Musculoskeletal Loads within the Rats Hind Limb

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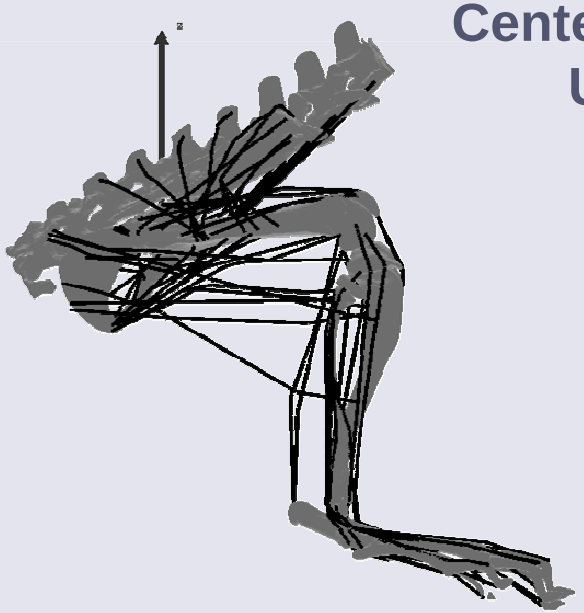

The web cast will start in a few minutes….

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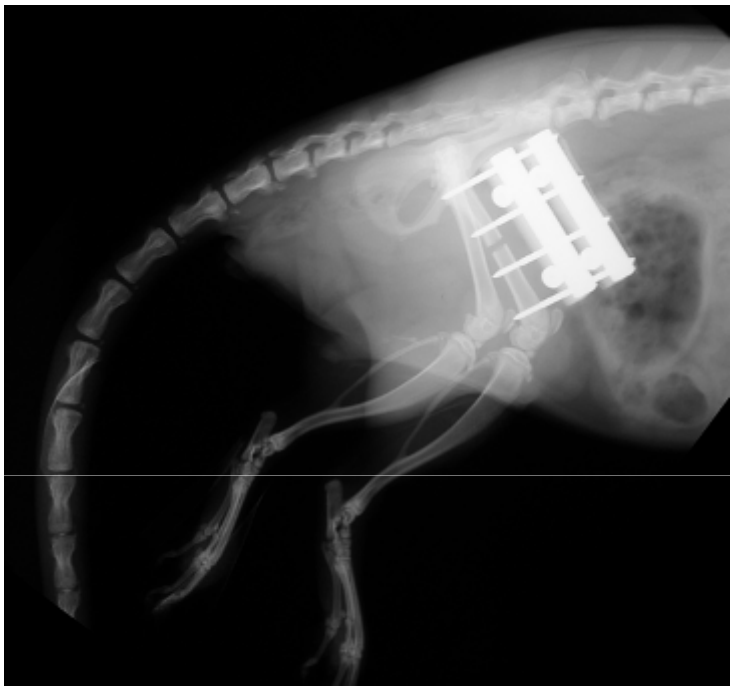
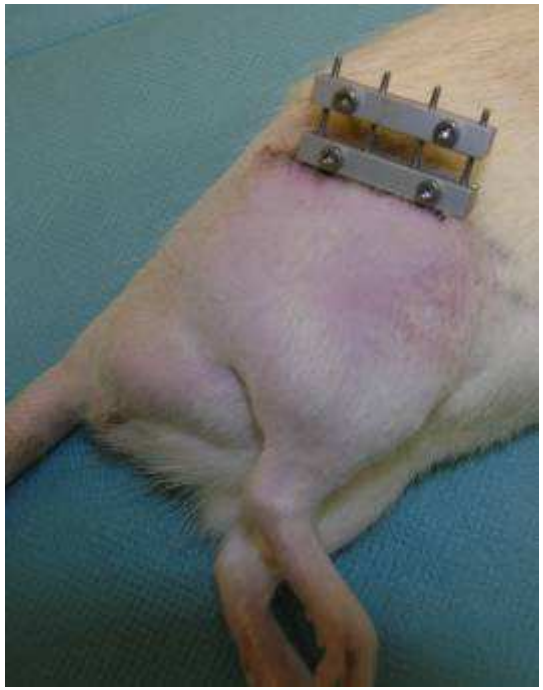
Introduction



