Seated Human Model Validation

Christian Gammelgaard Olesen
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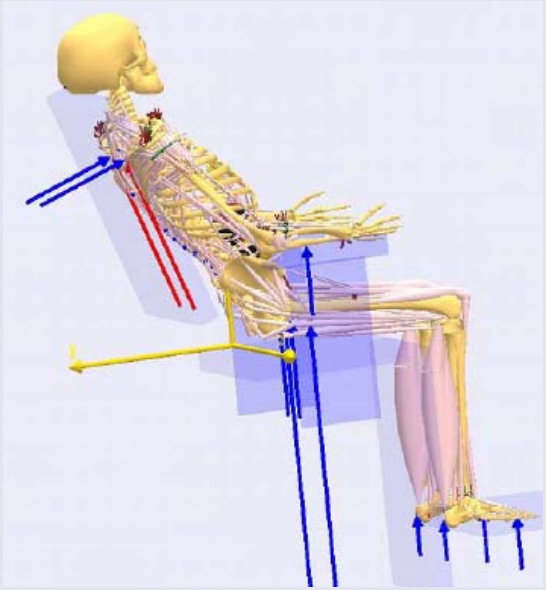
Aalborg University



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Presenters

Christian Gammelgaard Olesen
(Presenter)

Mark de Zee
(Panelist)

Arne Kiis
(Webcast host)

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Q&A Panel

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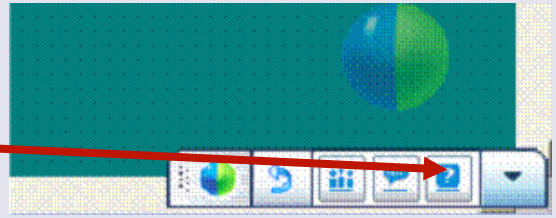

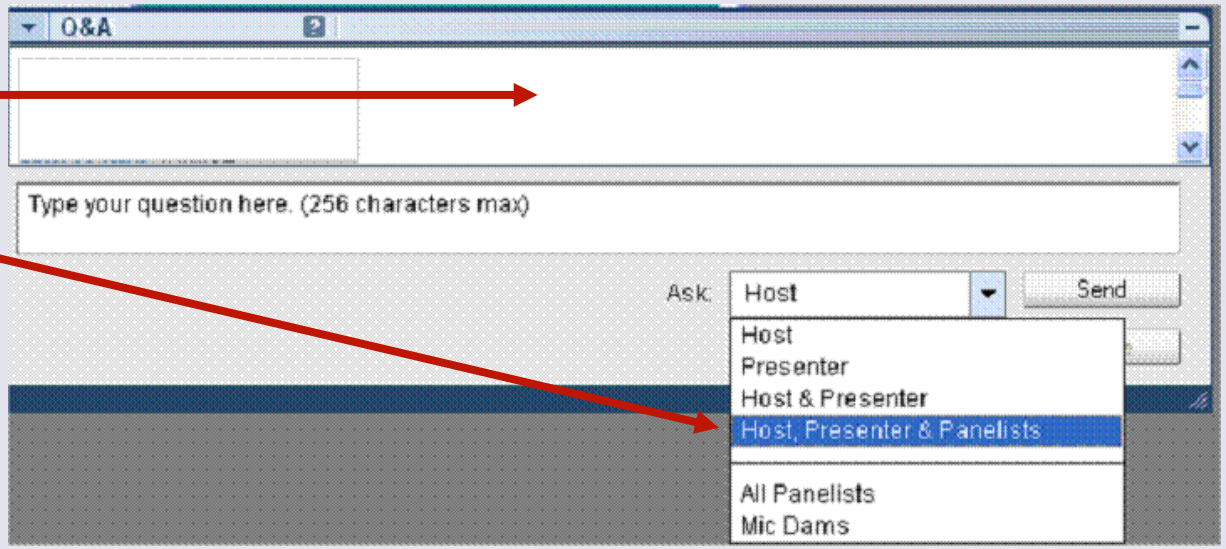

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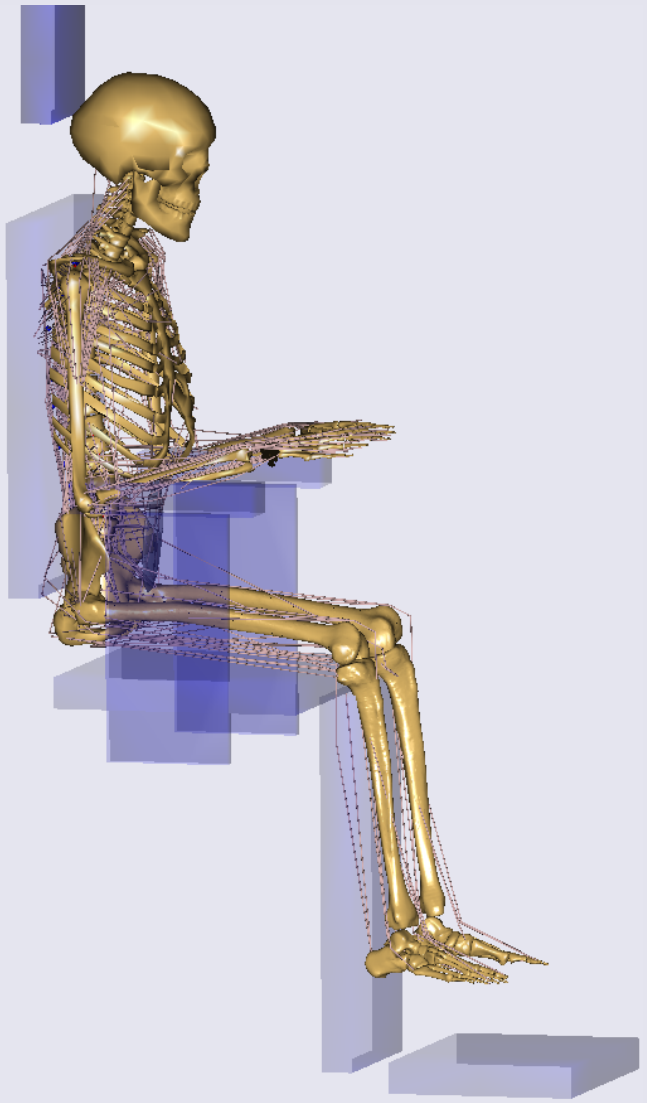
Introducing myself

- Christian Gammelgaard Olesen
- Biomedical Engineering (M.Sc.)
  - Specialized in Biomechanics
- PhD Student in the AnyBody Research Group Dept. Mech. Eng. Aalborg University
- Supervisor: Prof. John Rasmussen & Dr. Mark de Zee

Agenda

- The Seated Model
- Objective (Pressure ulcers)
- Validation Experiment
- Validation results
- Next step



Questions, it is ok to ask

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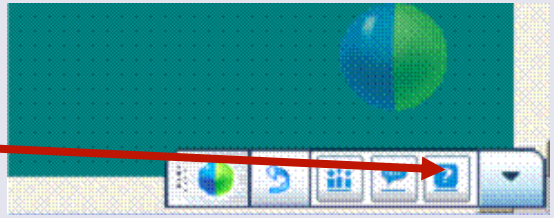

