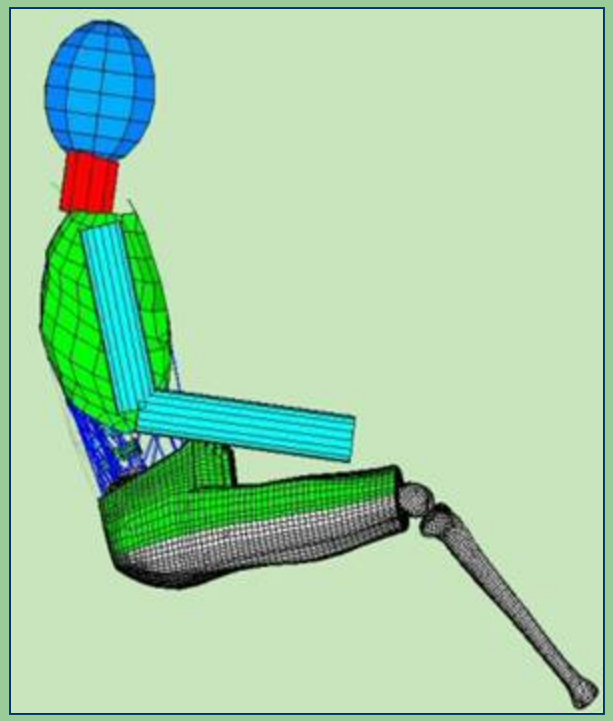
Digital Human Modeling for PLM



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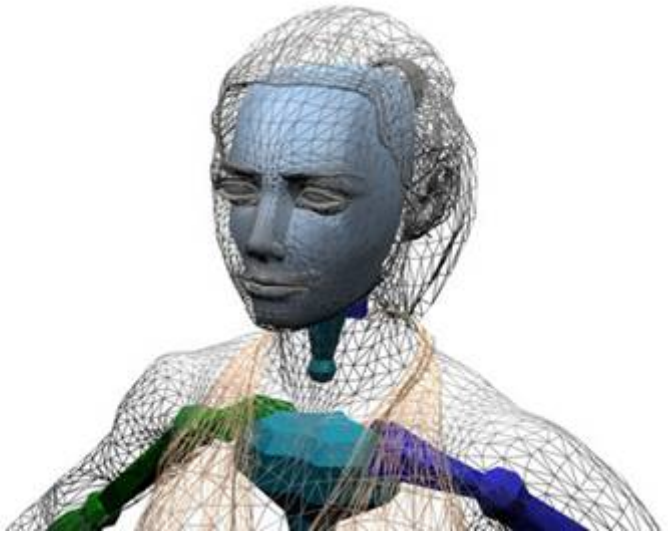
Overview

- Introduction/Background
- DHM in Manufacturing
- DHM in PLM
- Catia V5 & UGS Jack Integration for PLM
- Future Work
- Discussions

What is DHM?

- Digital human models (DHM)
  - A digital representation of the human inserted into a simulation or virtual environment to facilitate prediction of safety and/or performance
  - Includes a visualization & math/science in background (Sundin, 2006)



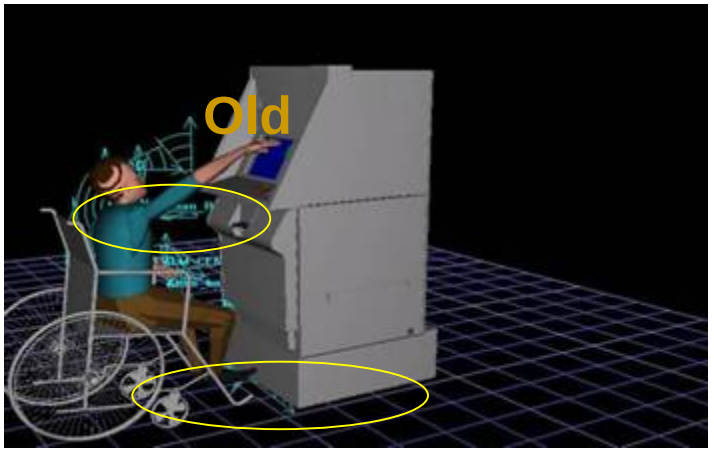
Potentials of DHM

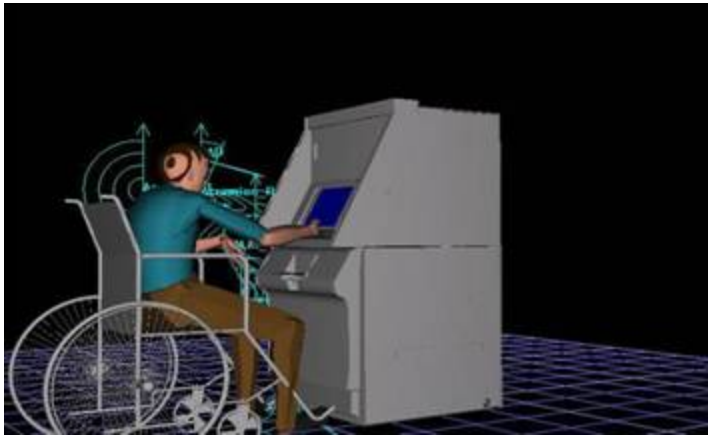
- Has potential to enable engineers
  - incorporate ergonomics & human factors engineering principles earlier in the design process (Duffy, 2004; Chaffin, 2005)

