“Assessing Injury Biomechanics during Dynamic Phases of Spaceflight”

Spaceflight requires tremendous amounts of energy to achieve Earth orbit and to attain escape velocity for interplanetary missions. Although the majority of the energy is managed in such a way as to limit the accelerations on the crew, several mission phases may result in crew exposure to dynamic loads. These phases include launch, launch aborts, reentry, descent, and landing. Risk factors unique to spaceflight include omni-directional, lower energy loading due to the vehicle design, bone, muscle and ligament deconditioning due to exposure to microgravity and unloading, radiation exposure include solar particle events and galactic cosmic rays, pressure suits including bulky, non-conformal helmets and other rigid elements, and exposure to dynamic loads in every mission, unlike other analogous environments where dynamic loads only occur in emergency conditions.

Because of these unique challenges, new approaches to using analytical tools and injury assessment reference values are needed to assess vehicle design safety and mitigate crew injury. These tools include anthropomorphic test devices (ATD), dynamic models of the human, numerical finite-element models of ATDs, and numerical finite-element models of the human. By applying new and revised tools and methods, an appropriate approach for mitigating the risk of injury due to dynamic loads can be developed ensuring crew safety in future NASA vehicles.