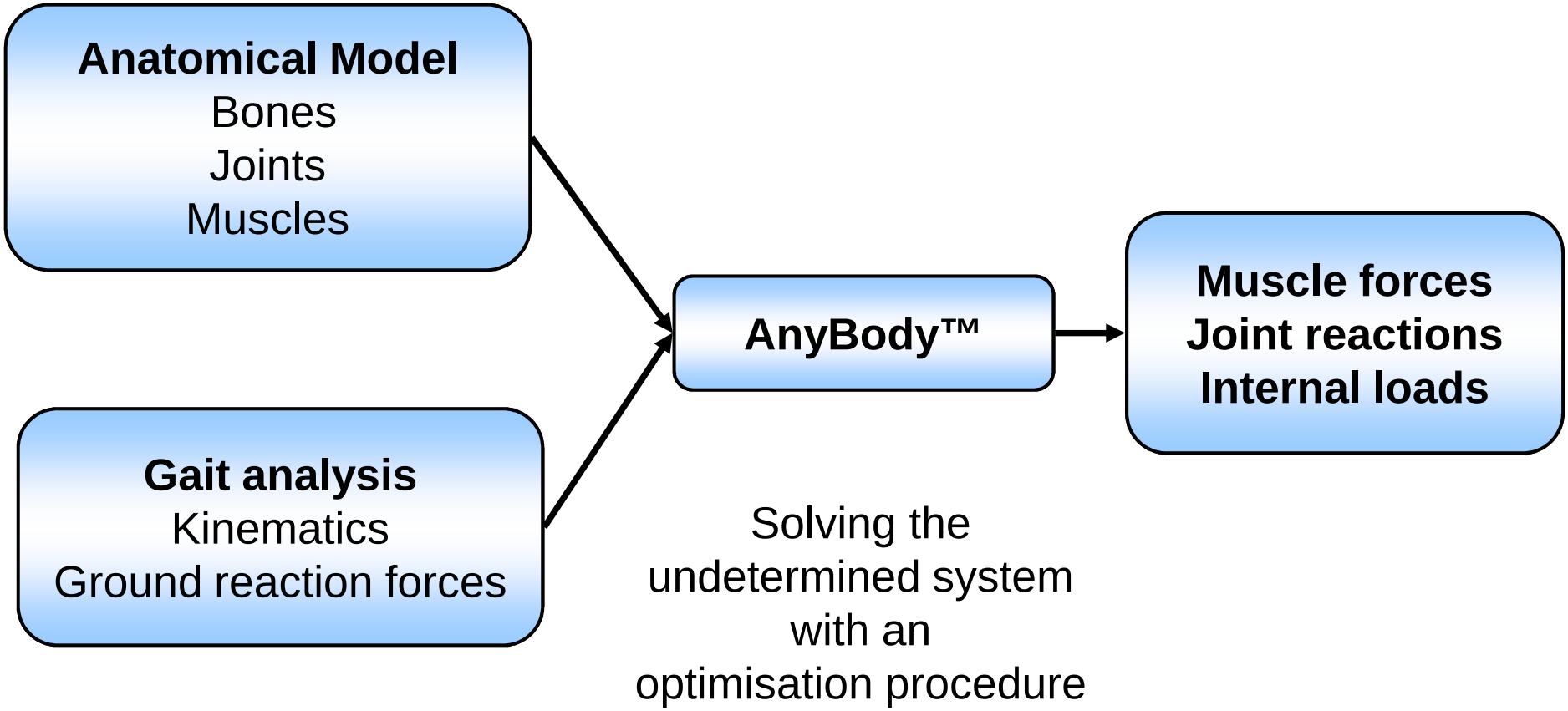


Increasing importance of the rat for fracture healing studies

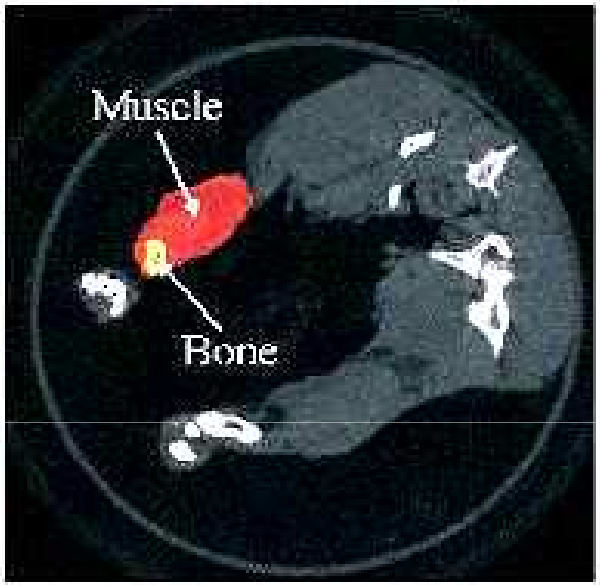
Aims: **- Development of an inverse-dynamic model of the rats hind limb**