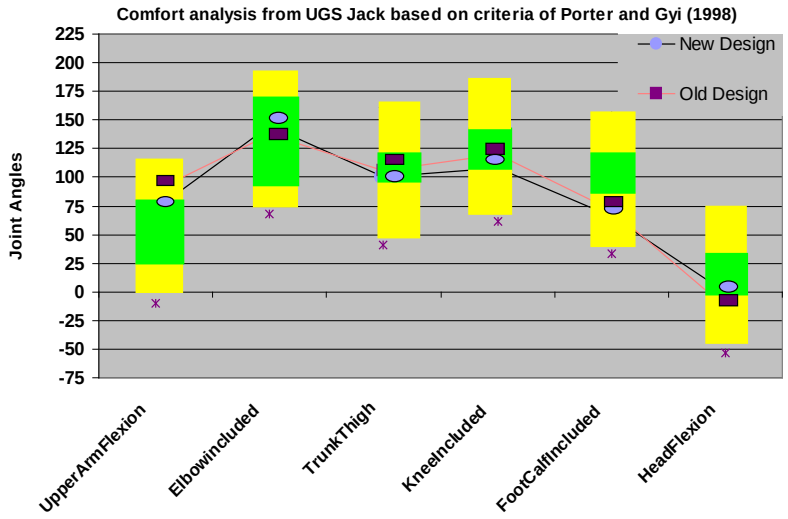
- Providing real cost savings
    - $8.8 Million avoided in injury costs
      - Brazier, et al. (2003)

Potentials of DHM

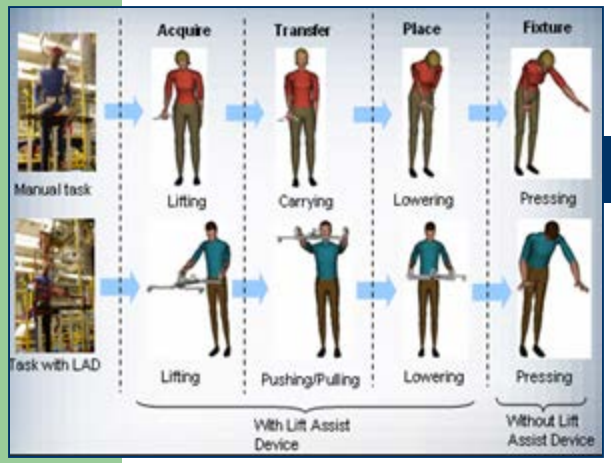
- Motion capture can be used to drive the DHM and facilitate ***reduction of injuries*** & comfort prediction through ***virtual interactive design*** of work stations and some new products
- This method ***allows manufacturers to predict*** potential risk before production begins.







