THOMO

NEWSLETTER

Development of a Finite Element Model of the Human Thorax and Upper Extremities

Issue 1, October 2009

In 2004, in the European Union, there were 42,193 road fatalities and 1,213,300 accidents involving injuries. The socio-economic cost of road crashes to the EU 15 is twice the EU's annual budget. The number of casualties is so important that it shall be reduced by all the available ways.
Numerical human body models could be used to assess injury risks in different scenarios, to improve safety in vehicles, regulations, and anthropomorphic dummies.
The current project proposes to give to passive safety players a tool capable of assessing real safety. It aims to improve finite element models of the human thorax including upper extremities based on the research, development, and validation of the models for the 5th, 50th, and 95th percentile of each gender.
This project aims to bring new data and knowledge on the thorax to a worldwide project, called Global Human Body Model, whose goals are to create and to maintain the world's most biofidelic human body models.

In this Issue :

Objectives of THOMO

1- Development and maintenance of a biomechanical database focused on the thoracic segment. Eighteen thorax tests with instrumentation of the ribcage are planned, in frontal and side impact, with loading conditions representative of those encountered in automotive car crashes. The 50th percentile male and the 5th percentile female are considered.

2 - Improvement of the knowledge of the geometrical and mechanical properties of the ribcage. The main goal is to define typical geometrical rib properties along the curvilinear abscissa. Mechanical tests will be performed on rib samples.

3- Development of numerical models, consisting of gross motion and numerical validations in a first stage. With help of results from the tests performed in the project, a focus will be given to the validation of strain fields, in order to exhibit the rib fracture mechanisms. The 5th, 50th and 95th percentile thorax models are considered, with help of scaling methods.

4- Mechanical and injury validation of the thorax models with tests coming from the literature or performed during the project. Use of personalization methods and optimization process to validate matched thorax models. Main goals: definition of acceptable values for soft tissue material properties and improvement of mainly used scaling methods for biomechanical results.

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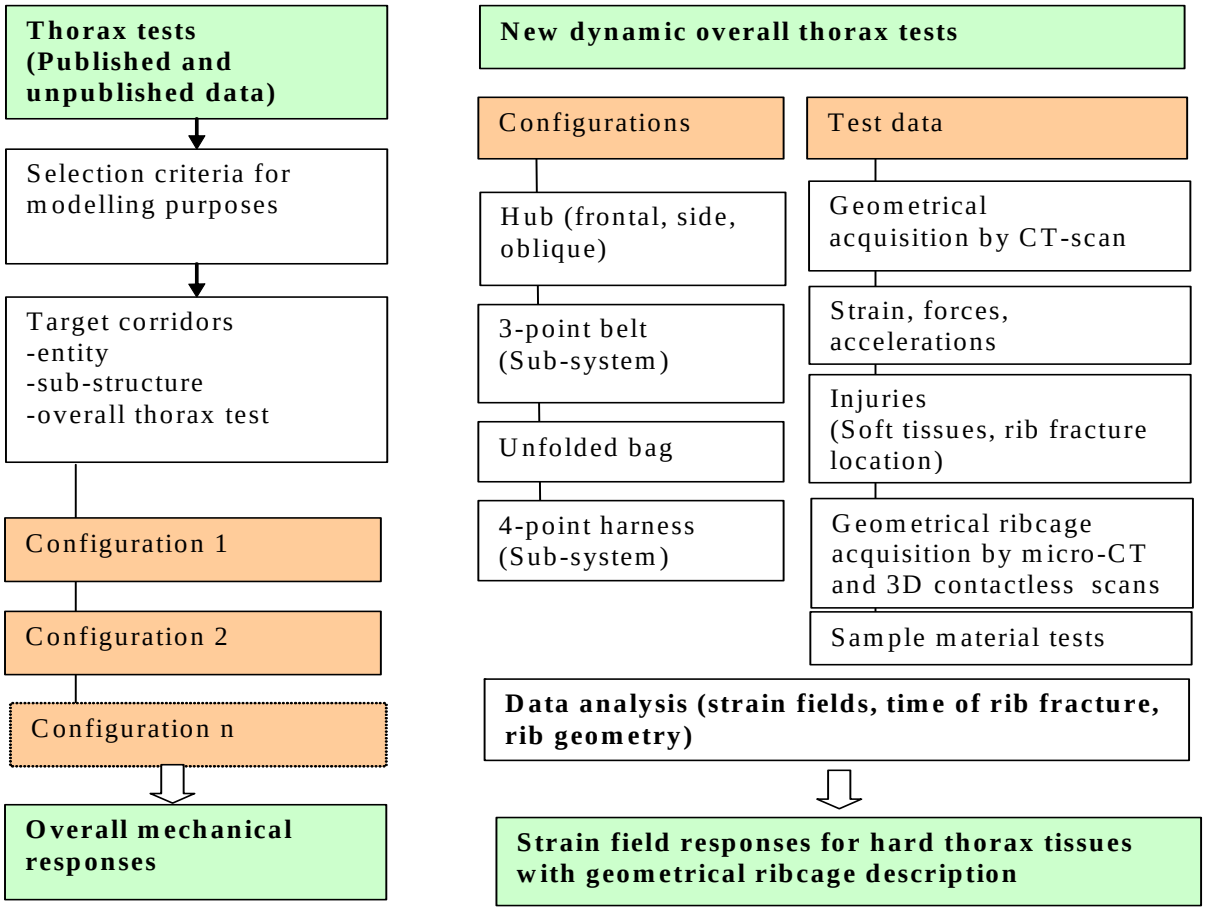
Description of the Work Package 2

The THOMO project started in January 2009. The first actions were focusing on the acquisition of new biomechanical data regarding the thorax (WP2).

As a first result, THOMO performed with success, for the THORAX project, a set of three thorax tests in frontal impact, whose conditions were discussed in the frame of COVER. Loadings with an unfolded airbag, with a 2-point belt, and with a 4-point harness were chosen. Two hub tests were also performed in side and oblique impacts. A particular attention was given to the instrumentation of the ribcage, with more than one hundred strain gauges, in order to exhibit the strain fields and rib fracture mechanisms.

In order to improve the knowledge of geometrical rib properties, a methodology, from data acquisition by micro-CT and 3D contactless scans to reconstruction of rib CADs with dedicated tools, was defined. The complete process was performed with success on a rib, ending in simplified inner and outer cortical bone surfaces.

First Results



Organizations

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