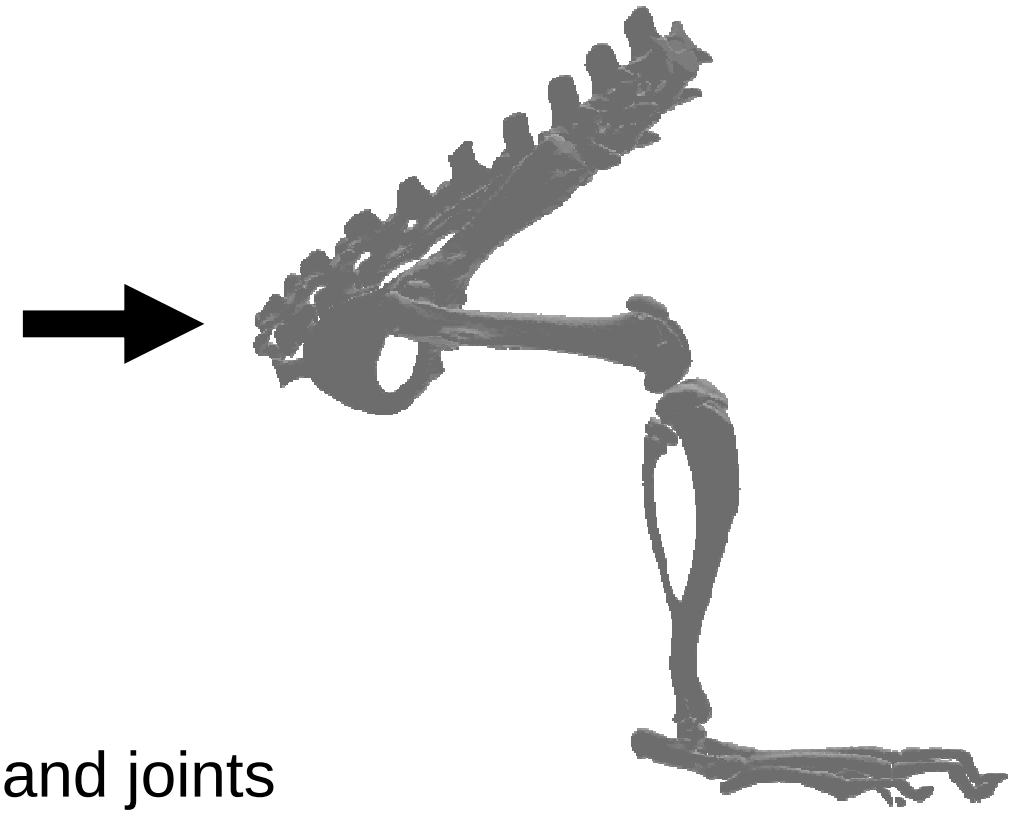
- Determine the internal loads in the femur during gait

Creating the inverse-dynamic model



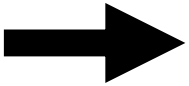
Anatomical model:

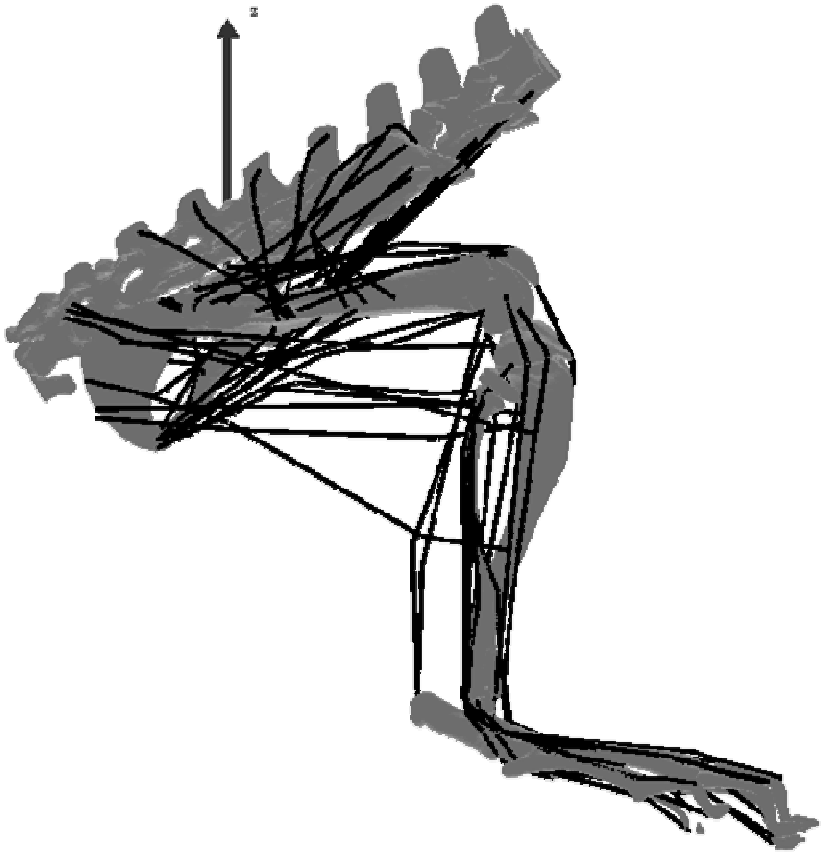




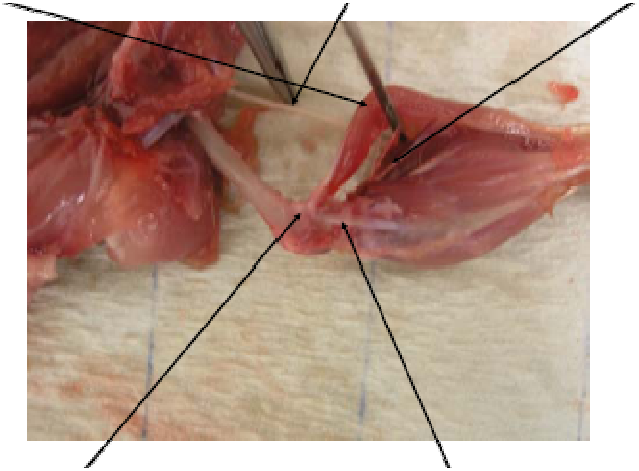
- µCT-Scan $(160\mu m)^3$
- reconstruction of bones and joints
- Mass, center of mass, inertia moments

Anatomical model:



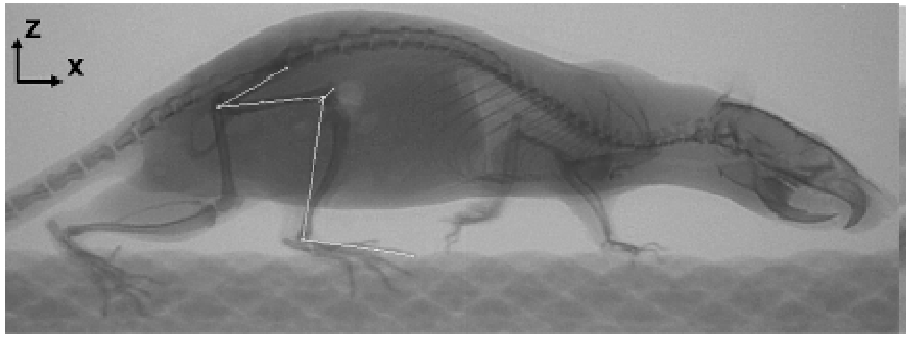


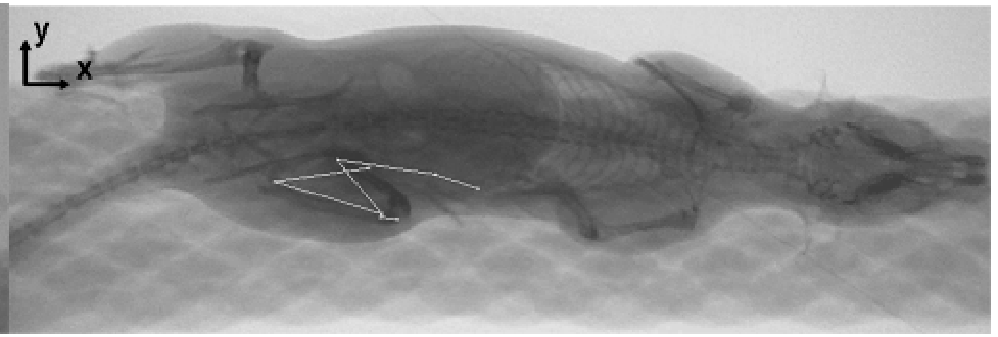
M. gastrocnemius N. ischiadicus M. soleus

