UNIVERSITÀ DEGLI STUDI DI TRENTO
Dipartimento di Ingegneria Civile, Ambientale e Meccanica

INSTABILITIES

Instabilities and nonlocal multiscale modelling of materials
erc-instabilities.unitn.it

European Research Council
Established by the European Commission

AVVISO DI SEMINARIO

Si comunica che **venerdì 02 marzo 2018 a partire dalle ore 10.00** si terrà presso l'aula **F2** (via Mesiano 77) il seguente seminario

Vibrations in discrete and continuous gyro-elastic media

Dr Michael Nieves

School of Computing and Mathematics, Keele University

We discuss some discrete and continuous models for elastic media that utilise chirality to control vibrations and produce surprising dynamic phenomena.

We first consider an chiral elastic triangular lattice with gyroscopic spinners attached to the junctions. We show if the array of spinners is non-uniform then it is possible to identify exponentially localised uni-directional waveforms propagating within the lattice in the high-frequency regime [1]. In addition, it is illustrated that by tuning the properties of this chiral medium the path of this waveform and the frequency at which it occurs can be controlled.

Next, we investigate the "gyro-beam", which is a beam with a continuous distribution of stored angular momentum [2]. This distribution is represented by the gyricity parameter appearing in the associated governing equations. We investigate the dynamic behaviour of this element and show that when the gyricity is high, its eigenfrequencies cluster in the low-frequency regime. This can be exploited to design an efficient support system of resonators for frame-like civil engineering structures exposed to seismic vibrations [3].

In the final part of the talk, we consider a system represented by the interaction between Euler Bernoulli beams and gyroscopic spinners [4]. For the beams, we derive a novel chiral boundary condition embedding this interaction, which is referred to as a gyro-hinge, under the assumption the nutation angles of the spinners are small. We show this condition leads to the coupling of flexural waves with rotational motion in the time-harmonic regime, where it is also demonstrated how the spinner properties dramatically influence the eigenfrequencies of the system. The formulation is then extended to investigate an infinite system of beams connected by periodically placed gyro-hinges. One drawback in the formulation of the gyro-beam is that the gyricity parameter appearing in the governing equations, which couples the transverse motions of the beam, is not defined in terms of physical quantities. Hence the construction of such an element is impossible in practice. We give an interpretation of this parameter in terms of the physical properties of the beams and gyroscopic spinners comprising the infinite periodic system.

References

[1] Carta, G., Jones, I.S., Movchan, N.V., Movchan, A.B., Nieves, M.J. 2017: "Deflecting elastic prism" and unidirectional localisation for waves in chiral elastic systems, Sci. Rep. 7 no. 26. (doi:10.1038/s41598-017-00054-6)

UNIVERSITÀ DEGLI STUDI
DI TRENTO
Dipartimento di Ingegneria Civile,
Ambientale e Meccanica

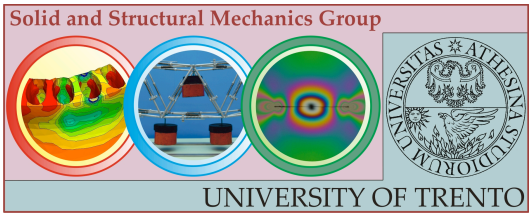
[2] D'Eleuterio G.M.T., Hughes P.C., 1984. Dynamics of gyroelastic continua. J. Appl. Mech. 51, 415-422. (doi: 10.1115/1.3167634)

[3] Carta G., Jones I.S., Movchan N.V., Movchan A.B., Nieves M.J., 2017. Gyro-elastic beams for the vibration reduction of long flexural systems. Proc. Math. Phys. Eng. Sci. 473, 20170136. (doi: 10.1098/rspa.2017.0136)

[4] Carta G., Nieves M.J., Jones I.S., Movchan N.V., Movchan A.B., 2018. Elastic chiral waveguides with gyro-hinges. Quart. J. Mech. Appl. Math., accepted. (doi: 10.1093/qjmam/hby001)

Tutti gli interessati sono invitati a partecipare.

Il seminario è organizzato dal gruppo di Scienza delle Costruzioni
(D. Bigoni, L. Deseri, N.Pugno, A. Piccolroaz, F. Dal Corso, M.F. Pantano, R. Springhetti, D. Misseroni)



SOLID AND STRUCTURAL
MECHANICS GROUP
ssmg.unitn.it