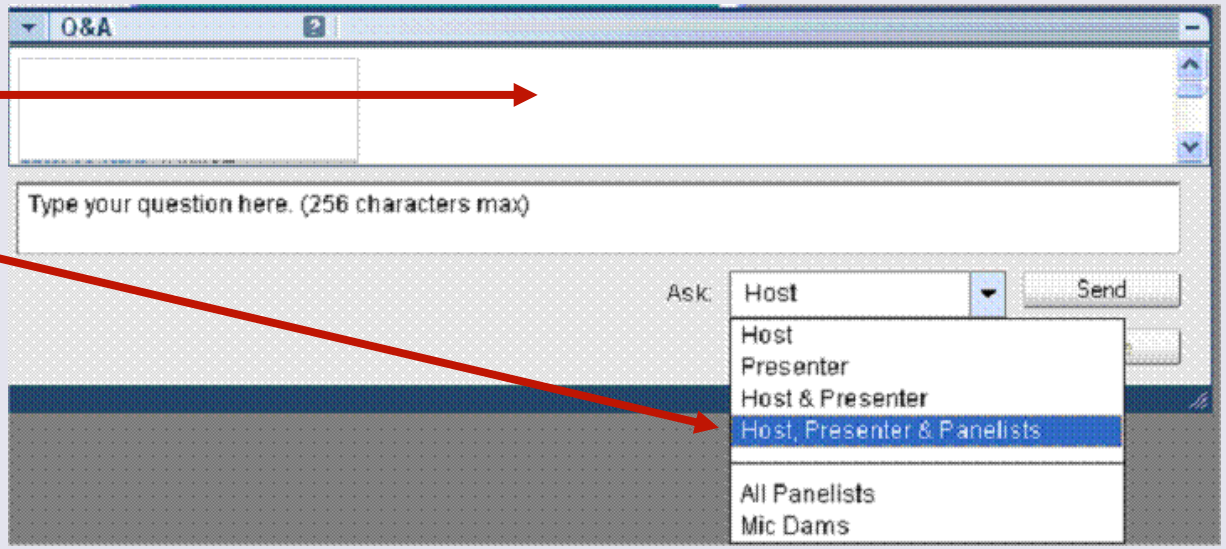

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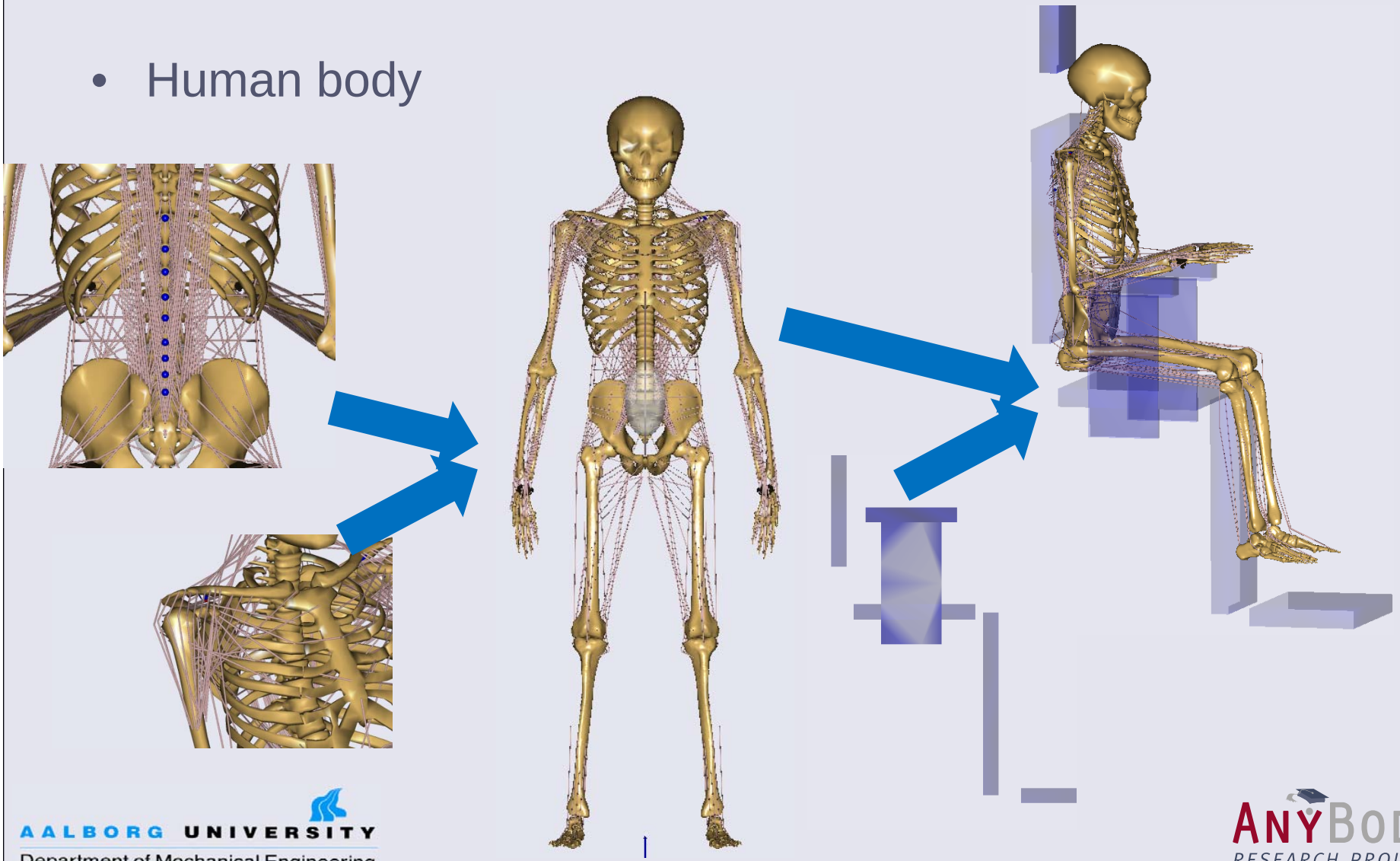
The Seated Model

- Developed by the furniture industry
  - Previous webcast – Prof. John Rasmussen
  - Public domain (www.anyscript.org)
- Inverse dynamic model
- Human sitting in a generic chair
- Chair
  - Seat, Backrest, Armrest, Legrest, Footrest, and headrest
  - Adjustments:
    - Friction coefficients
    - Chair size
    - Backrest, seat, foot, etc., can be adjusted

