A "Kane's Dynamics" Model for a Flexible Plate

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ABSTRACT:

Military hardware must undergo extensive shock-response analysis to ensure its survivability to threshold levels of mechanical shock. Non-lethal impulsive shock loads can disable critical electronic or mechanical components, rendering otherwise sound hardware inoperable or unsuitable for its intended purpose(s). At higher frequencies statistical methods, such as statistical energy analysis, prove necessary, while lower frequencies call for deterministic methods, such as finite energy analysis or finite difference. Many types of military hardware contain flat plates of various geometries and boundary conditions. Although, finite element modeling is commonly used to model such hardware, alternative methods which offer the possibility of shorter modeling, modification, or simulation times continue to be desirable. This research effort applies Kane's dynamics to the problem of plate modeling, toward shock-response analysis of homogeneous plates having various geometries and boundary conditions. Analytical equations of motion are found for a continuous flexible plate that is discretized in checkerboard fashion as a patchwork of rigid rectangular patches connected by flexible springs and damped modally. A MATLAB® implementation is used to validate the model against pertinent analytical and numerical benchmark analyses, for a variety of boundary conditions.

KEY WORDS: shock, vibration, plate, Kane's dynamics

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