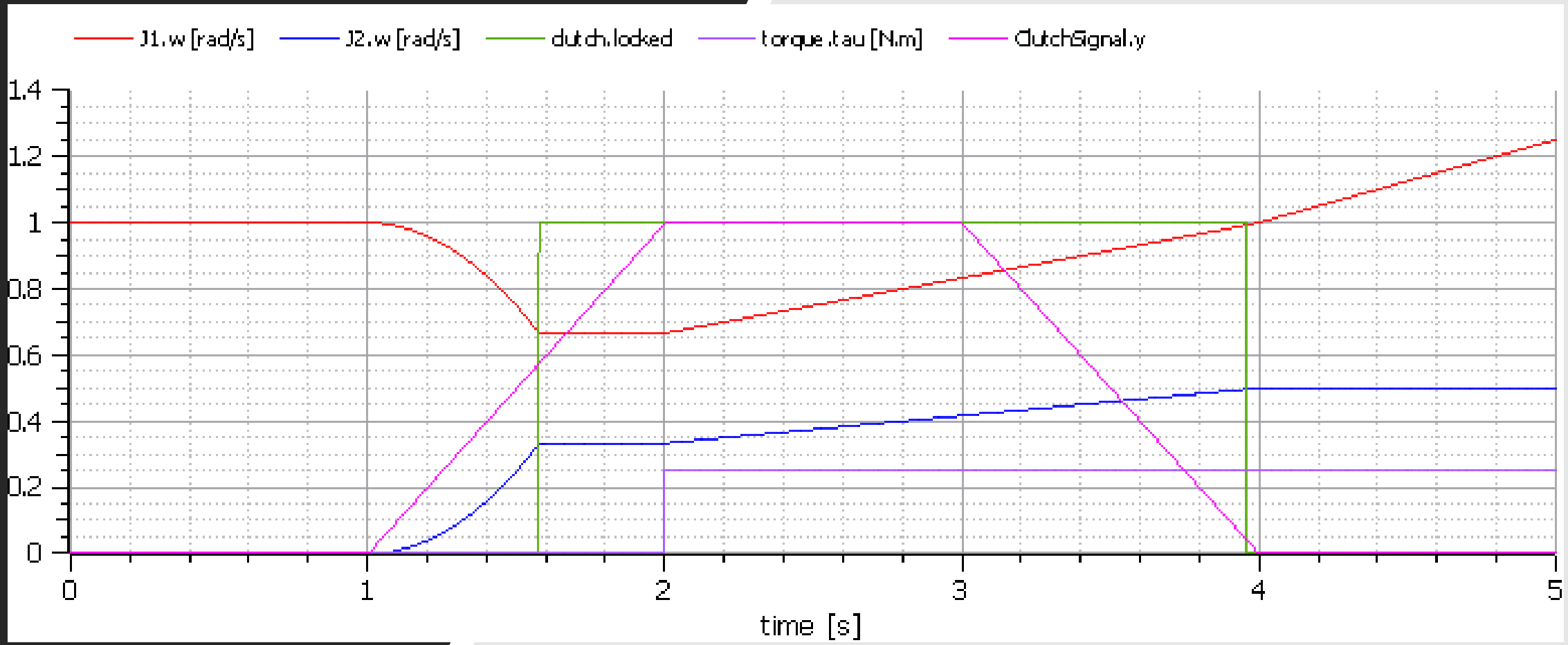
$$(J_e + J_v)\ \dot{\omega}_{c,in} = M_e - M_v$$
$$\omega_{c,in} = \omega_{c,out}$$

$$M_{c,locked} = M_e - J_e\ \dot{\omega}_{c,in}$$

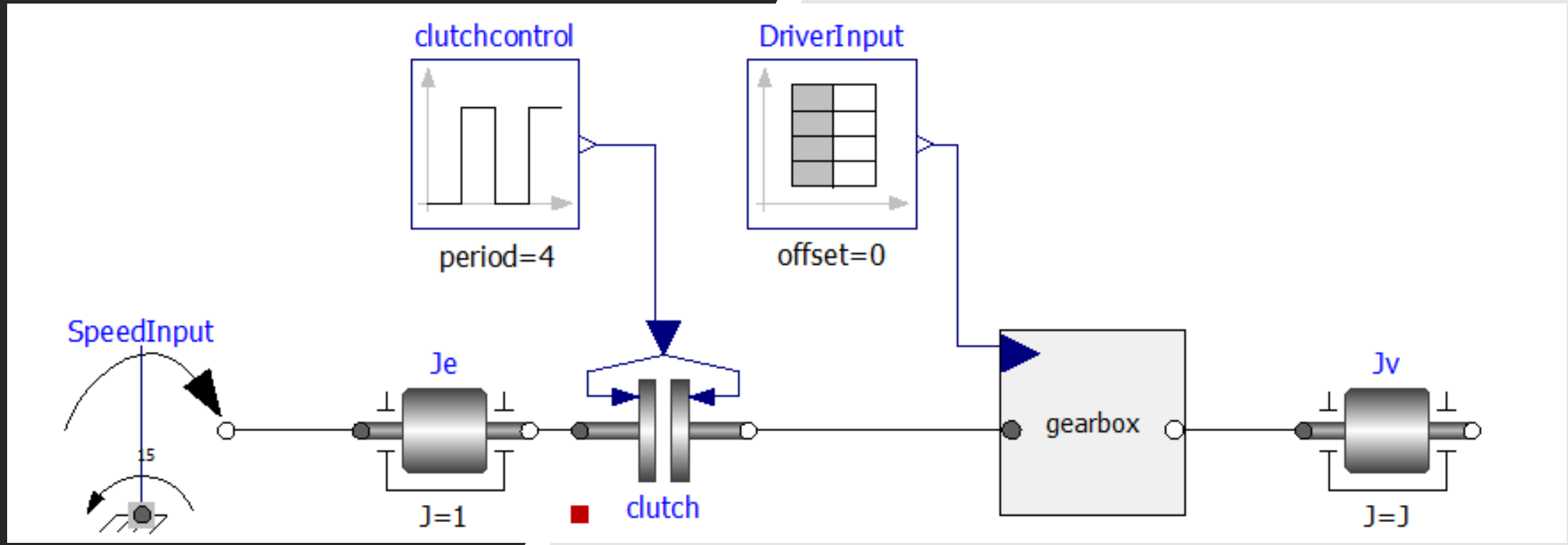
Clutch (Parameters)

