Asociación Argentina
de Mecánica Computacional

Resúmenes de Mecánica Computacional Vol II, pp. 13-13
A. Caggiano, G. Etse, P. Folino, M. Goldschmit, M. Pucheta, M. Storti (Eds.)
P. Folino, P. Mininni (Issue eds.)
Buenos Aires, November 11-14, 2025

COMPUTATIONAL MODELING AND SIMULATION OF THE DYNAMICS OF TENSEGRITY LATTICES

Fernando Fraternali[a]

[a]*University of Salerno, Department of Civil Engineering, Italy, f.fraternali@unisa.it*

Keywords: Tensegrity, Mechanical Metamaterials, Dynamics, Computational Modeling.

Abstract. A research area that has garnered significant attention across various engineering fields is the use of noninvasive tools to detect defects in materials, as well as devices for monitoring the structural health of materials and structures. Most current methods for focusing and defocusing acoustic waves, primarily based on linear acoustic effects, are limited by narrow tunability ranges and poorly scalable dimensions. However, the use of highly nonlinear systems, which allow for greater control over acoustic speed, could lead to the development of revolutionary devices with advanced impact-protection and wave-focusing capabilities. This lecture explores the wave dynamics of systems created by combining lumped masses with tensegrity units to form novel mechanical metamaterials. The tensegrity units behave like elastic springs, with mechanical responses that can be finely tuned by applying an initial state of self-stress to the system. In the linear dynamic regime, monoatomic, diatomic, and Maxwell-time mass-spring chains with tensegrity architecture exhibit a tunable frequency bandgap response under small amplitude compression loading. In contrast, the nonlinear response of tensegrity mass-spring systems supports the propagation of solitary waves under impact loading. These waves range from compact compression waves to rarefaction solitary waves, depending on whether the unit response transitions from stiffening to softening, respectively. The final part of the talk discusses the peculiar wave dynamics of 2D and 3D tensegrity beams and plates with a stiffening-type response (acting as phononic crystals). The findings reveal that the dynamics of such systems are characterized by the thermalization of the lattice near the impacted regions of the boundary. The absorbed energy that moves along the longitudinal direction is transported by compression waves with compact support. These waves emerge at nearly constant speed, with only slight modifications to their spatial shape and amplitude after colliding with compression waves traveling in the opposite direction.

ISSN: 3072-7723 DOI: 10.70567/rmc.v2.ocsid8674