Peridynamics of thin films undergoing through thickness delamination

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In the framework of bond-based peridynamics [1] we propose a two dimensional model for thin films, that is capable of retaining information on possible failures occurring through the thickness. The peridynamic theory, unlike classical continuum mechanics, is extremely well-suited for modelling fractures due to its fundamental equilibrium equations being in an integral form. These integral equations, in fact, do not require continuity of the displacement and stress fields. Peridynamic models for 2D elements have been proposed by several authors [2]-[3], although such models do not take into account the possibility of a crack propagating through the thickness as they only consider stretching and dynamic tearing. In this work, we specialized the peridynamic equations of motion for plates in order to consider delamination (in particular Mode-I delamination). Firstly, a discontinuous displacement field is chosen and then, the solution to equilibrium is sought with a variational approach. Indeed, a spatial curve representing the delamination surface is hypothesised, and by this assumption, the energy functional is computed and then minimized with respect to the unknown spatial curve. A practical example is shown, depicting the behaviour of a thin film under bending load. In order to foster a peeling effect, the film was thought as a transversely isotropic element, where the isotropic planes are those parallel to the main dimension of the film.

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