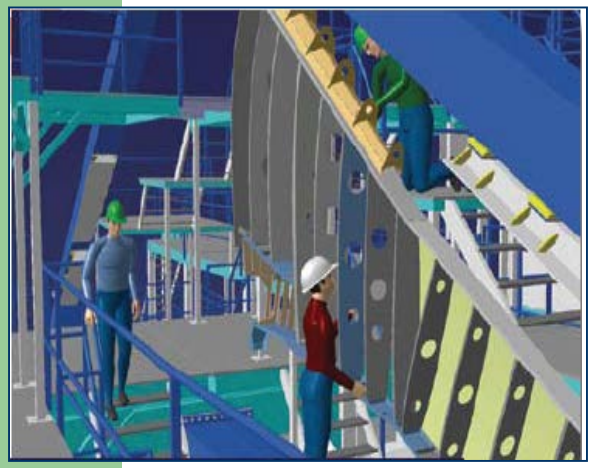
Applications of DHM



Prediction & Reduction of Injuries

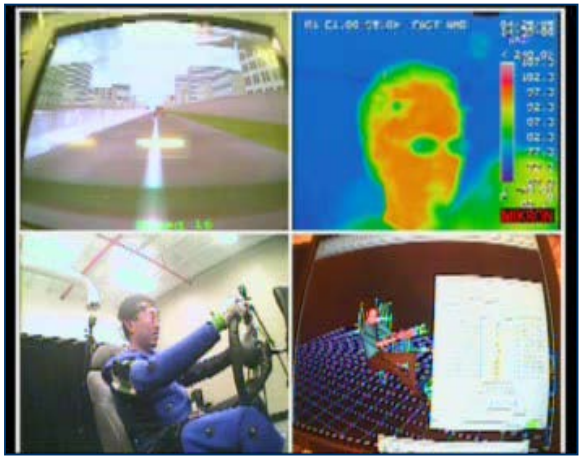
Automotive Design

Aerospace Design



Work Environment Simulation

Simulations & Training for Surgeons

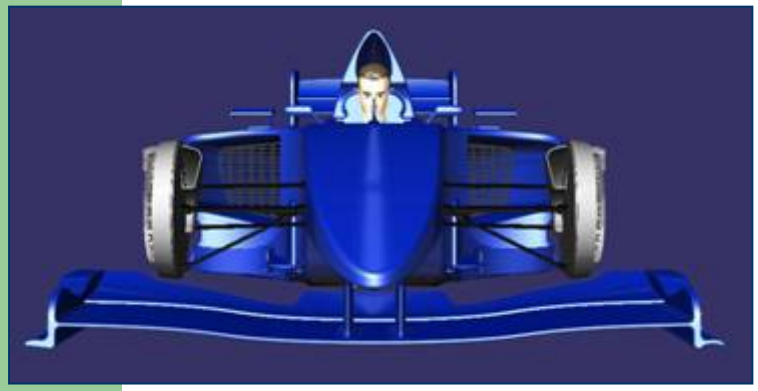


Cognitive Models

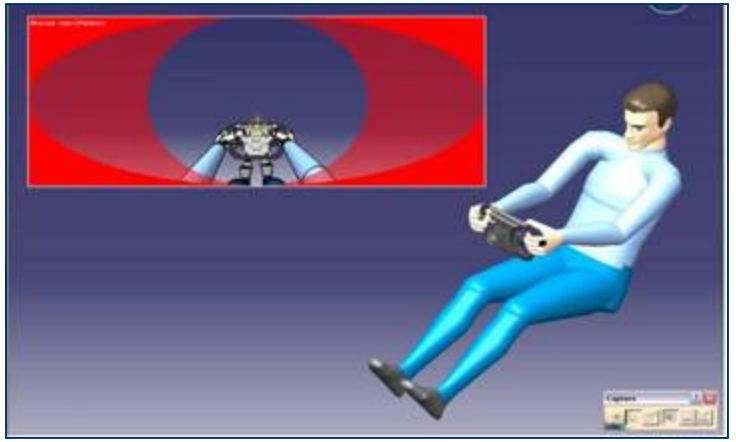
DHM in PLM

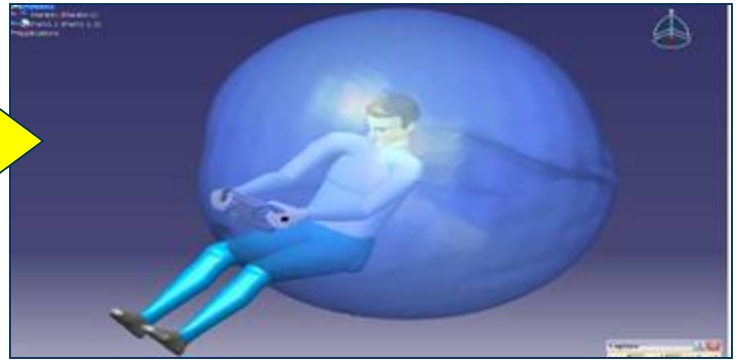
- Integration of PLM and DHM
  - Increases the engineering design and analysis capabilities
  - Improves the product ergonomics
  - Enables human-machine virtual reality applications
  - Provides cost and time savings

