Band diagram and forced response analysis of periodic and quasi-periodic panels

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ABSTRACT

The vast majority of structures introduce symmetry in one/two dimensions, which can be a periodicity in the case of constructing several identical unit cells. Periodic structures found a big interest in engineering applications because they introduce frequency band effects, due to the impedance mismatch generated by periodic discontinuity in the geometry, which can improve the vibroacoustic performances. However, the presence of imperfections/defects/irregularity in the structure, leads to a partial lost of regular periodicity (called quasi-periodic structure) that can have a noticeable impact on the vibrational and/or acoustic behaviour of the elastic system. The tailored irregularity, which is a designed loss of periodicity, is dedicated to the analysis of the impact of this design on the dynamical behaviour of the structure. In the present paper numerical studies on the vibrational analysis of two-dimensional non-planar periodic and quasi-periodic structures have been performed. The contents deal with finite and infinite systems. The finite element models of sold structures focused on the band diagram analysis of the infinite systems and the forced responses of the finite structures. The quasi-periodicity is defined by invoking the Thue-Morse sequence for building the assigned variations (geometry) along the domain of finite element model. For the finite panel the numerical model is build out of two different size unit cells embedded on board the bare panel according to the Thue-Morse sequence. Considering the out of plane flexural elastic waves, the frequency ranges corresponding to band gaps are investigated. The wave characteristics in quasi-periodic panels, present some elements of novelty and could be considered for designing structural filters and controlling the properties of elastic waves.