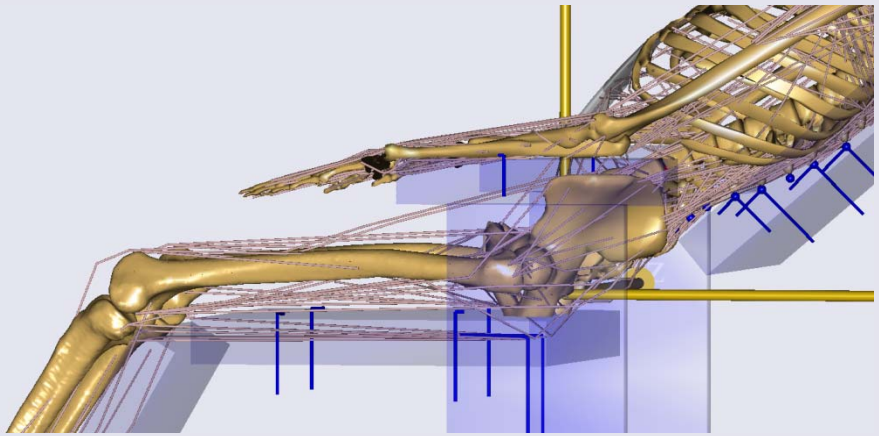
The Seated Model

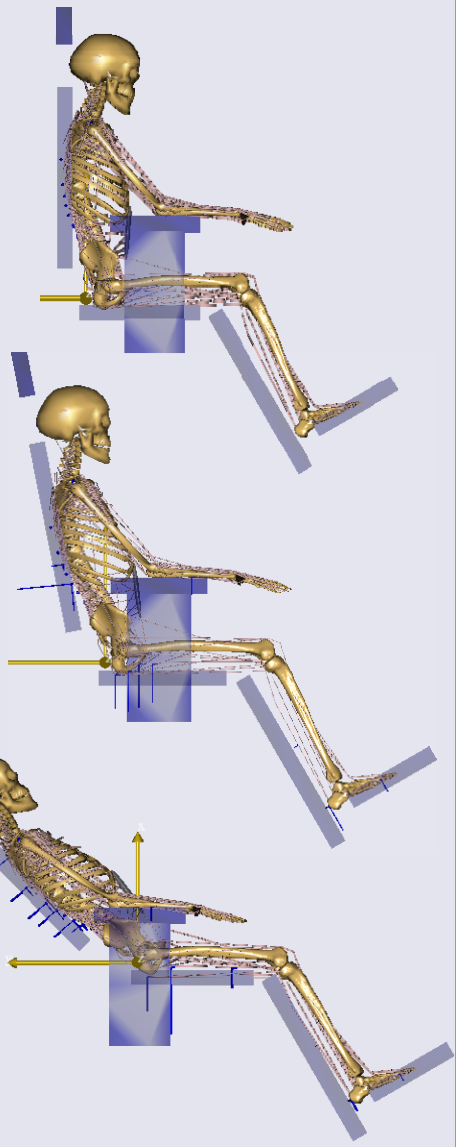
- Human body



The Seated Model

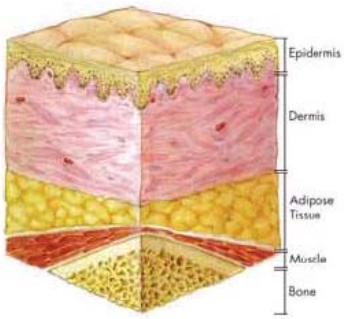
- Setup
  - Angles and distances
- Calculating external forces
- Calculating internal forces
  - Muscles, joints etc.

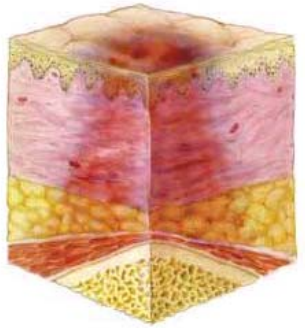




Objective

- Seated Discomfort (Healthy)
- Pressure Ulcer (Paraplegic)
- Sitting Aquired Pressure Ulcers
  - Deep Tissue Injury (DTI)



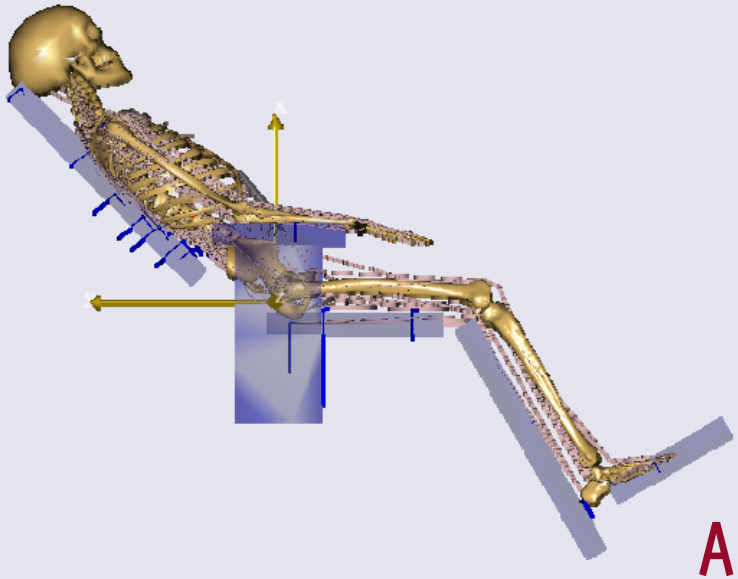


www.npuap.org

www.epuap.org

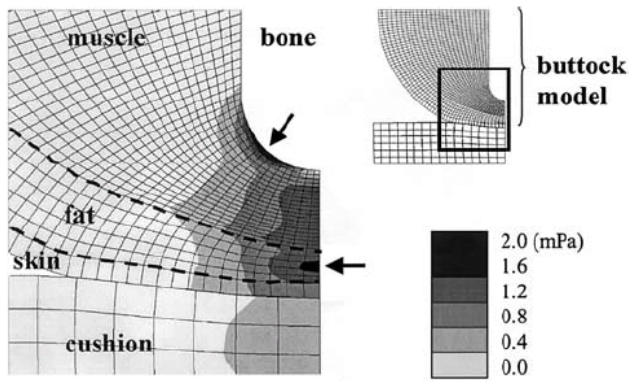
Objective

- Pressure ulcer risk factors (externally)
  - High pressure (pressure mapping)
  - **High shear force (difficult to measure)**
  - Large pressure gradients
  - Heat
  - Moisture
  - Nutrition
  - etc.

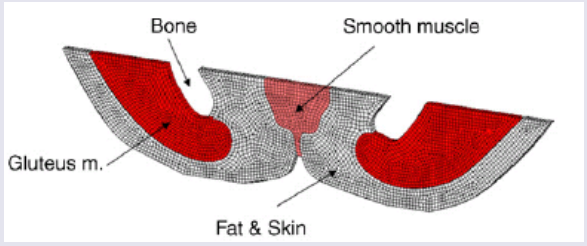


Objective

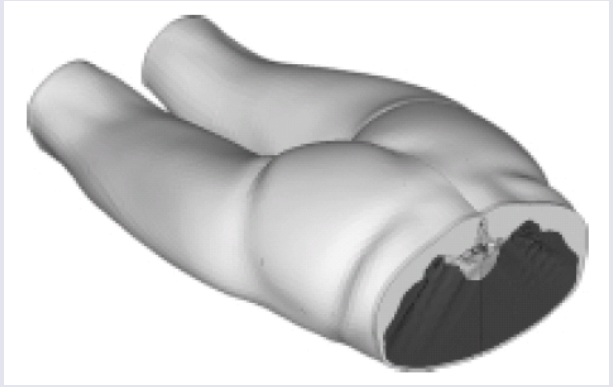
- What causes DTI?
  - Mechanical stress state in the soft tissue (Gawlitta D. et.al. (2007))
- How can we calculate the internal stress state inside the buttocks?
  - FE models



Bouten C.V. et.al. (2003)



Linder-Ganz E. et.al. (2007)



Then C. et.al. (2008)

Shear force?

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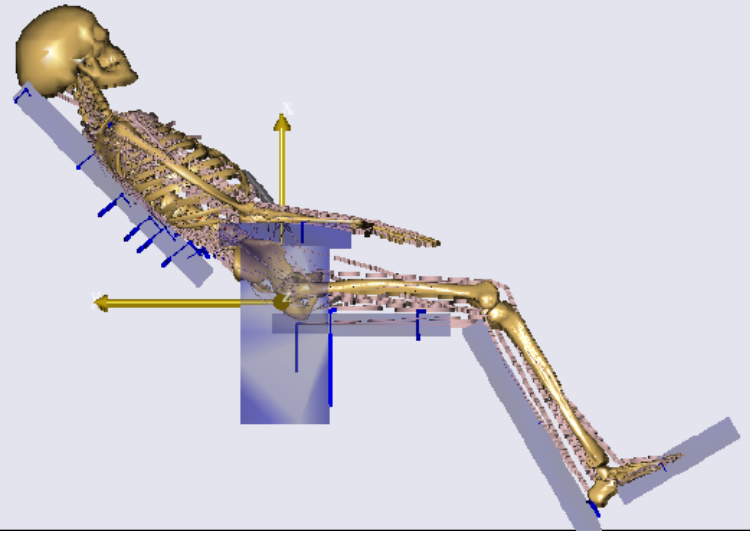
Objective

