Modeling of human head injuries in an armored vehicle

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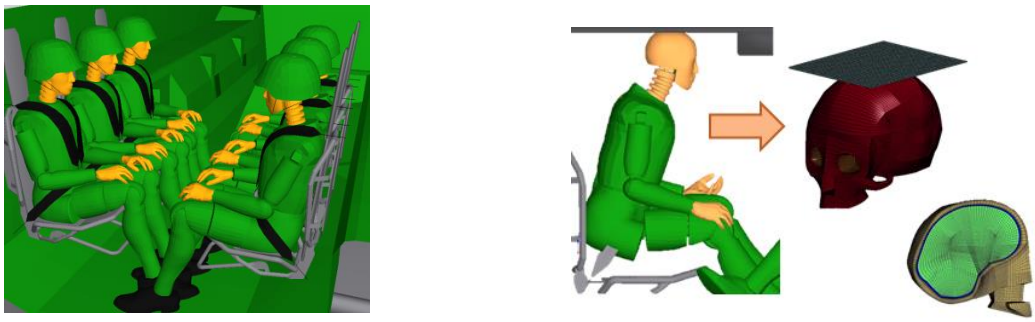
Abstract. The aim of the studies presented in this paper is numerical analysis of IED explosion impact on injuries of soldier's head in a wheeled armored personal carrier. The most dangerous scenarios for head injury have been selected for detailed analysis using FEM. The author's model of the human head allowed the analysis of dynamic effects on anatomical head structures. The results of the simulations made it possible to assess the parameters determining head injury of the soldier during the IED explosion which will enable the development of guidelines to improve their safety. The developed model allows to determine the parameter of stress, strain and pressure acting on the human head. In future studies, it is planned to use the model to carry out simulations, the results of which can be used to improve the construction of military helmets to minimize the possibility of head injury.

INTRODUCTION

As part of studies extensive model research was carried out using Multibody method and Finite Element Method. The model of wheeled armored personnel carrier, including the crew and their equipment, was developed. The model allowed to analyze a number of factors that may affect the safety of soldiers during the IED explosion. The simulations show that the use of 4 point belt harness provides a sufficient level of security compared to other systems analyzed in the paper. Adjusting the backrest of the seat at an angle of 100^0 allows to obtain lower injury criteria relative to other seat positions during an explosion. Authors assessed also safety of footrest [1]. Simulation results clearly indicate the need to mount all loose equipment in the vehicle, as they can cause serious injuries to soldiers during an explosion. The most dangerous scenarios for head injury have been selected for detailed analysis using FEM. Finite Element Modeling has been used in many studies to asses safety of human head during car crashes [2,3].

NUMERICAL MODELS

As a part of studies extensive model research was carried out using Multibody method and Finite Element Method. Boundary conditions for detailed analysis using FEM method were derived from Multibody simulations of armored personnel carrier (Fig.1).



(a) (b)

FIGURE 1. (a) Multibody Model of armored personnel carrier, (b) detailed analysis using FEM method

RESULTS AND CONCLUSION

Studies allowed to create a hybrid model of human head. The model was validated by Nahum studies [4]. The author's head model allows to analyze head injuries using the HIC criterion and using the values of the stress, strain and pressure in the head. Studies show that the most dangerous scenario for human head is during contact with the celling of the vehicle. Extended research indicated critical situations in which probability of head AIS3+ injury was high. Detailed information will be included in the full version of this article.

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