UNIVERSITY OF THESSALY
School of Engineering - Department of Civil Engineering

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Buckling, restabilization and dynamics of extremely deformable structures subject to configurational forces

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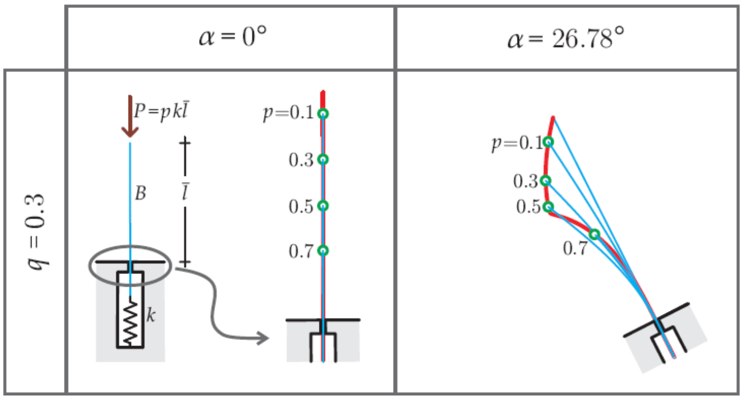
Wednesday **1/12/2021**, Time: **11:00**
Webinar: Microsoft Teams
Live Streaming: DIAVLOS and YouTube

Abstract:

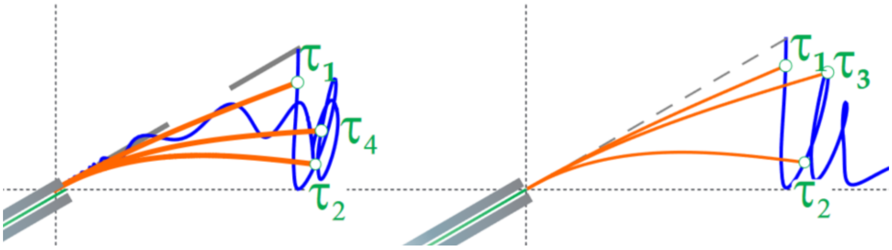
The concept of configurational force has been introduced by Eshelby to describe the motion of massless (for instance voids, microcracks, vacancies, or dislocations) or heavy (for instance inclusions) defects within a solid body as the result of mechanical or thermal loading. This concept has been exploited through the years for modelling the crack-driving force in fracture mechanics, the Peach–Koehler force of dislocations, or the material force developing on a phase boundary in a solid under loading. The action of configurational forces on elastic structures has been theoretically and experimentally proven in the presence of a specific movable constraint: a frictionless, perfectly smooth and bilateral sliding sleeve.

Intriguing mechanical behaviours are disclosed for compliant structural systems involving configurational constraints. The following cases will be presented:

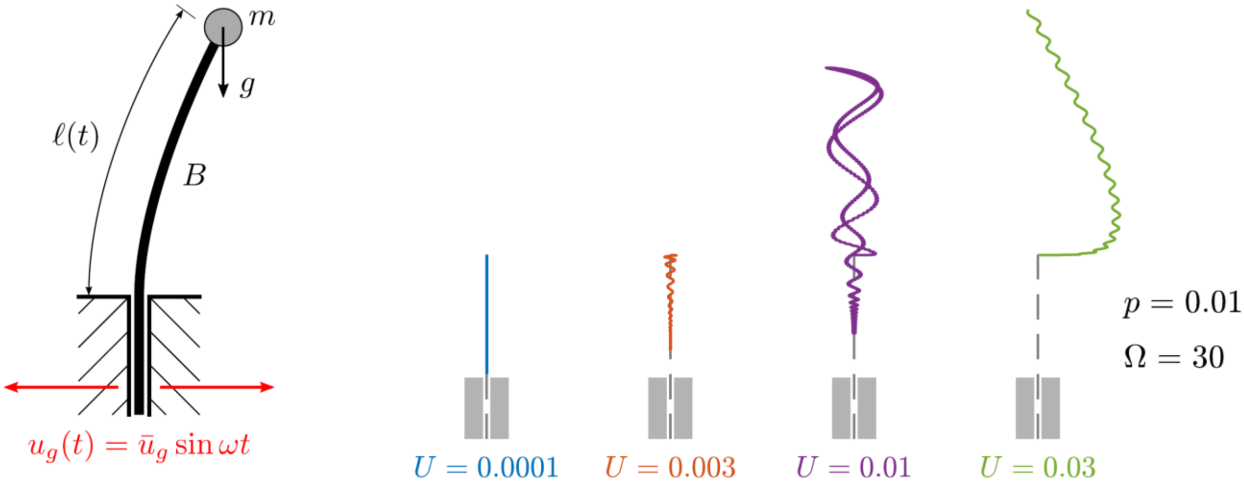
- An elastic rod constrained by a frictionless sliding sleeve ending with a linear spring and subject to a dead load at the other end. It is found (i.) an increase of buckling load at decreasing of elastic stiffness; (ii.) a finite number of buckling loads; (iii.) more than one bifurcation loads associated to each bifurcation mode; (iv.) a restabilization of the straight configuration after the second bifurcation load associated to the first instability mode. Moreover, in the case that the constraint is tilted with respect to the dead load direction, an 'asymptotic self-restabilization' in the following sense: although bifurcation does not occur because the system is imperfect, the deflection initially grows and subsequently decays up to vanish during a monotonically increasing loading.



- The sudden release of a rod with a concentrated weight attached at one end and partially inserted into a frictionless sliding sleeve at the other. It is shown that the configurational force generated at the sliding sleeve is defined by the same expression obtained under quasi-static assumptions. Moreover, it is found that due to the system flexibility the set of constraint inclinations corresponding to ejection is enlarged with respect to the rigid case.



- The periodic oscillation of a configurational constraint during the fall of a rod. Through Finite Element simulations it is shown that three final stages can be attained: (i) final injection; (ii) final ejection; and (iii) a steady state motion around a finite external length.



The results represent innovative concepts in mechanics to be used in advanced applications, as for example in actuation mechanisms, energy harvesting, vibration mitigation, shock absorbers.