

To analyze resultant forces and behavior of each part of the human body during impact, we are developing a computational model of the human body called "THUMS" (Total Human Model for Safety).

**Fig. 1** shows the outline of an occupant model (50% average American male) developed as the first phase. The present computational model, which simulates the contour and dynamic characteristics of the human body (bone strength and skin tenderness) more faithfully by using the finite element method, has the following characteristics:

- (1) The human body consists of bones, skin, ligaments, etc. (excluding internal organs).
- (2) Joints are modeled in detail including the ligaments, tendons, etc.

(3) To realize a practical level of computation time, only sections expected to receive damage were selected for detailed modeling for analysis. The rest of the human body is modeled in a rough mode.

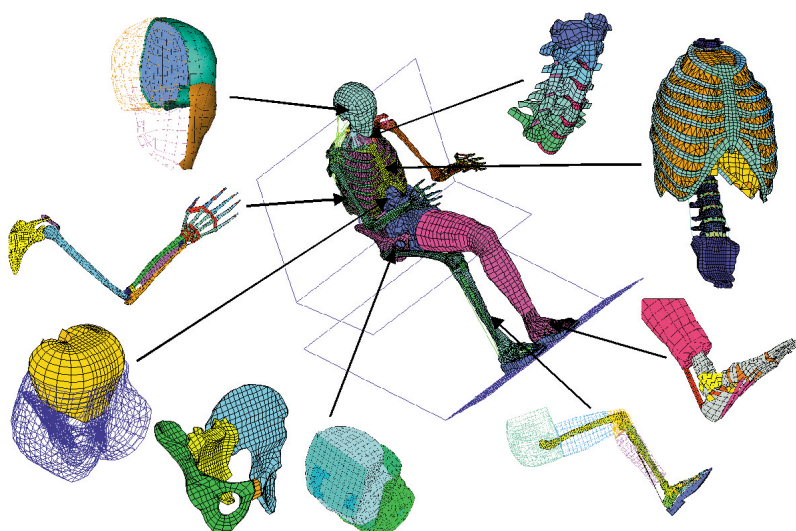
**Figs. 2 and 3** show a comparison of the computational results using the present computation model and the results of the cadaver test<sup>1, 2)</sup>. This phrase doesn't add anything meaning for. We compared and reviewed the results of the test conducted on respective cadaver sections and the results of computation using the present computational model, by which we verified the biofidelity of this model.

We are now developing computation models for females of smaller physique, young and old aged people, and pedestrians. We are also developing models for muscles, internal organs, brains and other soft human body systems sequentially and incorporating them into the finite element model of the human body.

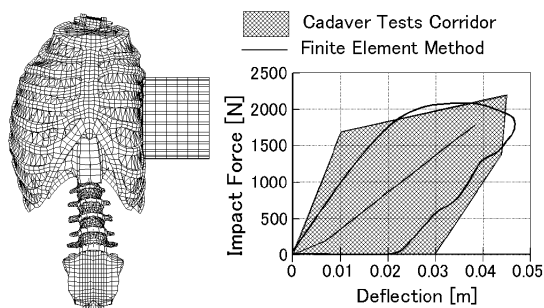
References:

- 1) Bouquet, R., et al. : "Thoracic and Pelvis Human Response to Impact", Proc. ESV Conf., 94-S1-O-03(1994)
- 2) Cavanaugh, J.M., et al.: "Lower Abdominal Tolerance and Response", SAE Tech. Pap. Ser., No.861878 (1986)

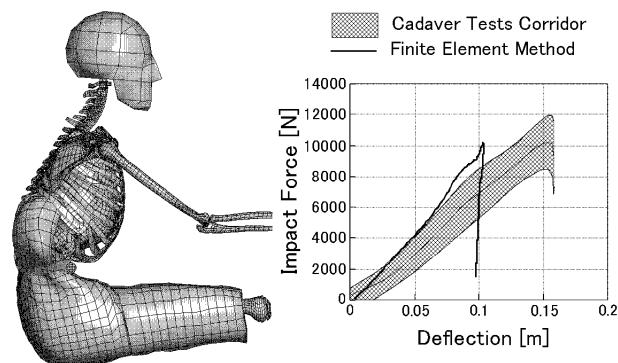
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**Fig. 1** Finite element model of human body.



**Fig. 2** Validation results of thorax on side impact.  
- Cadaver data from Bouquet, et al.<sup>1)</sup>



**Fig. 3** Validation results of abdomen on frontal impact.  
- Cadaver data from Cavanaugh, et al.<sup>2)</sup>