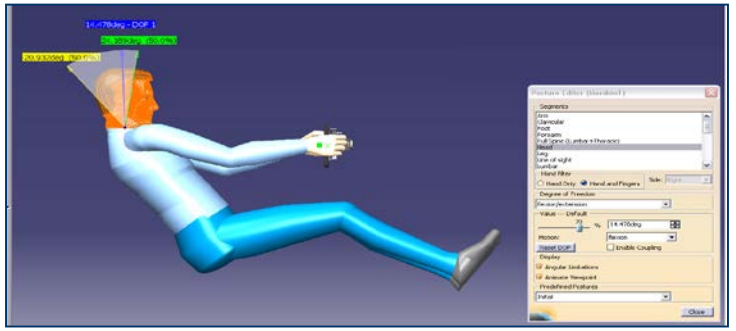
Integration Between Catia V5 & UGS Jack



Applied Human Model

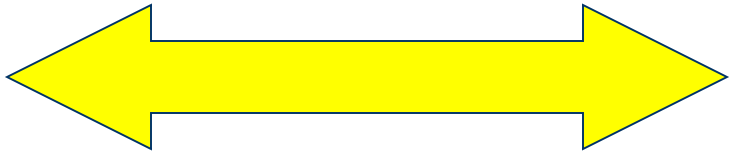


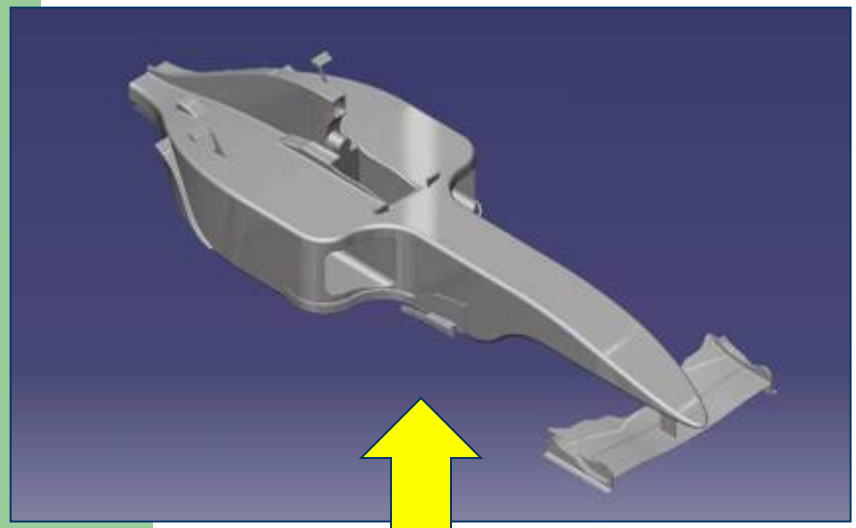


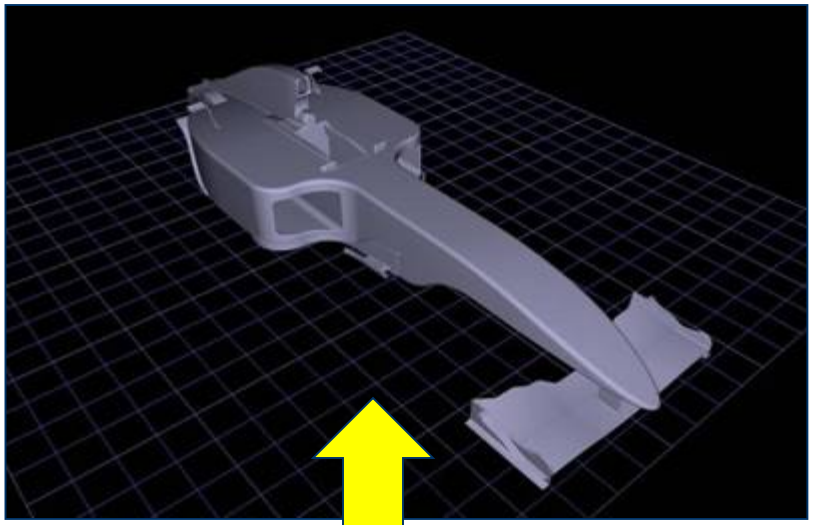


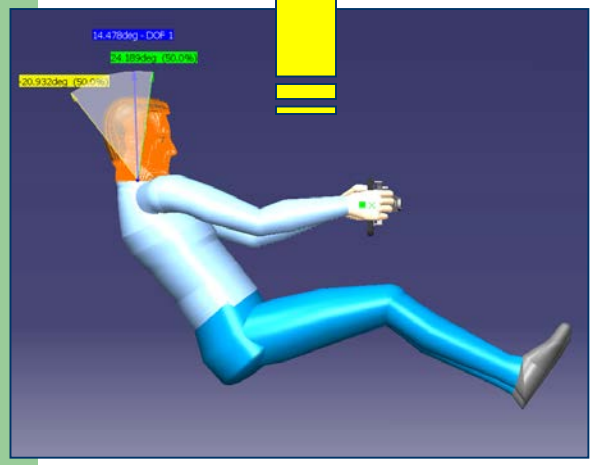
DHM Analysis

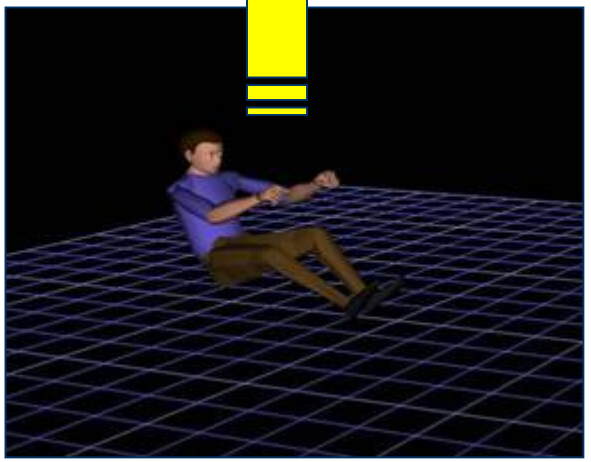
Integration Between Catia V5 & UGS Jack



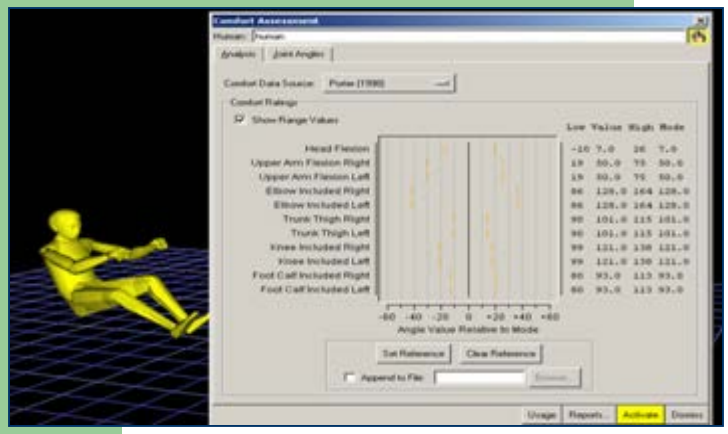


