



“Head Injury Criteria Based on Head FE Modelling”

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Abstract:

This paper presents an original numerical human head FE models followed by its modal and temporal validation against human head vibration analysis in vivo and cadaver impact tests from the literature. The human head FE model developed presents two particularities : one at the brain-skull interface level where fluid-structure interaction is taken into account, the other at the skull modelling level by integrating the bone fracture simulation. Validation shows that the model correlated well with a number of experimental cadaver tests including skull deformation and rupture, intra-cranial pressure and brain deformation. This improved numerical human head surrogates has then been used for numerical real world accident simulation. Helmet damage from thirteen motorcycle accidents was replicated in drop tests in order to define the head's loading conditions. A total of twenty two well documented American football head trauma have been reconstructed as well as twenty eight pedestrian head impacts and six formula one head traumas. By correlating head injury type and location with intra-cerebral mechanical field parameters, it was possible to derive new injury risk curves for injuries as different as skull fracture, subdural haematoma and neurological injury. Illustration of how this new head injury prediction tool can participate to the head protection system optimisation is also provided.

Keywords:

- FE Modelling
- Safety
- Biomed
- Head Injury