Mechanical Vibrations 2020/21

Matlab Teamwork Project

Continuous Systems

Read carefully before starting the Project

- Data are not provided. The choice of the parameters is left to the Group.
- All the projects must be developed in Matlab language (Plain Code Scripts and Functions): the only accepted file format and extension is ".m" file
    - Projects solved in Simulink (or another environment/software) will be **not considered**.
    - Project developed in Matlab live Code format will be **not considered**.
- Every team must upload on Dolly 2020/21 website the following files:
    - a comprehensive **PDF report**,
        - See template
    - the **Matlab scripts** in .m files
- At the end of the project, every team will hold a **live presentation** (15min + Q/A session) on Google Meet.
- Group activity evaluation: pay attention to the "Rubrics", see Slide n.11 in Lesson02_organization.pptx.
- Respect deadlines and upload the required files, *with adequate notice,* on the dolly sections that will be created. Projects delivered after the deadline will be **not considered**.

1. Car induced vibrations on bridges

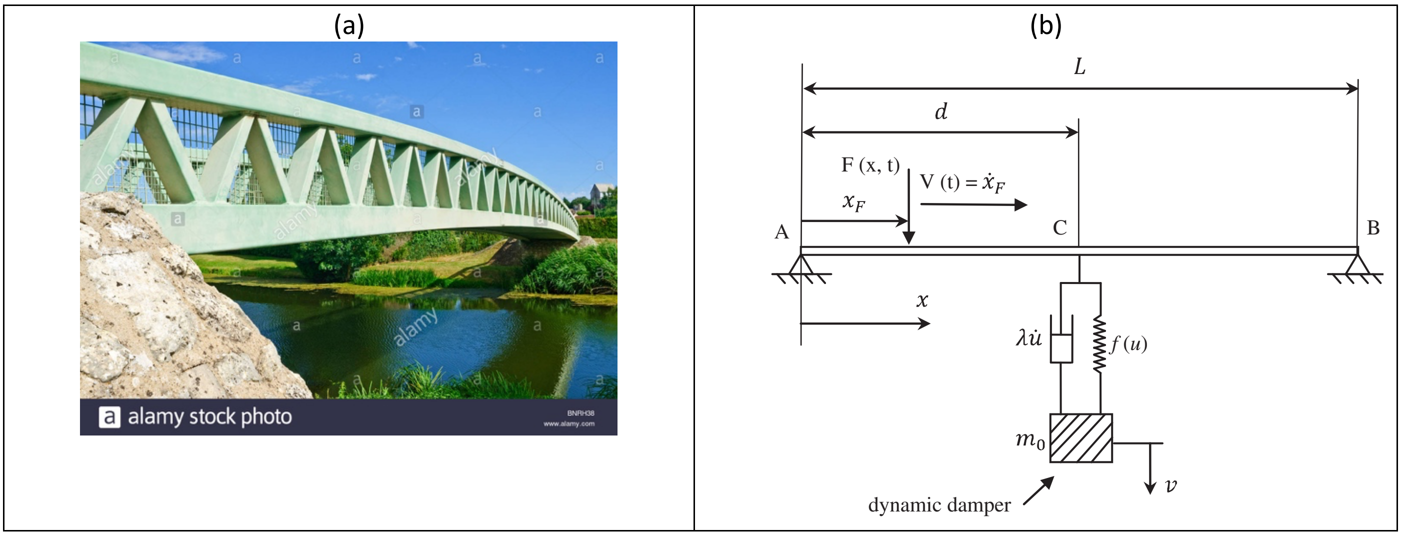

Fig. 1 - (a) single-span bridge, (b) beam model under a travelling load

The goal of the project is to explore vibration problems attaining the effect of running cars on bridges and the effect of mitigation devices.

