The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

Localized modes in imperfect periodic structures

Yilun Li[1], Régis Cottereau[2] and Bing Tie[1]

[1] Université Paris-Saclay, CentraleSupélec, ENS Paris-Saclay, CNRS, LMPS - Laboratoire de Mécanique Paris-Saclay, 91190, Gif-sur-Yvette, France, yilun.li@centralesupelec.fr

[2] Aix-Marseille Université, CNRS, Centrale Marseille, LMA UMR 7031, Marseille, France, cottereau@lma.cnrs-mrs.fr

[1] Université Paris-Saclay, CentraleSupélec, ENS Paris-Saclay, CNRS, LMPS - Laboratoire de Mécanique Paris-Saclay, 91190, Gif-sur-Yvette, France, bing.tie@centralesupelec.fr

Keywords: *Wave propagation, localized mode, Floquet-Bloch theory* Lack of periodicity in engineering structures can arise because of imperfections in the production process or a particular purpose to produce desirable physical effects. This contribution presents an approach to characterize the influence of the defects on wave propagation by applying the Floquet-Bloch theory in a two-scale framework. Localized defects are introduced periodically on a scale larger than the period of the periodic structure (cf. the example shown in Figure 1 (left)). For different structures with various periodic mechanical or geometric defects, the dispersion curves and shape of the first Bloch modes are analyzed and compared to the reference structure without defects. It is found that such defects can generate non-propagating modes (Figure 1 (right)) at frequencies located inside the bandgaps of the periodic structures (Figure 1 (center)). Parametric studies on the appearance, the eigenfrequency, and the stability of the localized modes are carried out by considering various mechanical or geometric defects. Their appearance is slightly influenced by the amplitude of the defects, but their eigenfrequencies vary monotonically with the amplitude of the defects. With the increase in the scale of the introduction of the defects, the deformations of these non-propagating modes are more and more located around the disturbed cell. Otherwise, the link between the observed localized modes and topological modes is studied and discussed.

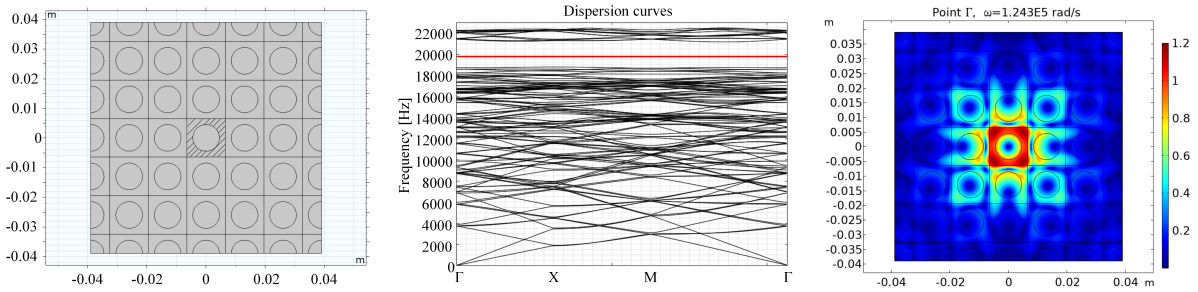

Figure 1: A multicellular two-scale model with a defect in Young's modulus of the central cell (left), the dispersion curves with the localized mode marked in red (center), and the Bloch deformation shape of the localized mode (right)