MECA-H303 TP3

MDOF

Double shaft in torsion

For the following system we ask you to:

1. Write the equations of motion in analytical and matrix form
2. Give the expression of the mass matrix and stiffness matrix of this system
3. Give the analytical expressions of natural frequency and eigen modes of the system.

Additional details for the exercise:

- The shafts have only a torsional rigidity k (in $[N/rad]$)
- The discs have an inertia I
- A torque C is applied to the first disc

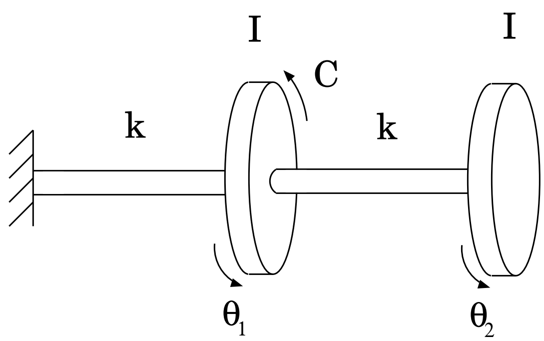

Figure 1: double shaft in torsion

MDOF & Isolation

Car suspension

The following mass/spring/damper system represents the suspension of one wheel in a car. For this system we ask you to:

1. Write the equations of motion of the suspension system in analytical and matrix form
2. Give the analytical expressions of the natural frequencies and eigen modes of the system. Compute them for the following numerical values:
   - $m_s = 240kg$
   - $m_{us} = 36kg$
   - $k_t = 160kN/m$
   - $k = 16kN/m$
3. Compare the natural frequency of the full system that you just calculated with the one of the un-coupled systems (fixed wheel & wheel alone) and comment on the differences between the un-coupled and coupled systems
4. Give the expression of the **static** displacement resulting from the application of an unit displacement w.
5. In the Laplace domain, write the transfer function between the velocity of the road $\dot{w}$ (input) and the acceleration of the suspended mass $\ddot{x}$ (output).

Additional details for the exercise:

- m_s is the suspended mass of the car on a wheel, corresponding to 1/4th of the full mass of the car
- m_{us} is the un-suspended mass of the car (the wheel)
- c is the damping provided by the suspension between the wheel and the car
- w is the base displacement imposed by the road

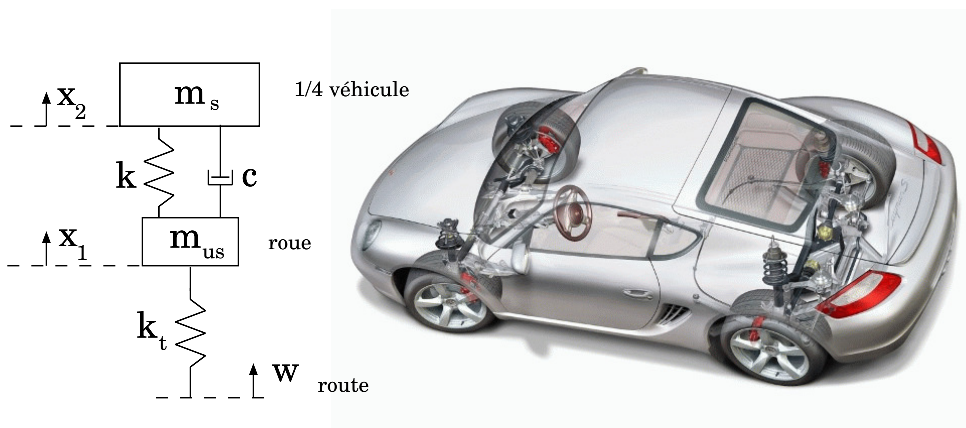

Figure 2: car suspension