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Toward reducing impact induced brain injury: Lessons from a computational study of army and football helmet pads

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We use computational simulations to compare the impact response of different football and U.S. Army helmet pad materials. We conduct experiments to characterize the material response of different helmet pads. We simulate experimental helmet impact tests performed by the U.S. Army to validate our methods. We then simulate a cylindrical impactor striking different pads. The acceleration history of the impactor is used to calculate the Head Injury Criterion for each pad. We conduct sensitivity studies exploring the effects of pad composition, geometry, and material stiffness. We find that: (1) The football pad materials do not outperform the currently used military pad material in militarily-relevant impact scenarios; (2) Optimal material properties for a pad depend on impact energy; and (3) Thicker pads perform better at all velocities. Our analysis suggests that by using larger helmet shells with correspondingly thicker pads, impact-induced traumatic brain injury may be significantly reduced.

Keywords: helmet, pad, head injury, traumatic brain injury, head injury criterion, impact

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