Accounting for damping in fairing separation shock wave propagation simulations

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On a launch vehicle, shock responses resulting from separation events are particularly challenging events to simulate as it is a transient phenomena involving high strain rate, ruptures, and shock wave propagations. Currently, many shock separation events related design features are resulting from a set of empirical and analytical data.

This often leads to additional required validation testing and potential overdesign. Simulation solutions for such event requires both an accurate simulation of non-linear event resulting from a separation event as well as a proper modeling of the shock wave propagation throughout the structure. Although mostly linear, the shock wave propagation modeling through a large and complex composite structure is challenging due to the high-frequency content of the wave and the need for proper accounting of damping throughout the structure in a transient manner.

The paper presents a simulation review of a fairing separation event on a generic composite fairing model. The simulation process proposes an innovative damping model for shock wave propagation evaluation throughout the structure. Results allow for an accurate estimation of the Shock Response Spectrum throughout the structure, which in turn is passed down for design requirements at the component level.