Consider a car running on a bridge, Fig.1(a). The bridge is modelled as a simply supported beam with a travelling load $F(x,t)$ (constant amplitude travelling force), Fig. 1(b). The velocity of the load $v(t)=\dot{x}_f$ is constant. A **linear** dynamic damper is connected to the beam at $x=d$. Consider the document 1.pdf (equation 1 and subsequent formulae) as a main reference.

i) Find the natural frequencies and the mode shapes,

ii) Plot the full transient response of the beam at $x=L/2$.

iii) Compare and discuss the results obtained with and without the dynamic damper.

2. Pipes vibration

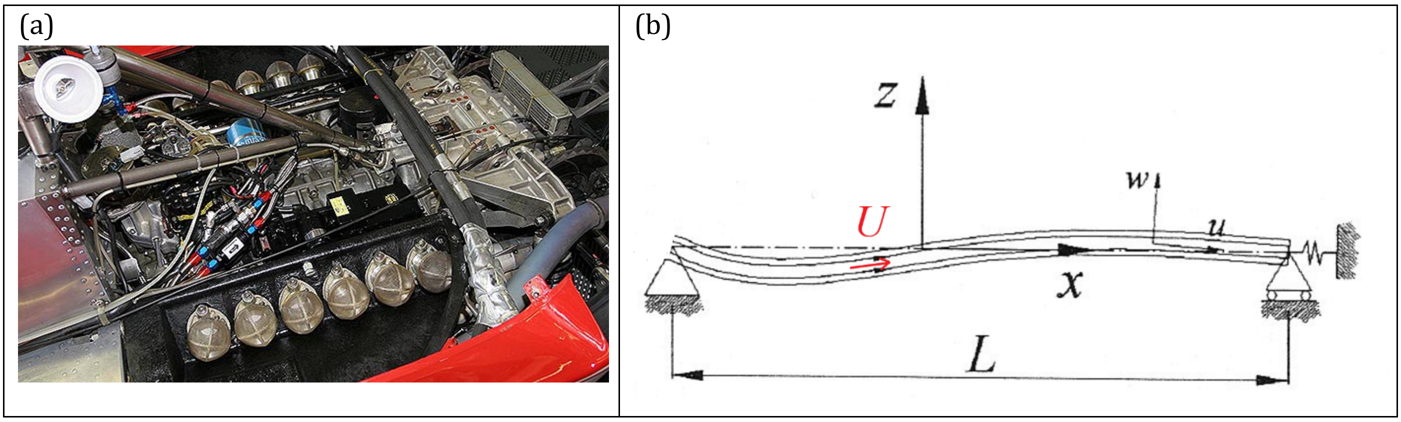

Fig. 2 - (a) system of pipes conveying flowing fluid, (b) simplified beam model

The goal of the project is to explore vibration problems attaining the effect of a fluid flowing inside a pipe.

Consider a pipe conveying a flowing fluid. The fluid velocity U is constant. The main beam oscillation is transversal (*w)*. Consider document "4.pdf" as main reference, where the equations of motions **must be linearized** (neglect nonlinear terms).

i) Find the natural frequencies, represent them v.s. the fluid velocity and find the critical speed.

ii) Find mode shapes (complex) and represent a modal oscillation (see e.g. document "5.pdf", figures 3 and 4)

iii) Study the transient response when the system is excited with a point force located in the mid span (see document "1.pdf" for managing the point force).