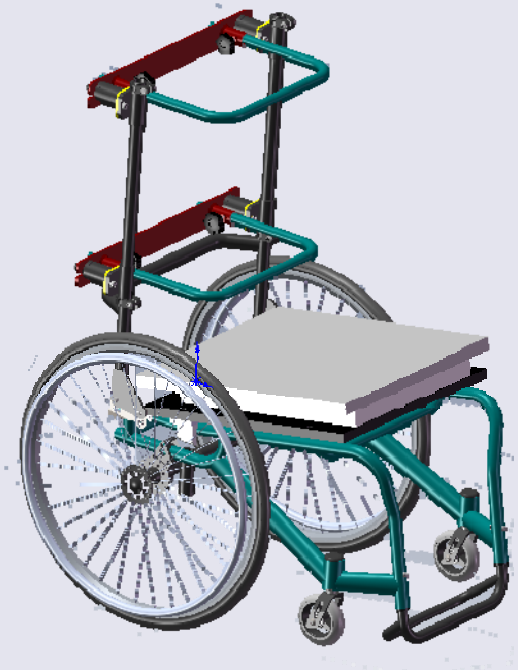
- Calculate forces acting between the chair and the human body for different postures.

Validate the Seated Human Model

- Trends & Absolute values



Validation experiment



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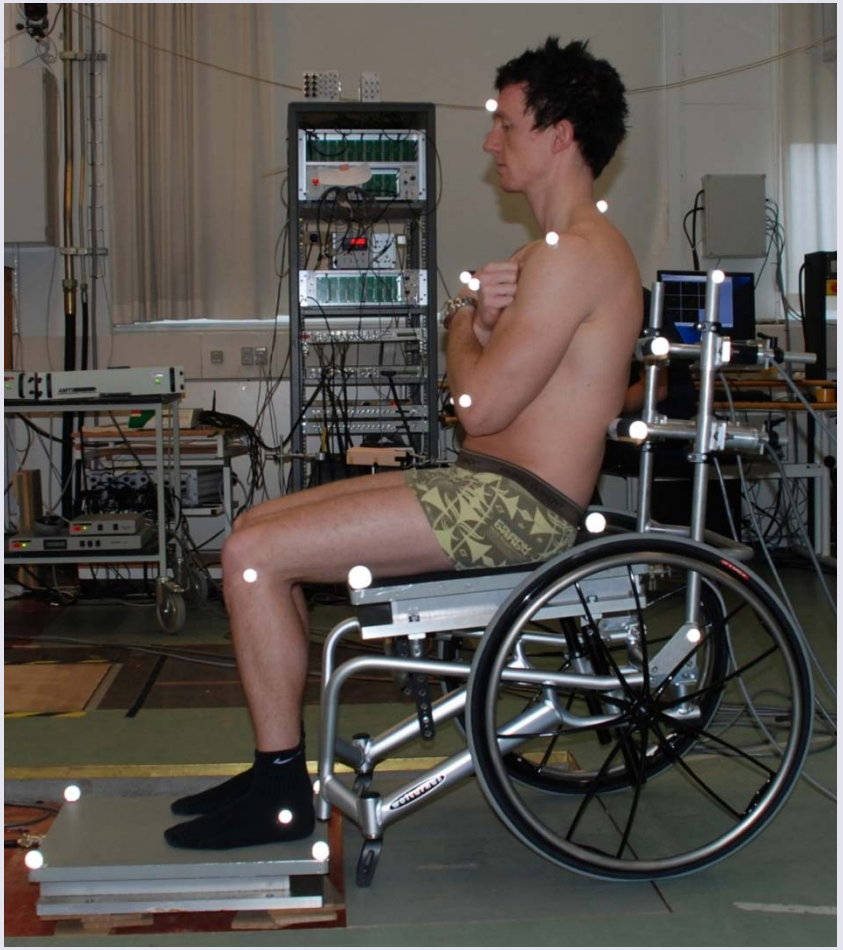
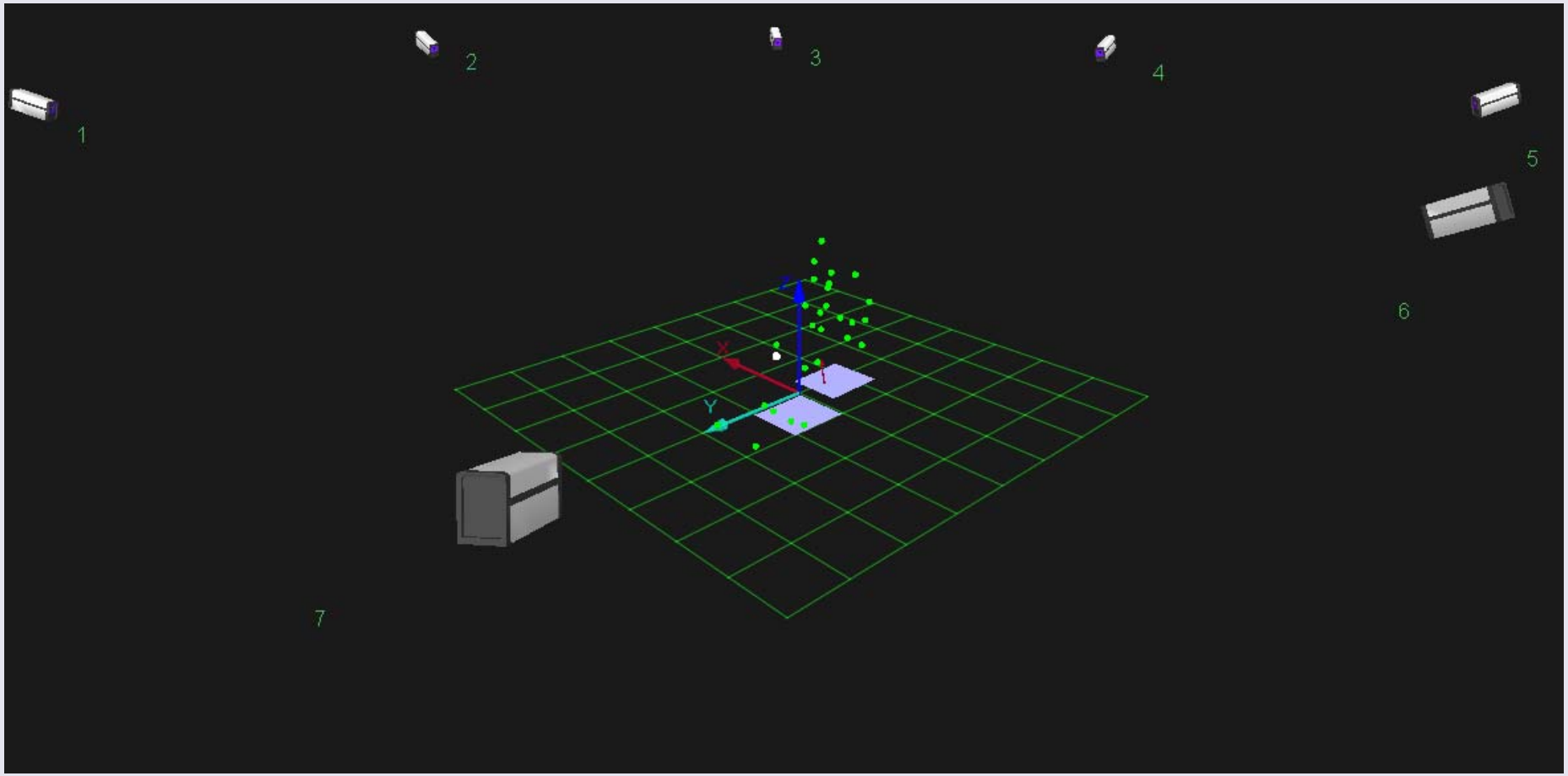
Validation experiment

