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Simulation of impact loading on bio-inspired electronic enclosures developed by additive manufacturing

Electronic components on printed circuit boards (PCB) often require protection from a variety of threats, such as shock, moisture, vibration, or contamination. Under these threats, all electronic packages behave differently depending on their location on the PCB, board supports, interconnects (e.g., solder balls, leadless, leads), geometry (e.g., dual inline, quads), and materials (e.g., plastic, ceramic, metal). One strategy to protect electronic components from moisture or contamination is to use encapsulation technologies, over-molding or potting epoxy, silicone, or polyurethane. Another strategy to mitigate vibrations is using standard mechanical fasteners to special standoffs, and have those standoffs connected into the enclosure. However, in critical situations both strategies fail to protect the most vulnerable packages. Ideally for each serious impact situation all the impact energy must be absorbed with minimal deformation of the PCB. Therefore, there is need to design adaptive support structures that are tailored for optimal energy absorption in different load scenarios. Using additive manufacturing (AM) of structural materials by extrusion (i.e., filamentary printing) is an agile processing pathway that can finely tune the material structures that we need by location. At the fundamental level, the modeling and simulation of electronic packaging schemes that will enhance survivability and mechanical robustness utilizing the unique capabilities of additive manufacturing (AM) needs to be studied. Preliminary results from two strategies are presented of:

-Additively-manufactured innovative negative stiffness bio-inspired crumple zone supports for the printed circuit board.

-Additively-manufactured innovative bio-inspired selective porous structure encapsulation for electronic packages that will minimize low frequency vibration transferred to the components that a bunker penetrating missile generates as it follow in its predetermined flight profile and hitting its target.