ABSTRACT

This thesis focuses on the numerical evaluation of lower extremity response and its injury mechanism in blast loading. It presents a numerical framework to design and validate a leg surrogate based on data generated using the THUMS^{TM} lower extremity (LE) model.

To achieve this goal, this work addresses the research question, ***"Can biofidelity and the injury predicting capability of the THUMS LE model be extended to blast loading? Can it be used to generate lower extremity response data in blast loading needed to support the design and validation of a surrogate leg?"***

Biofidelity of the THUMS LE model was evaluated against experiments with impact loading equivalent to underbody blast (UBB). CORA ratings were obtained to quantify the match. A numerical framework was developed by modelling 3D finite element simulation of landmine explosion using MM-ALE formulation. This framework was used to evaluate sensitivity of the THUMS LE model under a graded blast input in terms of explosive amount, standoff distance, and changing detonation location below the foot. The model was further investigated for its injury prediction capability by comparing the damage it predicted with experimental injuries from antipersonnel landmine blast reported in literatures. A methodology is presented to quantify the lower extremity damage in below heel antipersonnel landmine explosion. The foot was divided into three sections: the forefoot, which contains the metatarsals and phalanges; the midfoot, which includes the cuboid, navicular, and cuneiform bones; and the hindfoot, which comprises the calcaneus and talus. Tibia damage was also evaluated as it completes the load transfer path further up the leg. Further, trends for leg response and injury were developed from the simulations under varying mass of explosive and standoff detonated below heel. A numerical framework is *presented to design and validate a leg surrogate for blast using the generated response data. Overall, this thesis provides insights into lower extremity response to blast loading and lays the groundwork for further research in the field.*