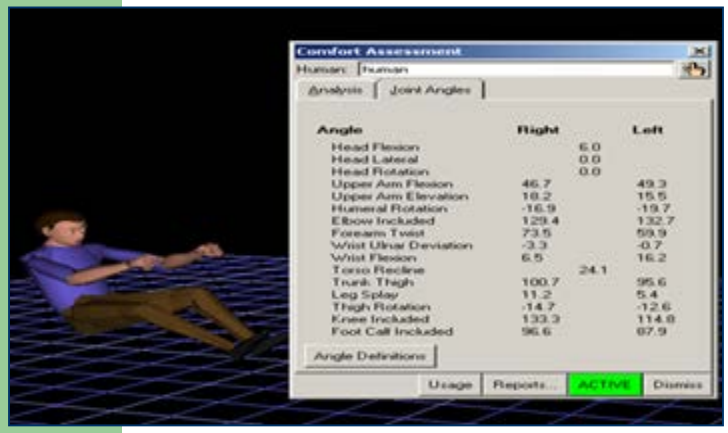


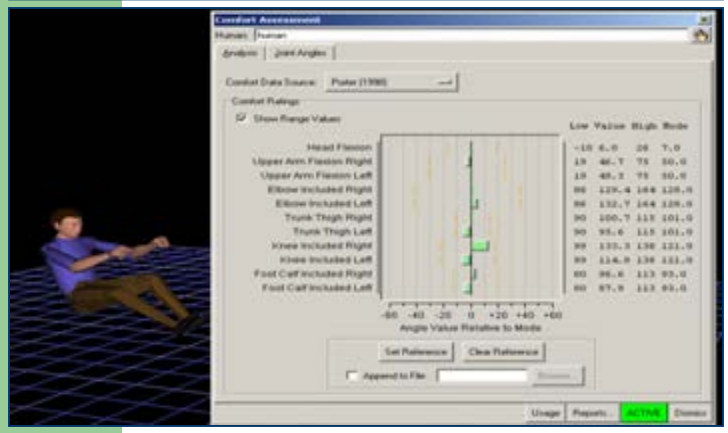




Driver Comfort Analysis







Occupant Packaging Report

Vehicle Code:	Comfort Assesment
Analyst:	H. Onan Demirel
Department:	Purdue
Date:	08/07/2006
Comments:	Male_Driving_Posture

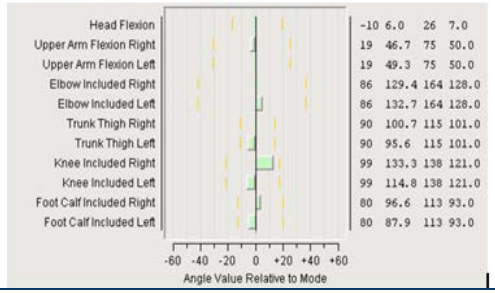
Human Figure Posture Details:

Comfort ratings based on: Porter (1998)

