get it right®

HUMAN MODELING

FOR SAFETY, COMFORT, ERGONOMICS AND MEDICAL APPLICATIONS

KEY BENEFITS

- Get closer to human behavior:
  - Kinematics,
  - Soft tissues deformation.
  - Injury mechanisms,
  - Muscle activity.
- Evaluate product design for specific subject or a population group.
- A component of ESI's End-to-End solutions (Virtual Performance Solution, Virtual Seat Solution).

APPLICATION DOMAINS

- Ground transportation,
- Aeronautics,
- Defense,
- Sports & leisure,
- Medical, paramedical & healthcare.

"The human-like thorax deformation under asymmetric loading, which is the loading case for most of the current restraint system configurations used in the automotive industry, cannot be seen using the Hybrid III model.[...] it is necessary to use more biofidelic tools like the THUMS. HIII Dummies are not able to analyze in detail thoracic injury mechanisms. Human Models like the THUMS can better predict thoracic injuries. Further work needs to be done in order to improve the prediction capabilities of the model [and] develop an age-dependent prediction capability of thoracic injuries."

Rommel Segura,
AUDI AG/LMU

WHY HUMAN MODELS?

Human models allow to understand the behavior of the human body in diverse domains and scenarios.

They were first developed in the automotive industry to complement crash test dummies. Their superior biofidelity gives insight into a real human body response during an impact.

Application fields have now extended beyond safety in transportation, to include seating comfort, ergonomics in day-to-day and working tasks, computer-aided diagnosis and surgery, medical device and sports equipment design.

Human models are available in ESI's Virtual Performance Solution (VPS) and Virtual Seat Solution (VSS).

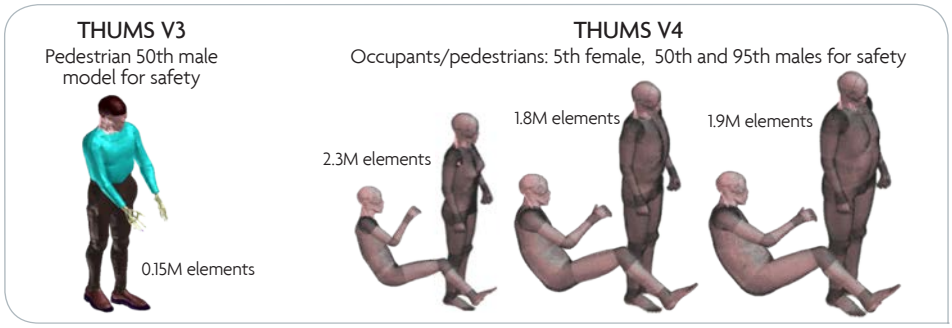
THUMS – TOYOTA'S TOTAL HUMAN MODEL FOR SAFETY

The Total Human Model for Safety (THUMS) is a family of Finite Element models developed by Toyota Motor Corporation and Toyota Central R&D Labs., Inc. distributed and supported in their VPS version by ESI Group.

THUMS models give access to the detailed local behavior of human body segments, and are capable to simulate damage, such as bone fracture or ligament tear.

The first model converted to VPS is the 50th percentile male V3 pedestrian. The corresponding V3 occupant model will also be proposed.

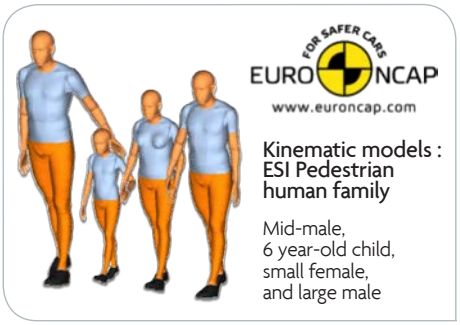
The new generation of THUMS V4 models, 5th percentile female and 50th and 95th percentile males, will be available in VPS, both for pedestrian and occupant applications.



KINEMATIC MODELS FOR PEDESTRIAN IMPACTS

Some applications do not require detailed local behavior. To complement the Finite Elements approach, ESI has developed kinematic human models. They are meant to capture the kinematics of the human body and the interaction of the human with its environment. These simplified models, built with articulated rigid segments, offer significantly shorter computing times.

These VPS models are accepted by EuroNCAP for its pedestrian testing protocol.



Kinematic models : ESI Pedestrian human family

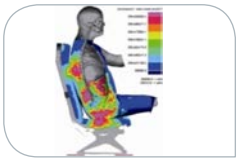
Mid-male,
6 year-old child,
small female,
and large male

HUMAN MODELS FOR SEAT OCCUPANT TO PREDICT ALSO...

Human models from different anthropometries and populations are available, such as 5th, 50th, 95th percentile human models developed in partnership with HYUNDAI Motor Company.

They are embedded in Virtual Seat Solution.

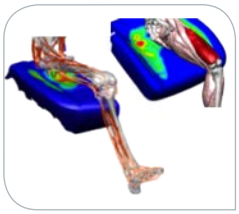
• Seat comfort



The detailed definition of all human articulations and the validated flesh properties enable inner stresses and contact pressure distribution.

Compression stresses inside Human body.

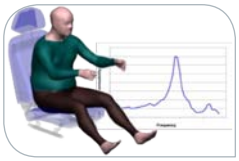
• Ergonomics



Ergonomic design is linked to the capability for the occupant to reach an equipment and perform a task in a comfortable way. The muscle activation related to a given motion can be computed taking into account external loading due to seat and flesh deformation.

Human/Seat contact pressure acting on the muscle activation.

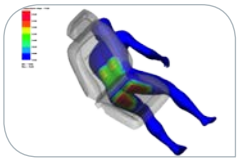
• Vibratory Comfort



ESI's human models can depict realistic human body reaction under seat vibrations, i.e. flesh compression, pelvis tilting and spine bending visible in the transmissibility curve.

Transmissibility curve at the interface between seat and human model.

• Thermal Comfort



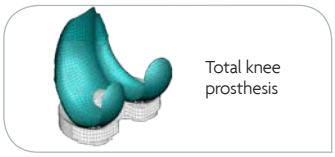
The temperature evolution of the occupant is calculated from the exchanges between occupant, seat and its environment. It is then used to evaluate occupant thermal comfort.

Temperature on the external skin of the occupant.

HUMAN MODELS FOR HEALTH CARE AND OTHER VARIOUS FIELDS

Human models help improve or develop innovative systems, or validate surgery planning. Insight into dynamic behavior of prostheses in everyday life situations helps to improve their lifetime and performance, as well as patients' well being. The prediction of blood flow in arteries after virtual clipping opens a new era in surgical practice.

Trachea mesh based on patient - specific geometry



Total knee prosthesis

DEDICATED TOOLS

Our multi-body and deformable FE human models can be fully articulated through computation and interactively positioned in ESI's Visual-Environment, using tools such as SIM-Positioner. Scaling technologies can be used to adapt our human models.

For more information, visit: www.esi-group.com/VirtualPerformanceSolution and www.esi-group.com/VirtualSeat

ABOUT ESI GROUP

ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials. ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product's behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact on product use under normal or accidental conditions. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 40 countries. ESI Group is a French company listed in compartment C of NYSE Euronext Paris.

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