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Analytical Solution of the Boundary Value Problem of Delaminated Doubly-Curved Composite Shells

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Abstract : Delamination is one of the major failure modes in laminated composite structures. Delamination tips are mostly captured by spatial numerical models in order to predict crack growth. This paper presents some mechanical models of delaminated composite shells based on shallow shell theories. The mechanical fields are based on a third-order displacement field in terms of the through-thickness coordinate of the laminated shell. The undelaminated and delaminated parts are captured by separate models and the continuity and boundary conditions are also formulated in a general way providing a large size boundary value problem. The system of differential equations is solved by the state space method for an elliptic delaminated shell having simply supported edges. The comparison of the proposed and a numerical model indicates that the primary indicator of the model is the deflection, the secondary is the widthwise distribution of the energy release rate. The model is promising and suitable to determine accurately the J-integral distribution along the delamination front. Based on the proposed model it is also possible to develop finite elements which are able to replace the computationally expensive spatial models of delaminated structures.

Keywords : J-integral, levy method, third-order shell theory, state space solution
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