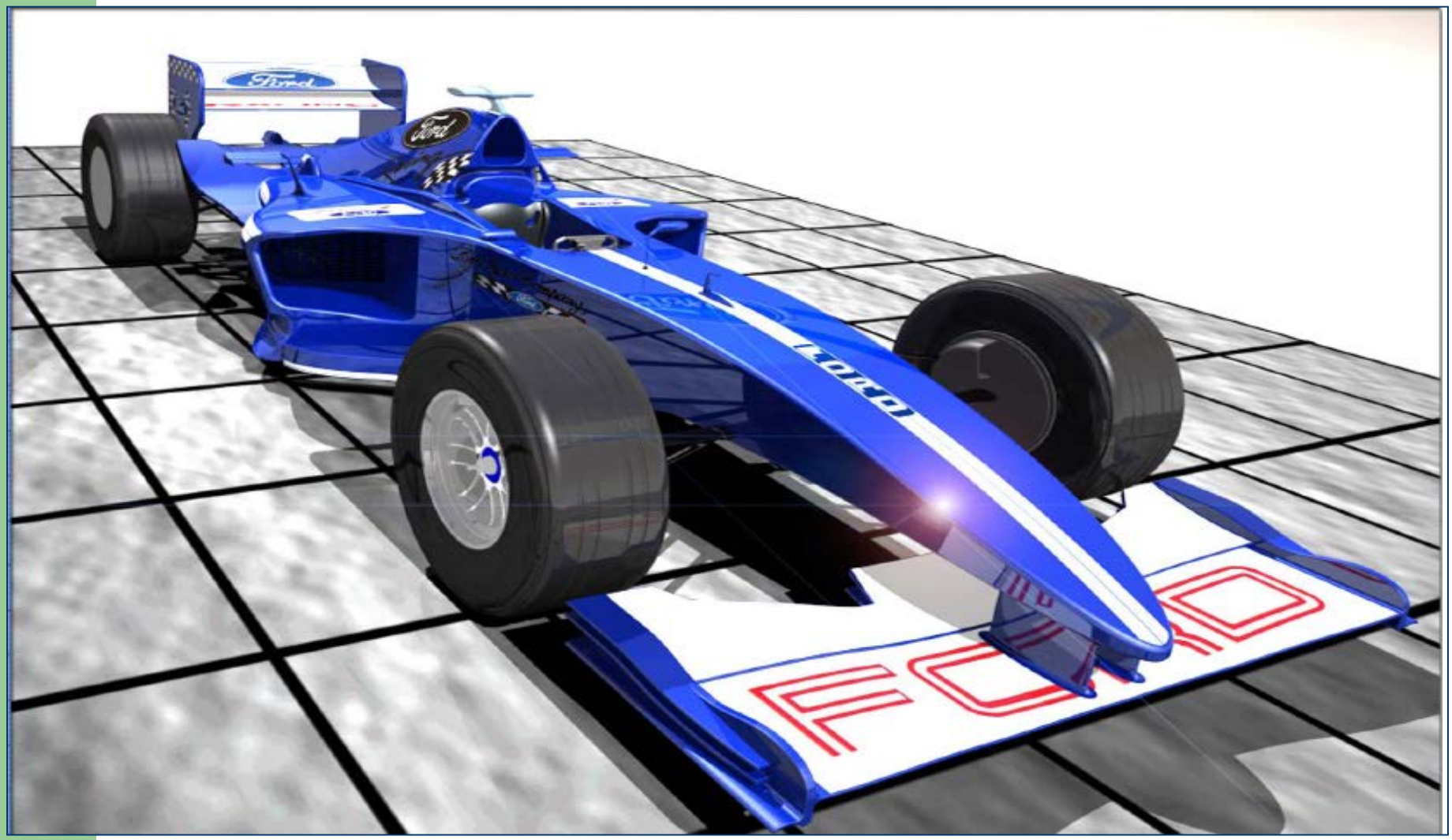
Angle	Right		Left
Head Flexion		6.0	
Head Lateral		0.0	
Head Rotation		0.0	
Upper Arm Flexion	46.7		49.3
Upper Arm Elevation	18.2		15.5
Humeral Rotation	-16.9		-19.7
Elbow Included	129.4		132.7
Forearm Twist	73.5		59.9
Wrist Ulnar Deviation	-3.3		-0.7
Wrist Flexion	6.5		16.2
Torso Recline		24.1	
Trunk Thigh	100.7		95.6
Leg Splay	11.2		5.4
Thigh Rotation	-14.7		-12.6
Knee Included	133.3		114.8
Foot Calf Included	96.6		87.9

Green = within comfort range
Yellow = outside of comfort range
Black = not part of Porter (1998) data source

Comfort ratings based on: Porter (1998)



Final Product



A Future Application

Biodynamic Response of shipboard sitting subject to ship shock motion (Z. Zong, K.Y. Lam)

- Underwater shock produced by an underwater explosion remains one of the biggest threats to ships and shipboard personnel.

- What is an underwater shock?
  - Extremely high acceleration
  - Very short duration.