- 3 healthy male subjects
- Age: 26 ± 2 year
- Weight: 76±3 kg
- Height: 177±3 cm

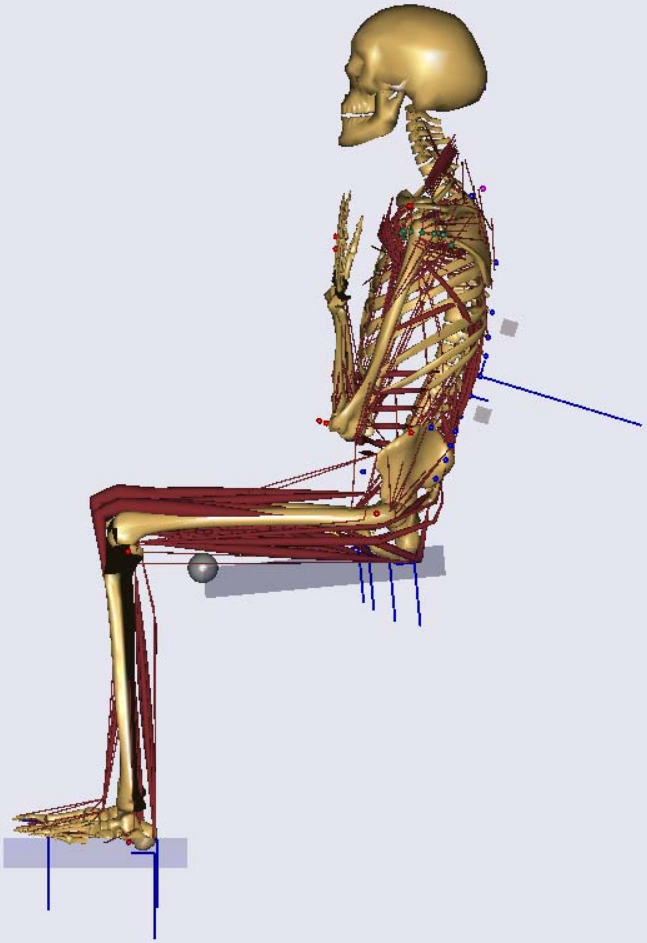


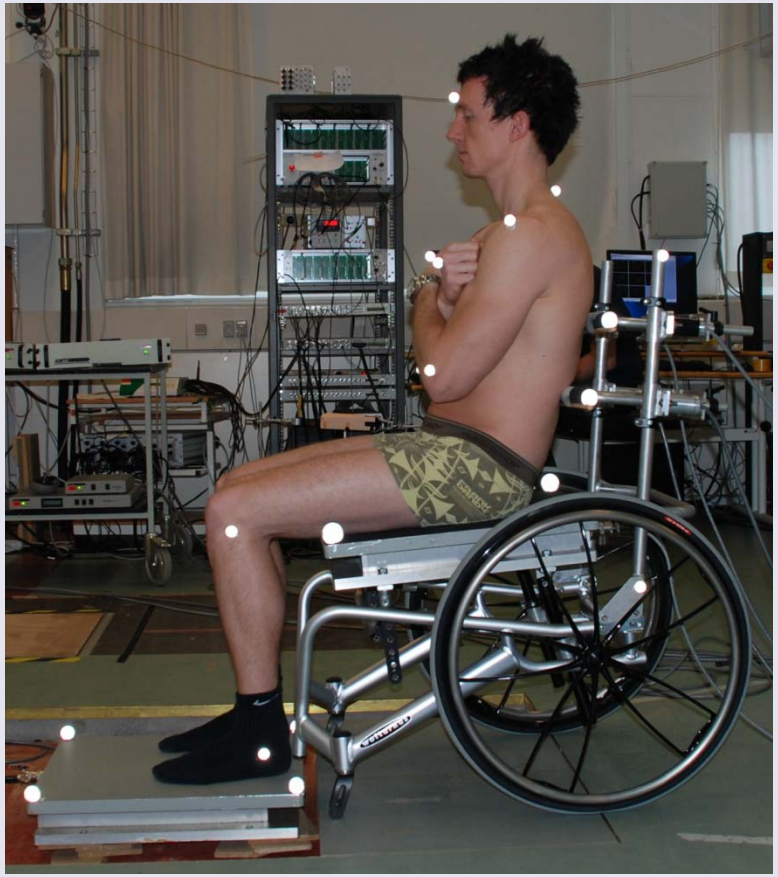
- 4 Parameters
- 5 Experiments
- 3 Trials (20 sec)