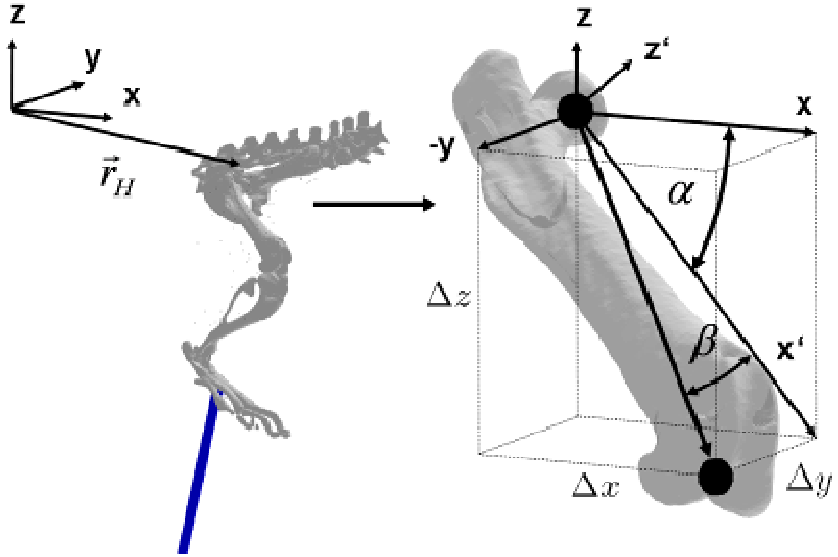


med. C. Femoris L. collaterale tibiale

Kinematics:





