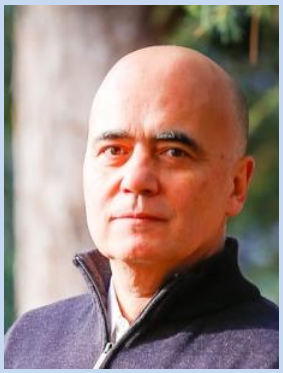
KTH SOLID MECHANICS KEYNOTE SEMINAR; Thursday, January 13th, 16.15; https://kth-se.zoom.us/j/67415551666

Davide Bigoni's KEYNOTE seminar "Flutter instability, homogenization, and hypoelastic materials without a strain potential"

Flutter, divergence instabilities, and Hopf bifurcations may occur in elastic structures subject to nonconservative loads such as follower forces and forces acting on a fixed line. This was theoretically shown by [10, 1, 9], among many others (see the review [8]). However, the practical realization of these nonconservative forces was considered for sixty years very difficult and often declared impossible. In this talk we will show theoretically and experimentally how to obtain follower forces of the Ziegler type and related instabilities by exploiting Coulomb friction, a result which sheds light on the interplay between friction and instability [5]. The destabilizing effect of dissipation will be given an experimental proof [4]. We will introduce forces acting on a fixed line and explain how these can be realized to demonstrate instabilities [3]. It will be shown that flutter and divergence instabilities (including Hopf bifurcation and destabilizing effects connected to dissipation phenomena) can be obtained in structural systems loaded by conservative forces, as a consequence of the application of non-holonomic constraints. The motion of the structure produced by these dynamic instabilities may reach a limit cycle,a feature that can be exploited for soft robotics applications, especially for the realization of limbless locomotion [2]. Finally, it is shown as the previous results can be used to demonstrate, via a rigorous application of homogenization theory [7], how to design a hypoelastic material violating the concept of strain potential [6].

[1] Beck, Z. Angew. Math. Phys. 3, 225 (1952).
[2] Cazzolli, et al. J. Mech. Phys. Solids 138, 103919 (2020).
[3] Bigoni, et al. J. Mech. Phys. Solids, 134, 103741 (2020).
[4] Bigoni et al. J. Mech. Phys. Solids 116, 99 (2018)
[5] Bigoni et al. J. Mech. Phys. Solids 59, 2208-2226 (2011).
[6] Bordiga, et al. J. Mech. Phys. Solids, 158 (2022).
[7] Bordiga, et al. J. Mech. Phys. Solids 146, 104198 (2021).
[8] Elishakoff, et al.. Appl. Mech. Rev. 58, 117 (2005).
[9] Reut, Proc. Odessa Inst. of Civil and Comm. Eng. 1 (1939).
[10] Ziegler, Adv. Appl. Mech. 4, 351–403 (1956).



Davide Bigoni is a mechanician working in solid and structural mechanics and material modeling, wave propagation, fracture mechanics. His approach to research is the employment of a broad vision of mechanics, with a combination of mathematical modelling, numerical simulation, and experimental validation. From 2001 Davide Bigoni holds a professor position at the University of Trento, where he is leading a group of excellent researchers in the field of Solid and Structural Mechanics. He has authored or co-authored more than 150 journal papers and has published a book on nonlinear Solid Mechanics. He was elected in 2009 Euromech Fellow (of the European Mechanics Society), has received in 2012 the Ceramic Technology Transfer Day Award (of the ACIMAC and ISTEC-CNR), in 2014 the Doctor Honoris Causa degree at the Ovidius University of Constanta and in 2016 the Panetti and Ferrari Award for Applied Mechanics (from Accademia delle Scienze di Torino). He has been awarded an ERC advanced grant in 2013. He has been guest lecturer for the Midwest Mechanics Seminars in 2018, he is fellow of the Accademia di Scienze e Lettere of Milan from 2019. An anniversary issue of the Journal of the Mechanics and Physics of Solids has been dedicated to him in 2020. He is co-editor of the Journal of Mechanics of Materials and Structures and associate Editor of Mechanics Research Communications and in the editorial board of 8 international journals.