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Multiscale Analysis of Head Impacts in Contact Sports[1] MARK GUTTAG, Brown University, SUBHAM SETT, SIMULIA, JENNIFER FRANCK, KYLE MCNAMARA, EYAL BAR-KOCHBA, Brown University, JOSEPH CRISCO, Rhode Island Hospital, JANET BLUME, CHRISTIAN FRANCK, Brown University — Traumatic brain injury (TBI) is one of the world's major causes of death and disability. To aid companies in designing safer and improved protective gear and to aid the medical community in producing improved quantitative TBI diagnosis and assessment tools, a multiscale finite element model of the human brain, head and neck is being developed. Recorded impact data from football and hockey helmets instrumented with accelerometers are compared to simulated impact data in the laboratory. Using data from these carefully constructed laboratory experiments, we can quantify impact location, magnitude, and linear and angular accelerations of the head. The resultant forces and accelerations are applied to a fully meshed head-form created from MRI data by Simpleware. With appropriate material properties for each region of the head-form, the Abaqus finite element model can determine the stresses, strains, and deformations in the brain. Simultaneously, an in-vitro cellular TBI criterion is being developed to be incorporated into Abaqus models for the brain. The cell-based injury criterion functions the same way that damage criteria for metals and other materials are used to predict failure in structural materials.

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