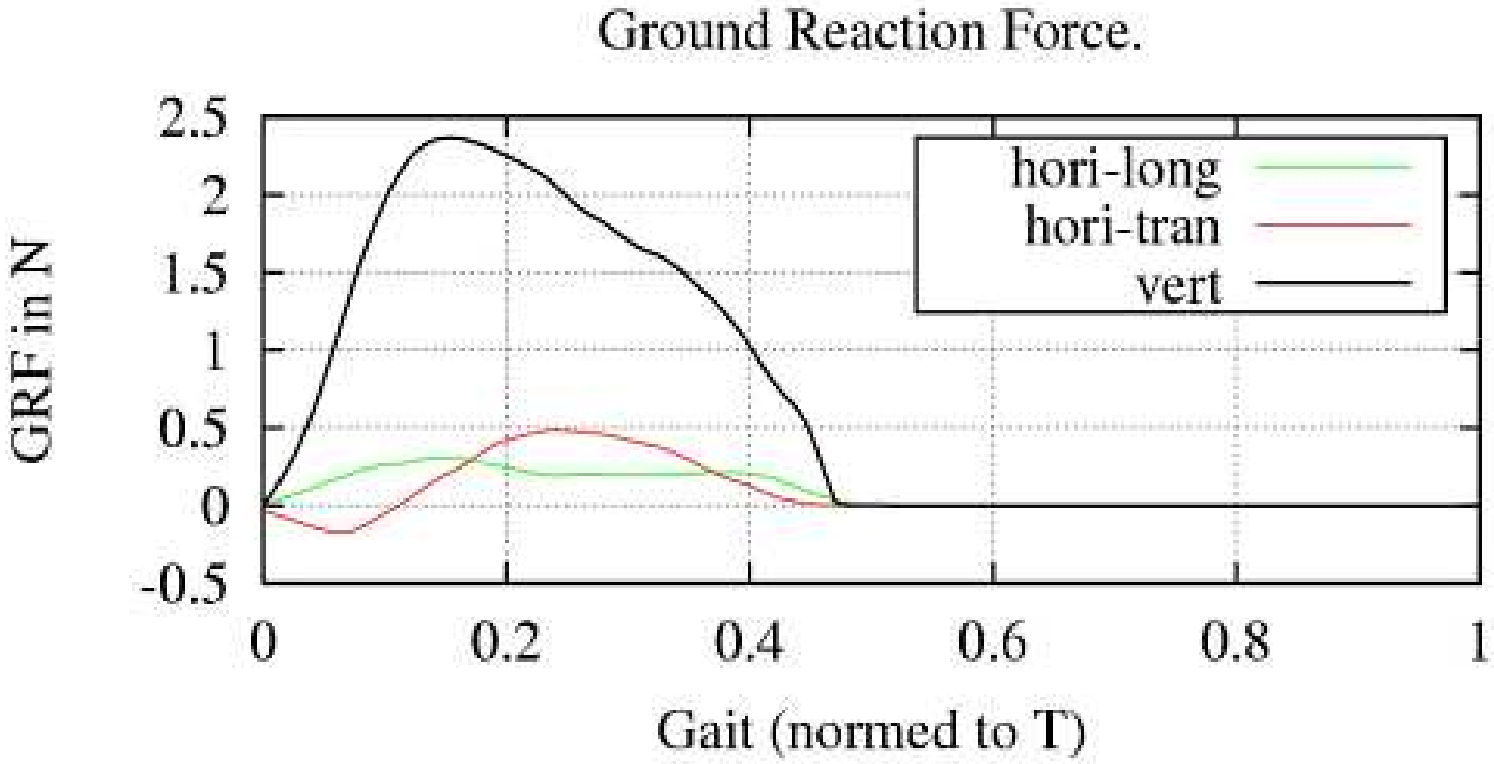


$$\alpha = \begin{cases} -\arccos\left(\frac{\Delta x}{\sqrt{\Delta x^2+\Delta z^2}}\right) & \text{for } \Delta z > 0 \\ \arccos\left(\frac{\Delta x}{\sqrt{\Delta x^2+\Delta z^2}}\right) & \text{for } \Delta z \leq 0 \end{cases}$$

$$\beta = \arctan\left(\frac{\Delta y}{\sqrt{\Delta x^2+\Delta z^2}}\right)$$

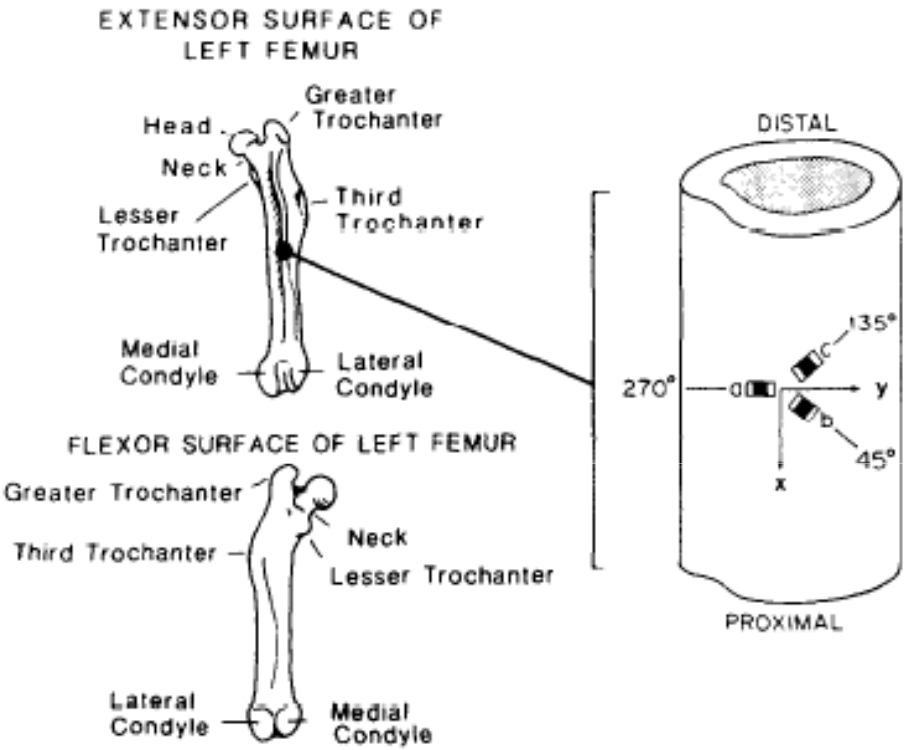
Ground reaction forces (GRF)