Test Set-up

Lumped Parameter System

- M = Unit Mass
- K = Spring
- C =Damper
- Y = Displacement
- i = Body Parts

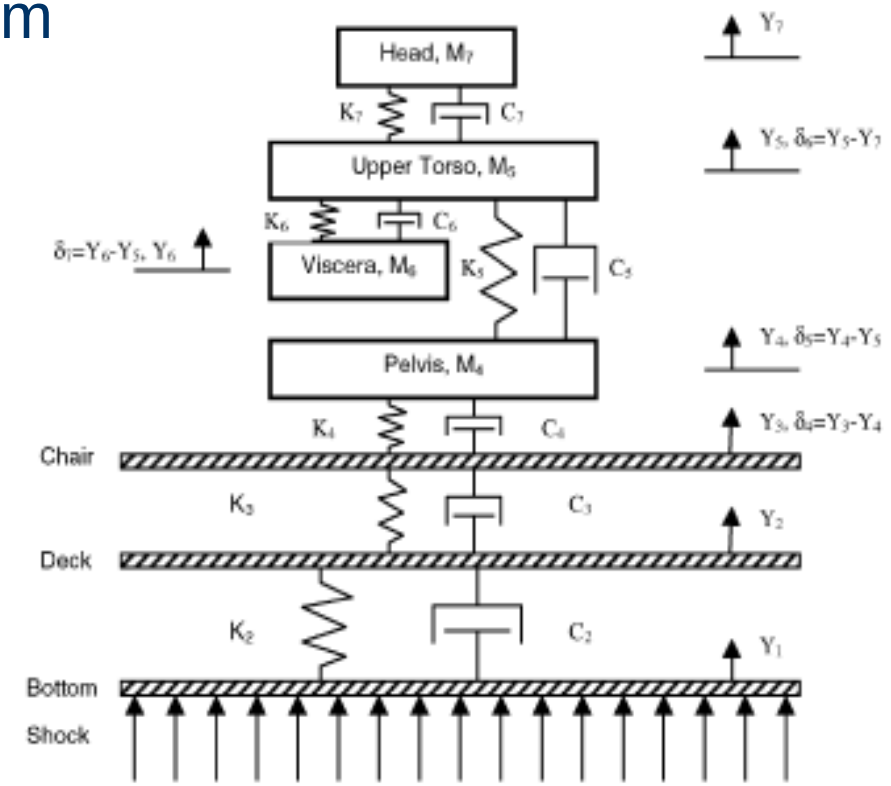


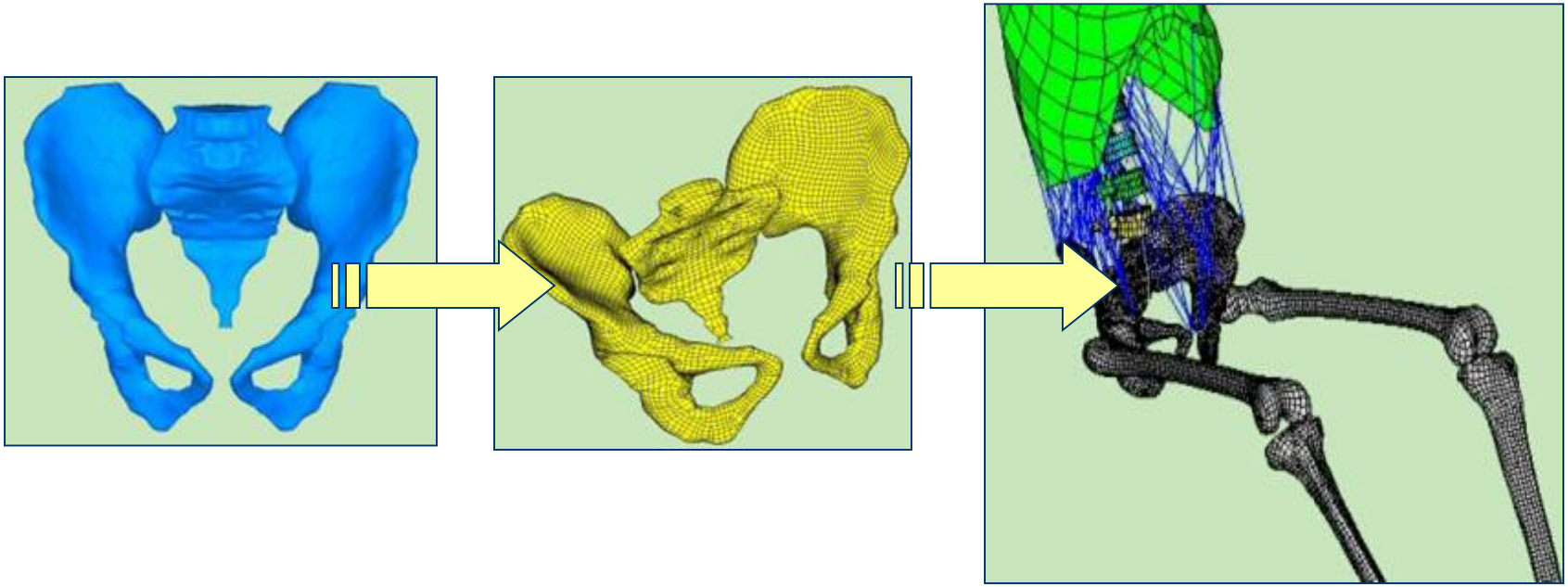
Fig. 1. Simplified mechanical system representing the human body sitting upright in a chair subjected to vertical shock.

