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VIBRO-ACOUSTIC WAVE INTERACTION IN CRACKED PLATE MODELED WITH PERIDYNAMICS

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The work is devoted to simulation of the phenomenon of vibro-acoustic wave interaction for a 2D model of a plate with a crack [1]. Recently, both the waves and crack-wave interaction based simulation and experimental techniques have been widely applied for damage detection [2,3,4]. They are considered very attractive as making possible the detection of short and narrow flaws. The authors investigate a possibility of simulation of sidebands generation for high frequency excitation in presence of low frequency model deformation corresponding to the planar normal mode with closing and opening the crack. A nonlocal approach, i.e. the peridynamics, has been applied to discretize mechanical continua and therefore to take an advantage of more convenient introduction of material discontinuities resulting from cracks [5,6]. The peridynamics is an integral based modeling and simulation technique - it constitutes a spatial partial derivative free governing equation with the definition of pairwise forces acting between subsequent subregions of solid, within a horizon of nonlocal interactions. The method may easily allow for spontaneous crack growth.

The object of the study is a rectangular aluminum plate undergoing periodic uniaxial stretching and compression resulting from external low frequency forces (LF) attached to the model's edges, as presented in Figure 1.

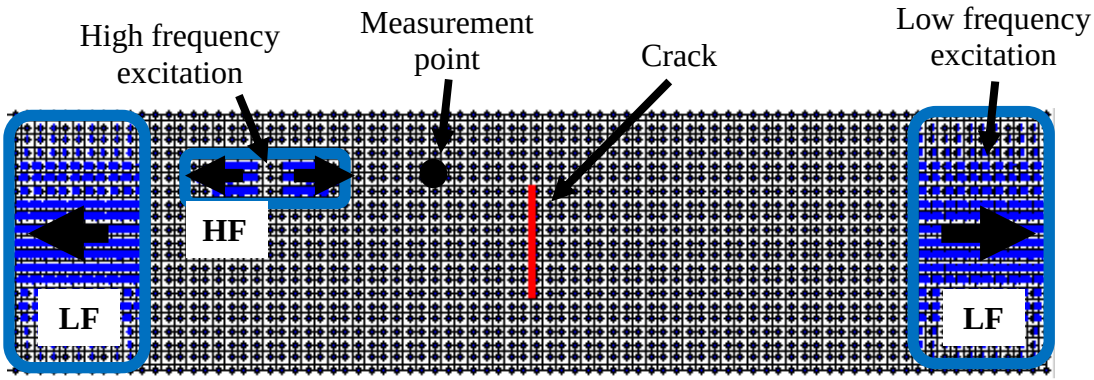

Figure 1. Model of an aluminum plate modeled with peridynamics

The frequency of the LF forces has been arbitrary chosen and corresponds to the first normal mode with in-plane opening and closing crack. Moreover there is applied an additional, asymmetrically localized excitation (HF). It characterizes approximately ten times greater frequency and is used for generation of a wave modulated by the LF wave. Figure 2 presents an example of the FFT plots for cracked plate and for three different excitation configurations.

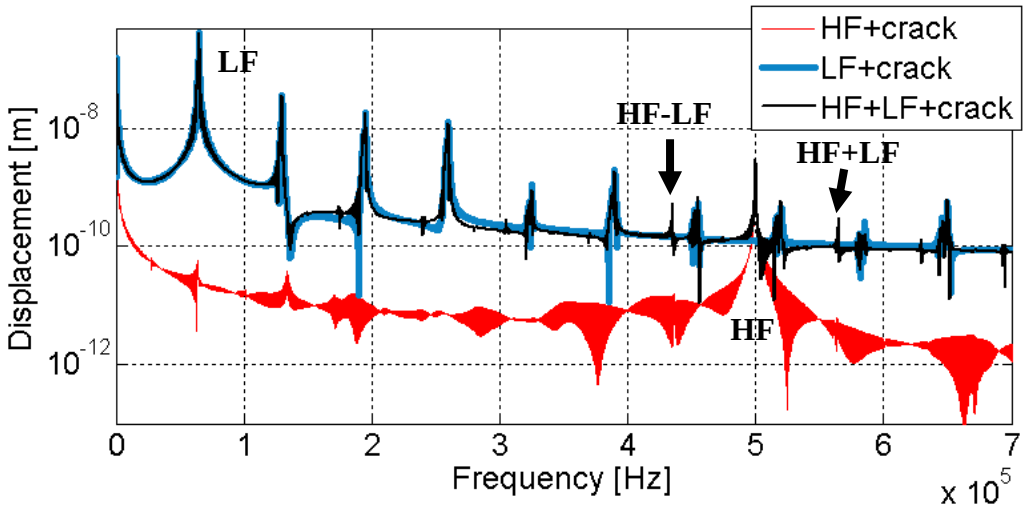

Figure 2. FFT plots for wave modulation and sidebands generation – horizontal displacement

The results clearly show that the phenomenon of wave interaction and modulation can be effectively simulated with the application of peridynamics. The HF wave gets modulated by the LF excitation. There are present the sidebands localized symmetrically with respect to the fundamental harmonics found for the HF wave at 500kHz.

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