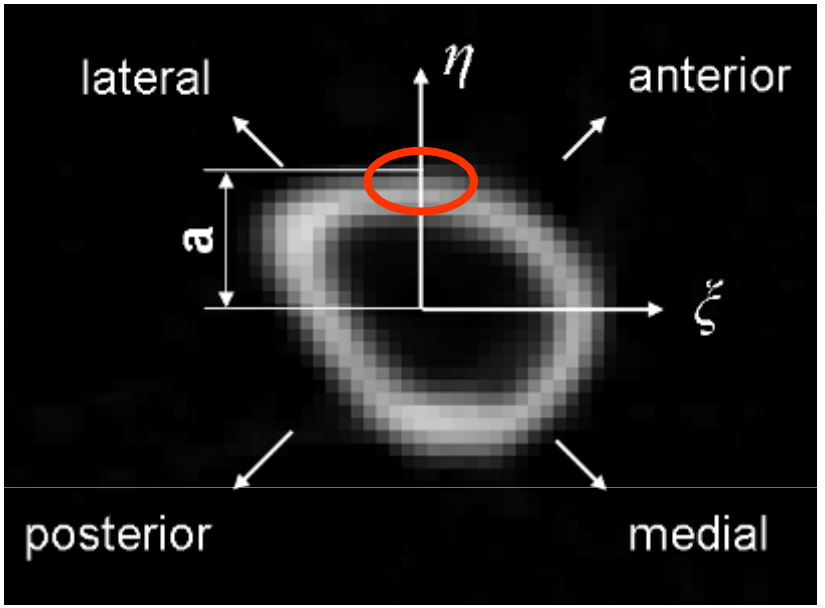
- taken from literature



Muir, G.D.: Whisaw, Q.I.: Ground reaction forces in locomotion hemi-hemiparkinsonian rats. Exp. Brain Res. 126: 307-314, 1999