1) Step torque (0.25Nm) from the engine.
2) Trapezoidal Signal is fed to the Clutch.
3) Signal 1 – Engaged and Signal 0- Disengaged.
4) Gear ratio is 2.
5) J1 and J2 are engine and vehicle inertias respectively
6) Initial angular velocity of engine is 15rad/sec and initially the vehicle is at rest.

Engaging Clutch



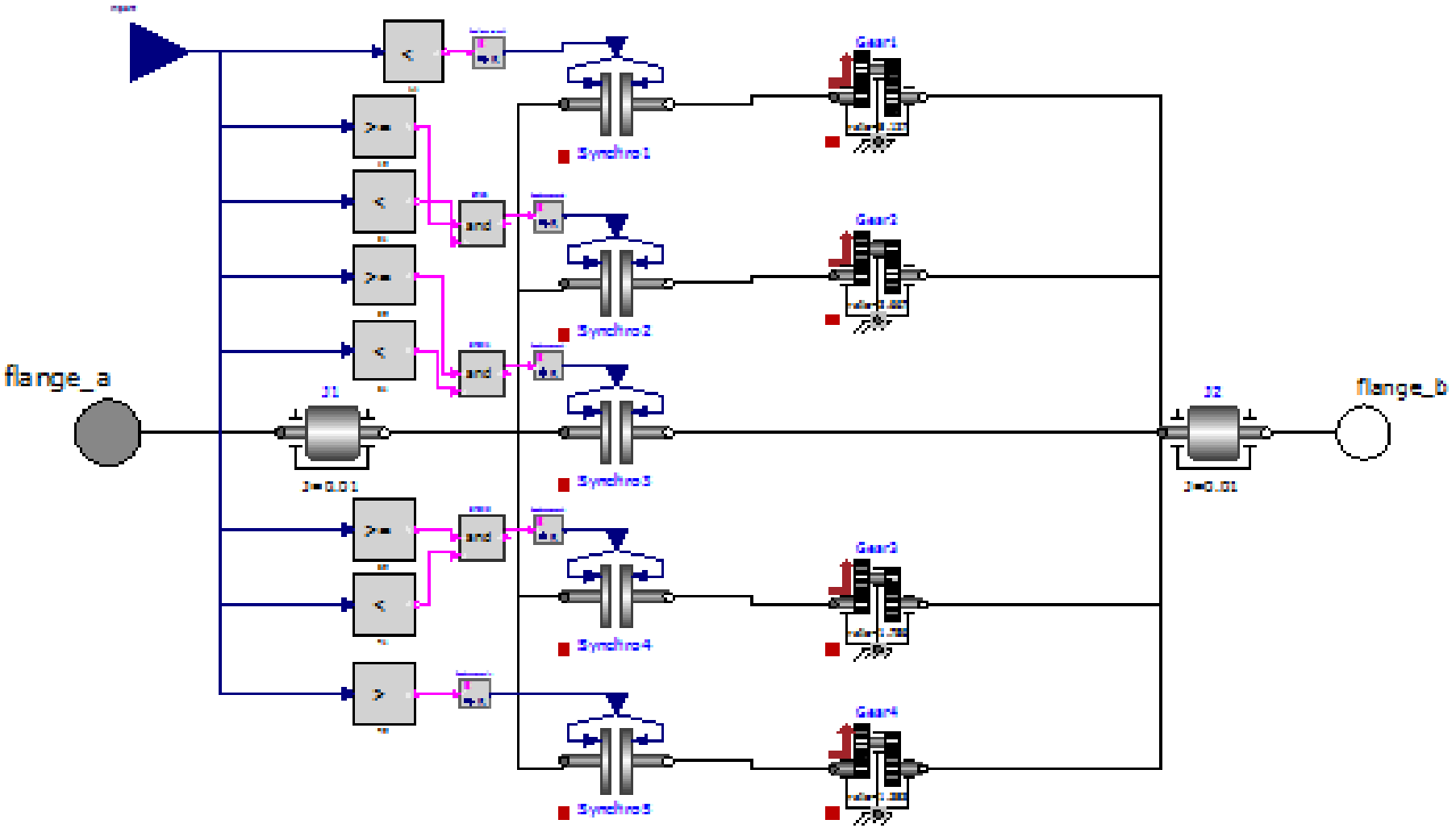
Model of Gearbox-Clutch in Modelica



Clutch and Gearbox (Parameters)

1) Constant velocity of 15rad/sec at engine shaft, irrespective of the torque
2) We want to analyze the velocity variations with shifting gears.
3) The vehicle initially is at idle.
4) While shifting the gears, the clutch signal is applied to disengage the clutch.
5) The clutch signal and gear shifting signal is synchronized.

Model of Gearbox in Modelica



Model of Gearbox in Modelica

References

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