Validation experiment

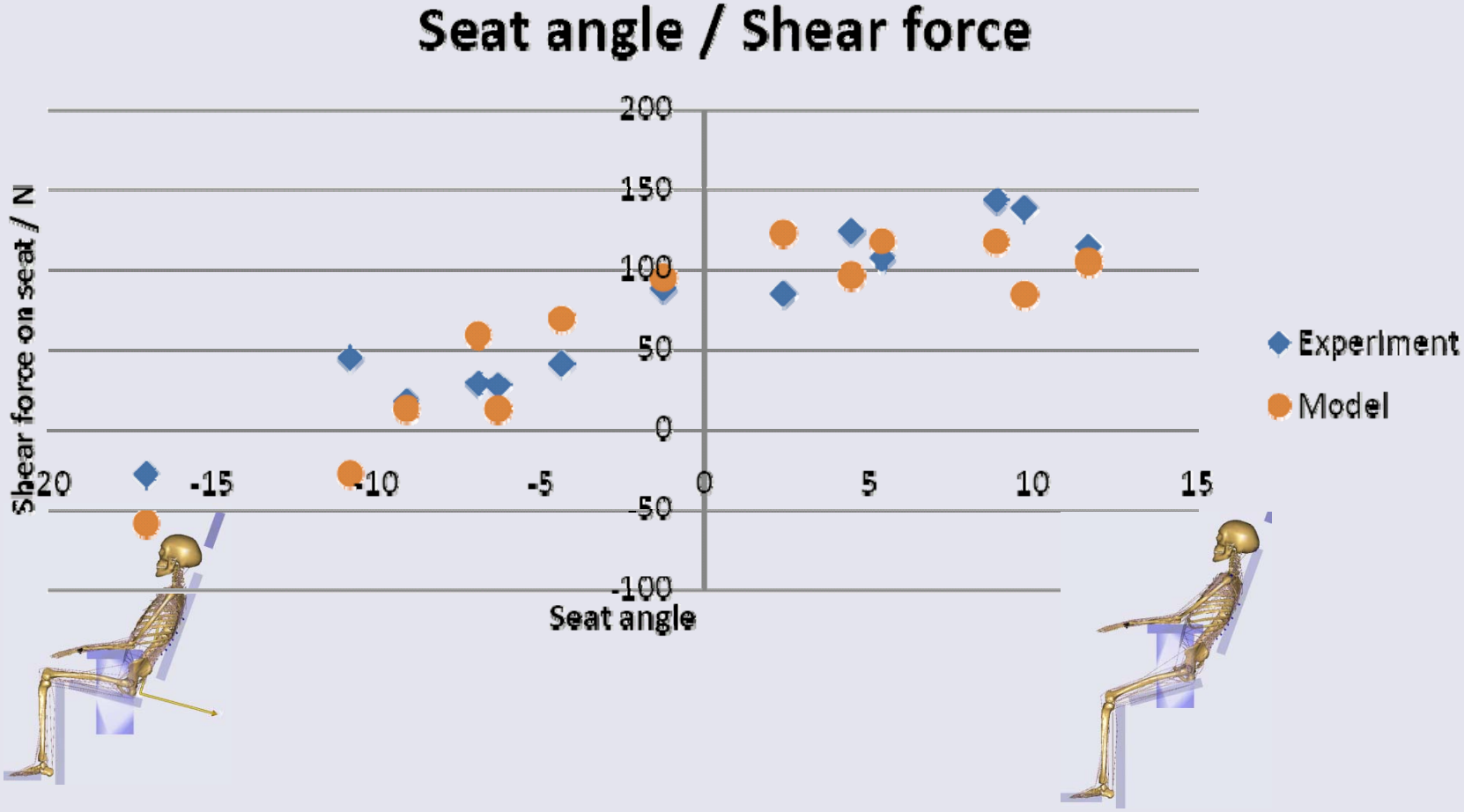


Comparison

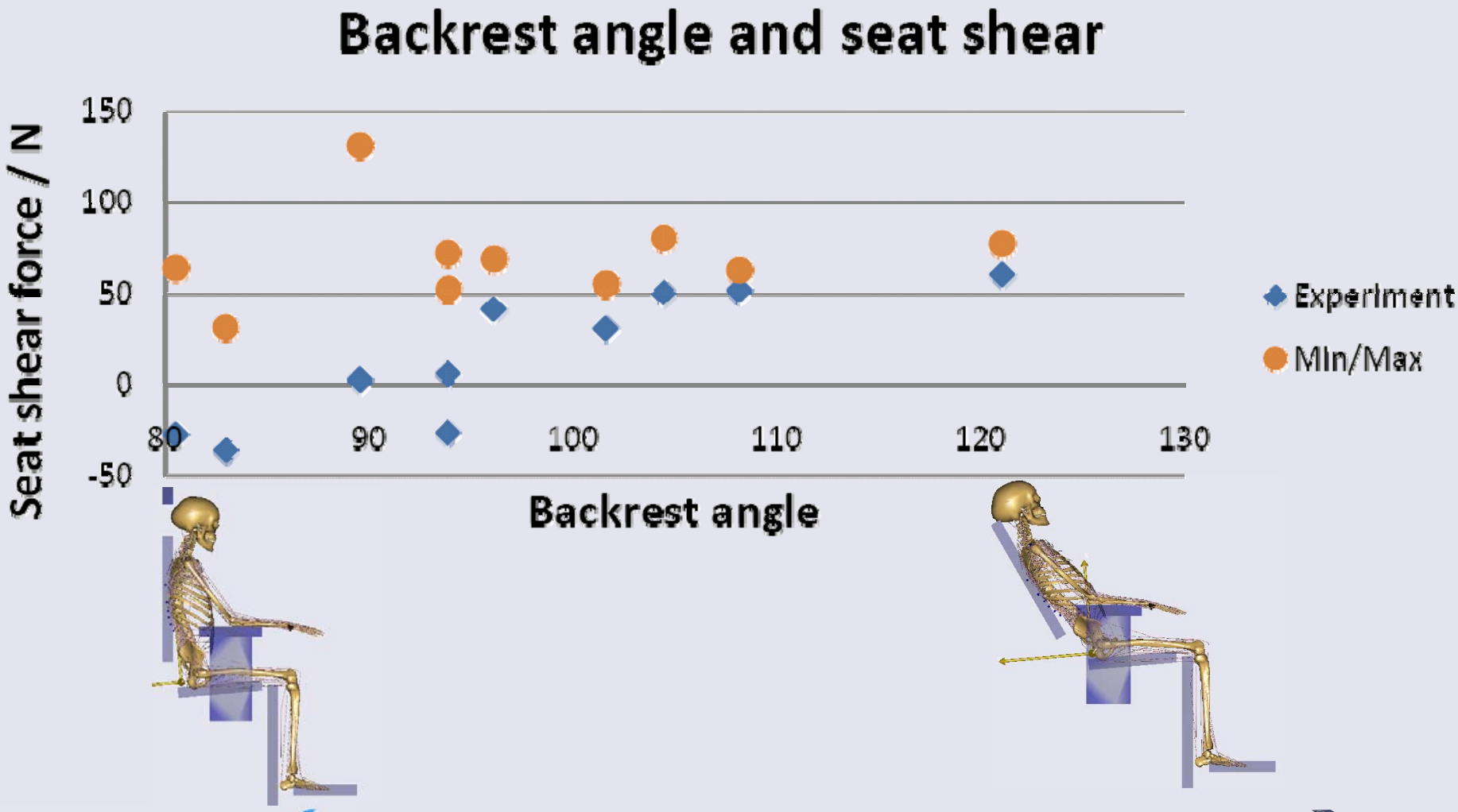




Results


Seat angle / Shear force
Shear force on seat / N
200
150
100
50
0
-50
-100
-20
-15
-10
-5
0
5
10
15
Seat angle
Experiment
Model