3. Engine belts vibration

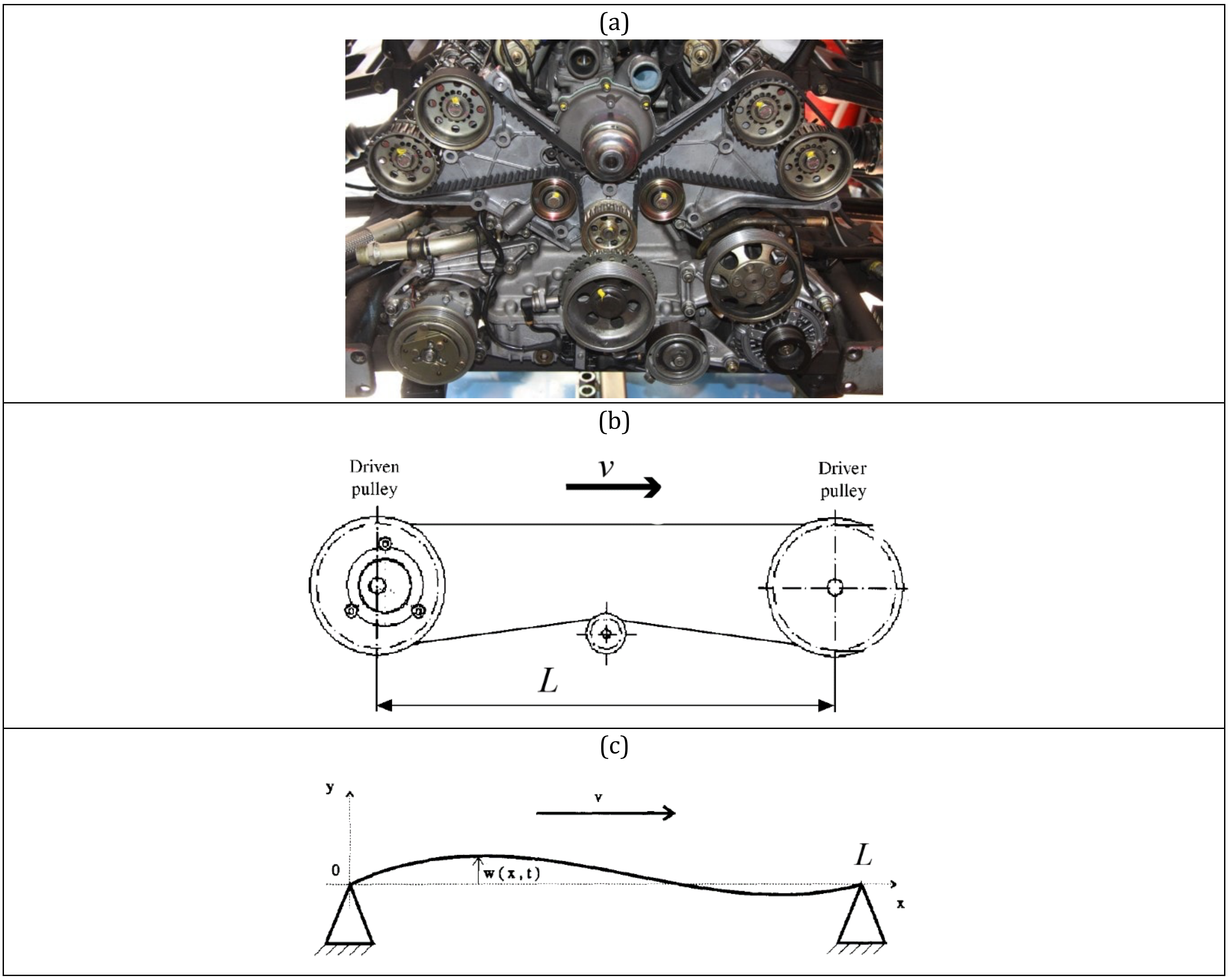

Fig. 3 - (a) belt transmission, (b) simplified two-pulley belt transmission, (c) travelling beam model.

Power belt transmission are widely used in internal combustion engine. The goal of the project is to investigate the effects of the axial speed on the dynamics of a belt.

Consider a power belt transmission, Fig.3(a,b). The upper branch of the belt can be modelled as a moving beam, see Fig.3(c). Neglect eccentricity and tension fluctuation. Consider document "5.pdf" as main reference, where the equations of motions **must be linearized** (neglect nonlinear terms).

i) Find the natural frequencies, represent them v.s. the axial velocity and find the critical speed.

ii) Find mode shapes (complex) and represent a modal oscillation (see e.g. document "5.pdf", figures 3 and 4)

iii) Study the transient response when the system is excited with a point force located in the mid span (see document "1.pdf" for managing the point force).