Results

- The risk for the pelvis injury is higher than the other parts.
- The part in direct contact with the structure is of high injury risk.
- The lumped parameter model (multi-degrees of freedom) is an improved way over SDF (single-degree-of-freedom)

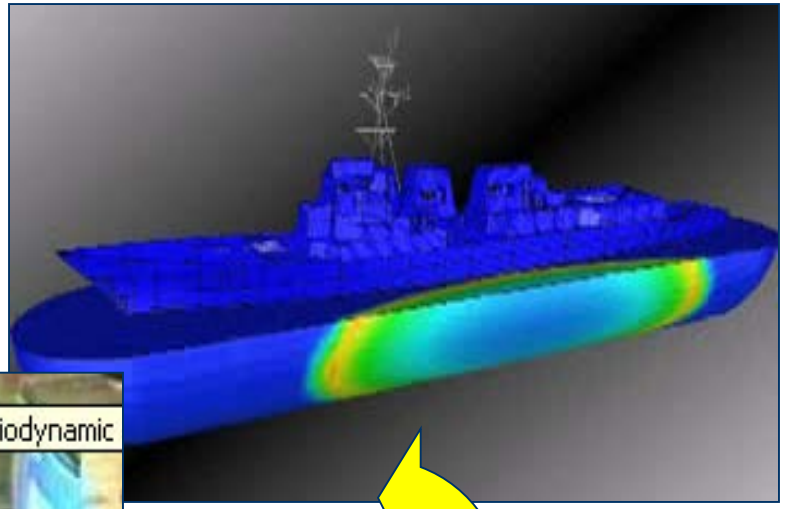
Discussions

- 3D FEM (finite-element-model) is a better method over compared with two methods.
  - Human body is very complicated, more data and parameters needed to construct a 3D FEM model.

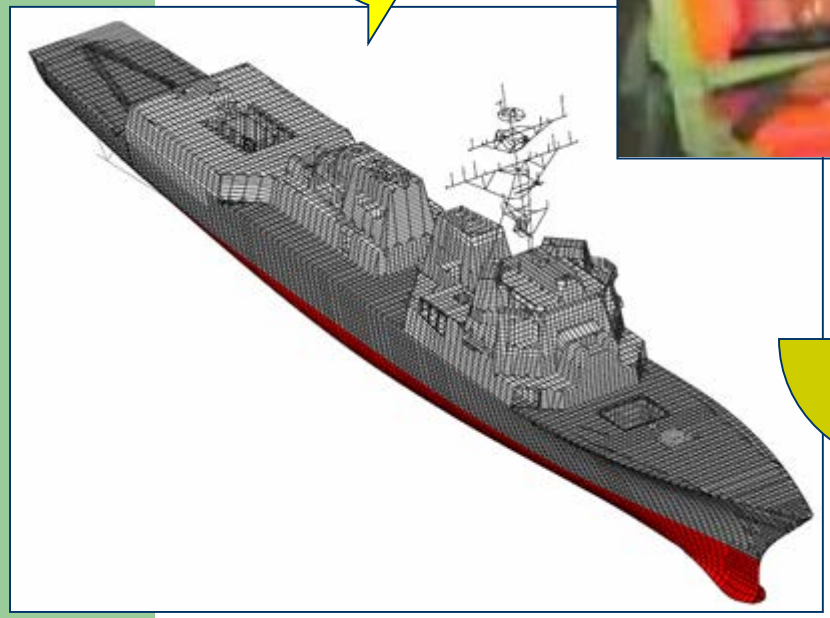


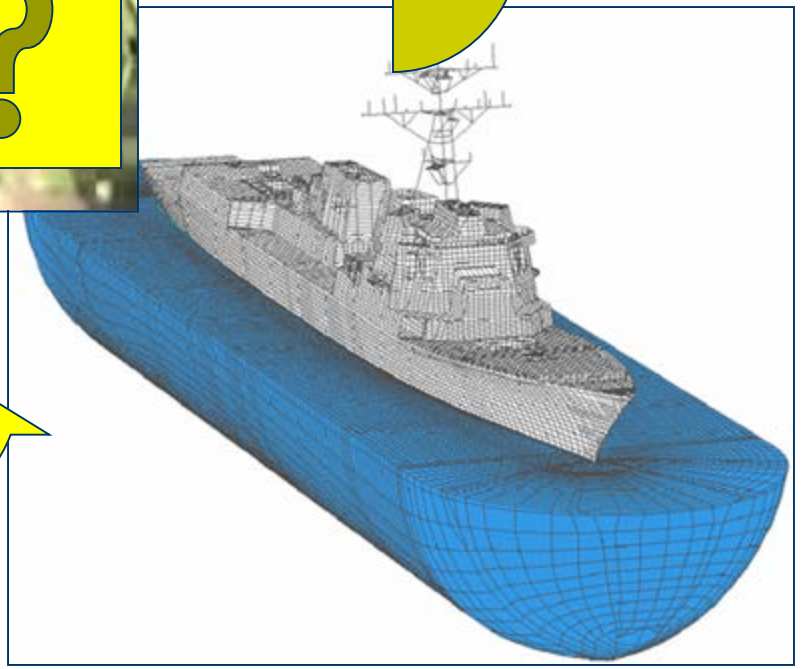
Discussions

- Isolation of the part of the body from direct contact with the structure (using isolator or cushion) may significantly reduce the injury risk.




Biodynamic
?





Any questions?