Results



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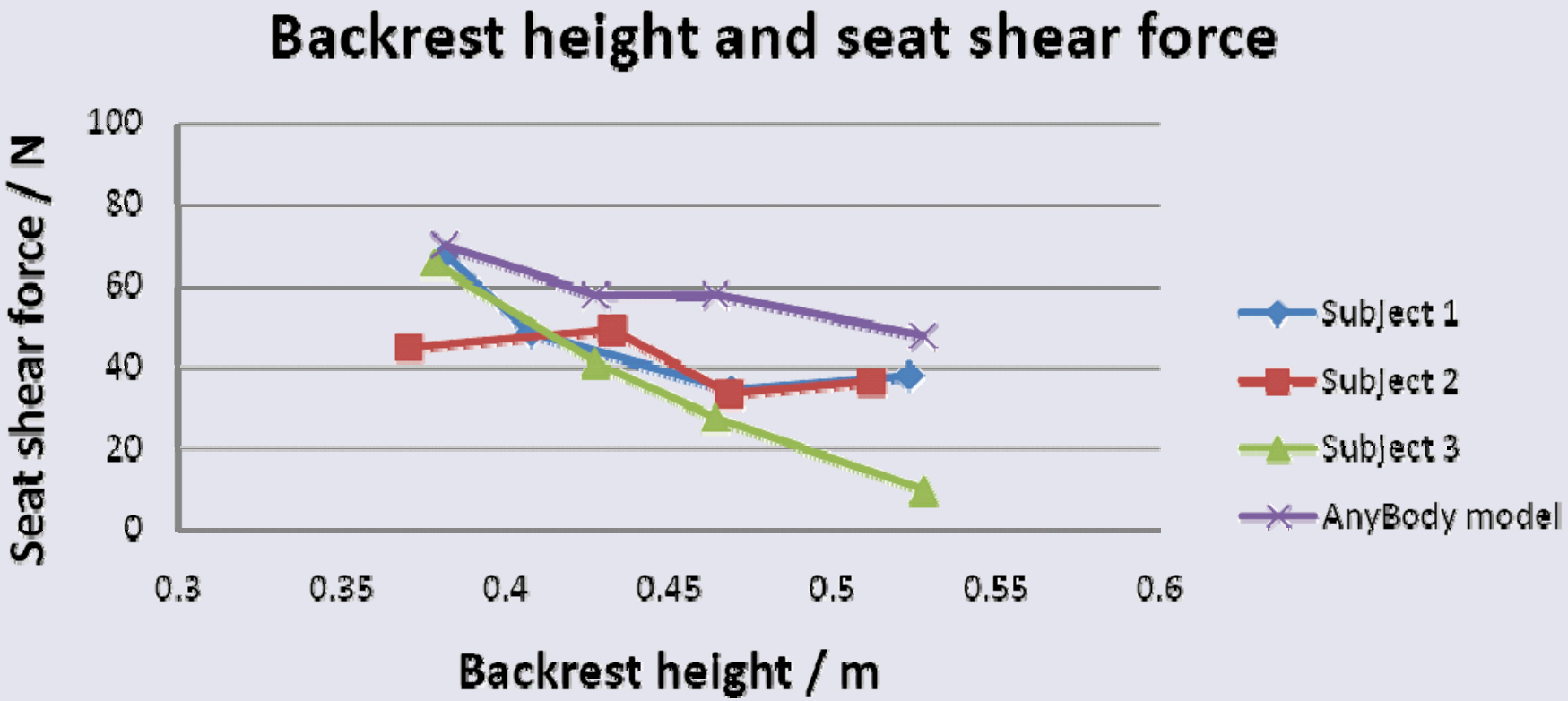
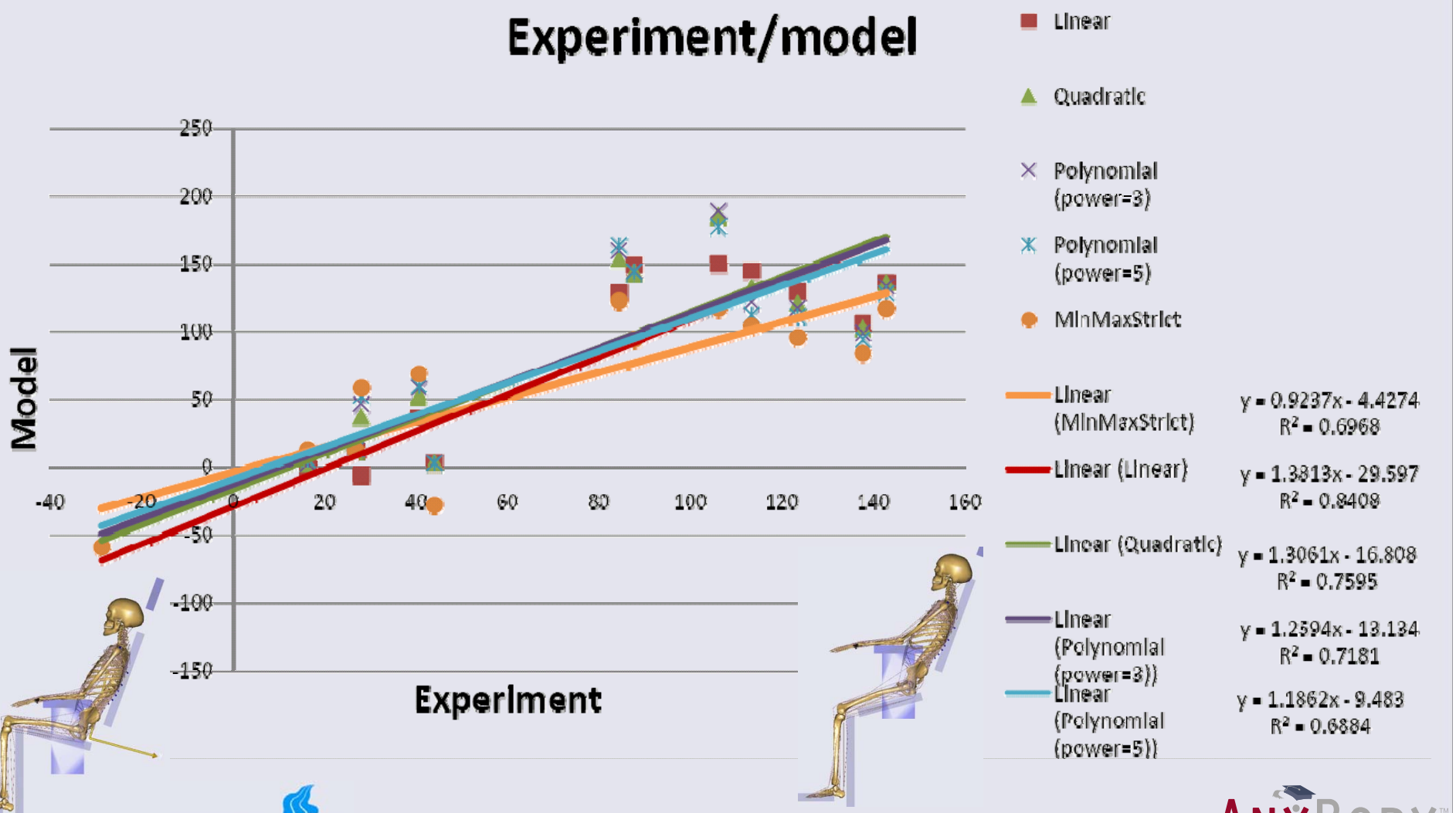
Results

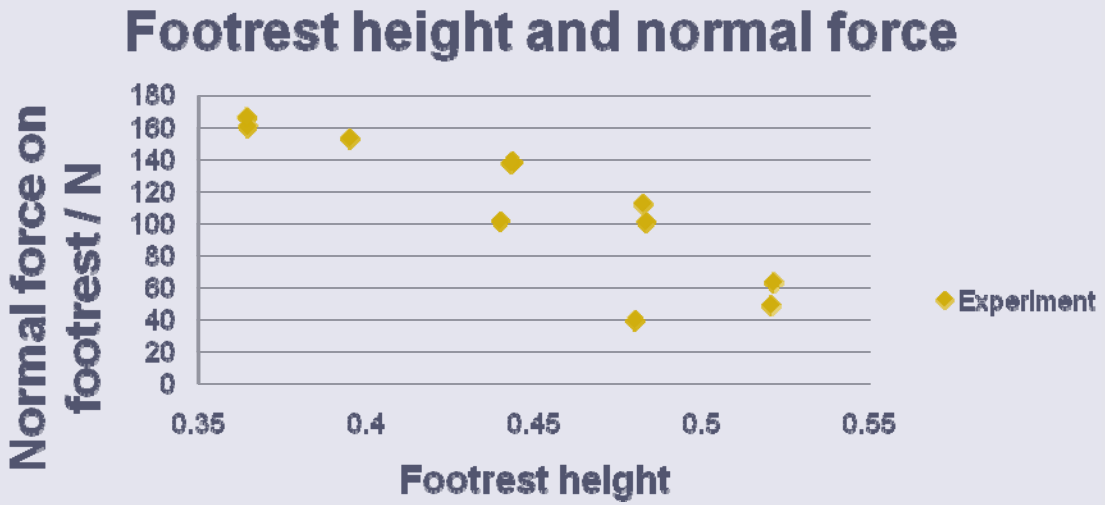

Backrest height and seat shear force
Seat shear force / N
100
80
60
40
20
0
0.3
0.35
0.4
0.45
0.5
0.55
0.6
Backrest height / m
Subject 1
Subject 2
Subject 3
AnyBody model

Results (Advanced)



Discussion

- Missing results
  - Height of footrest
  - Body COM
- Overall the results are promising



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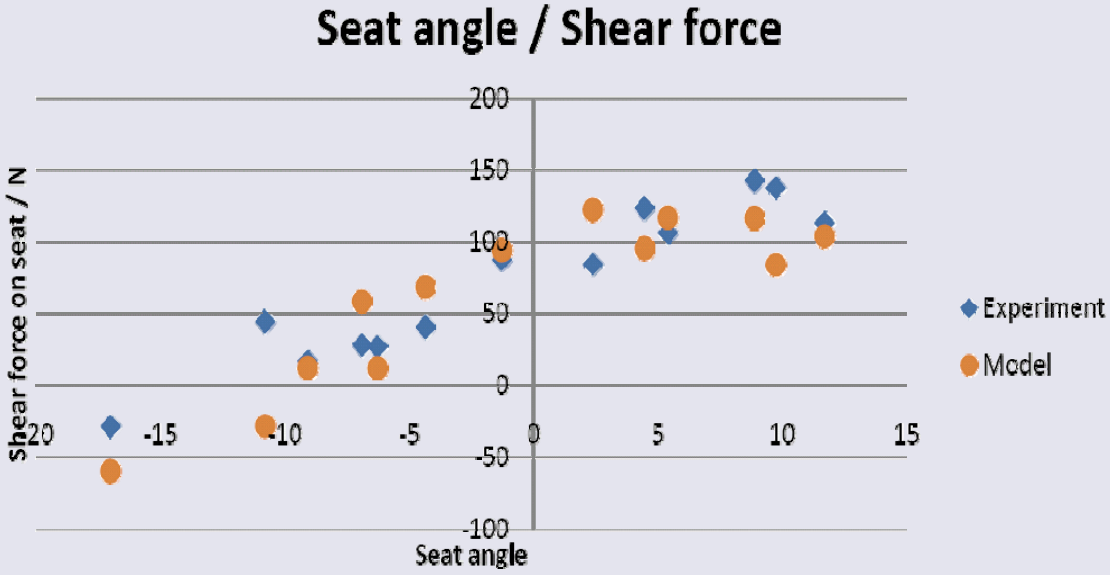
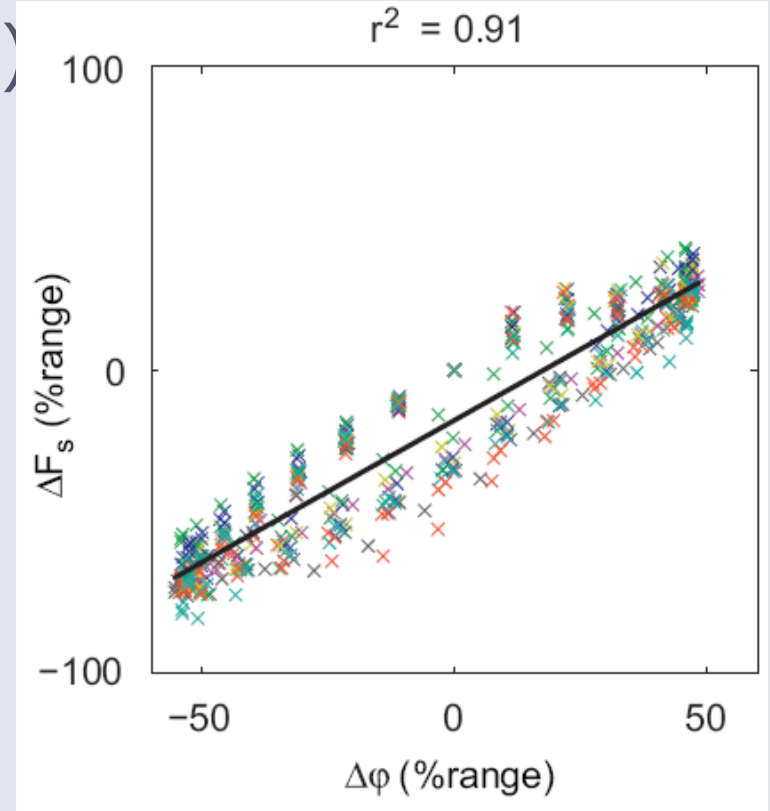
Discussion

- Were our experiments valid?
  - Van geffen, P. et.al. (2008)



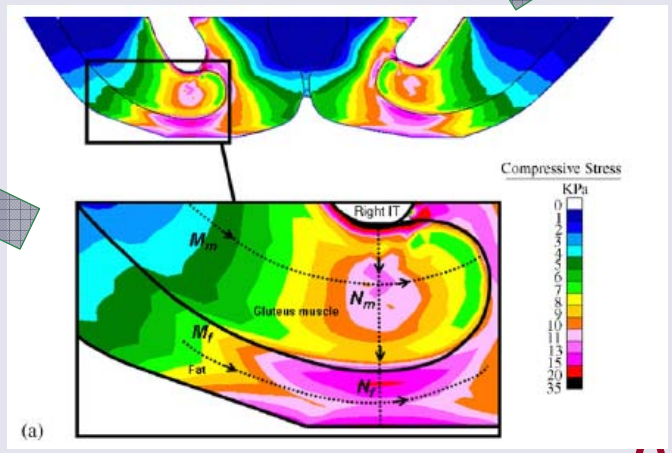


Future work?

- Validation completion
- Seated model providing boundary conditions for a FE model
  - Effect of shear force on tissue stress in the soft tissue
- Optimize seated posture, to minimize tissue stress underneath the buttocks

Future work

Then C. et.al. (2008)



Linder-Ganz E. et.al. (2007)

Optimize seated posture
Minimize tissue stress

Acknowledgements

Further questions:

Email: cgo@hst.aau.dk

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Next Webcast

- **June 25:** **Features of muscle recruitment algorithms**
- **Speaker:** **Prof. John Rasmussen, Aalborg University**

Q&A Panel

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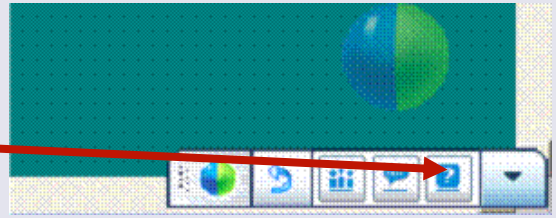

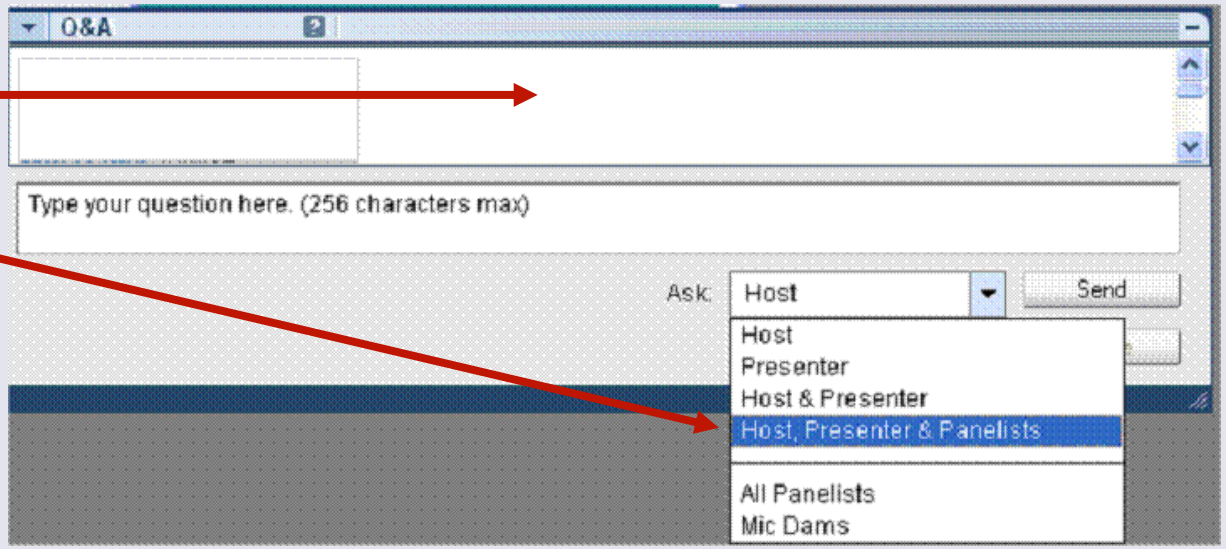

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