Validation

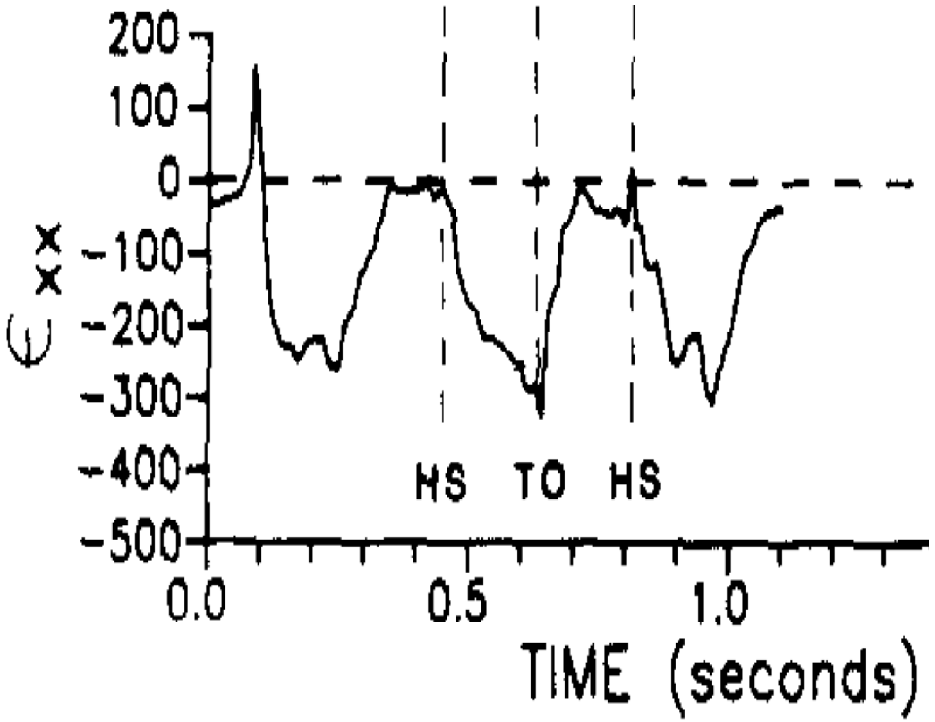




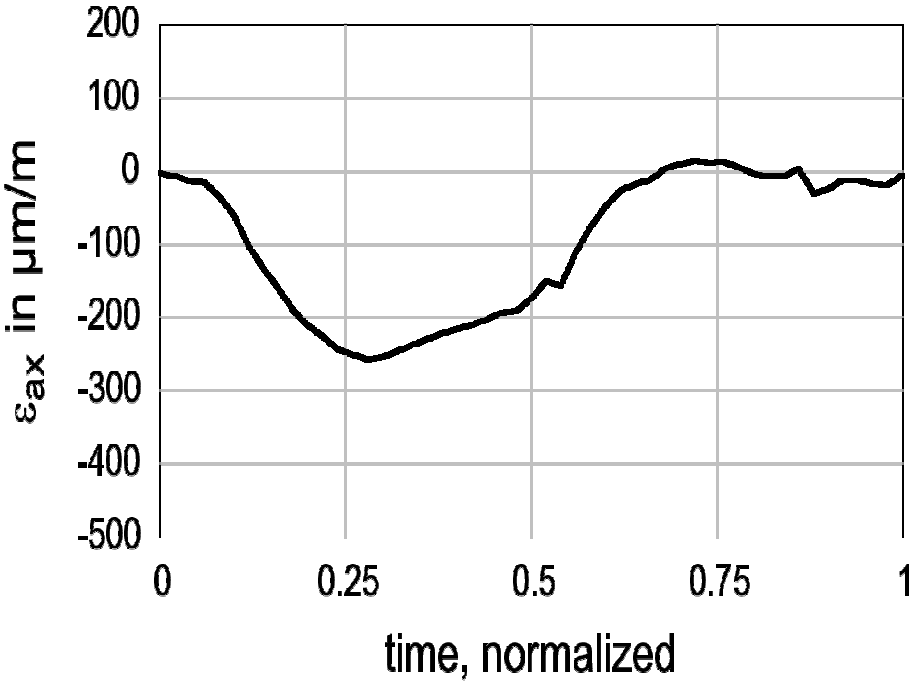
$$\sigma_{ax} = -\left(\frac{F_x}{A} + \frac{M_\xi}{I_\xi} \cdot a\right) \qquad \varepsilon_{ax} = \frac{\sigma_{ax}}{E_{ax}}$$

Keller and Spengler, J Biom 1989

Validation

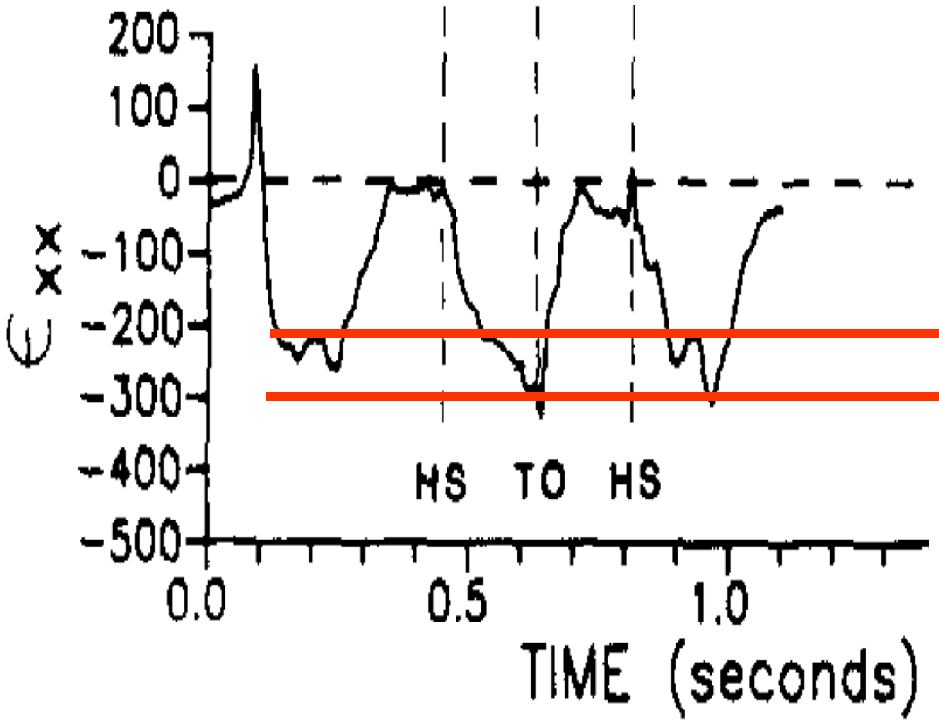


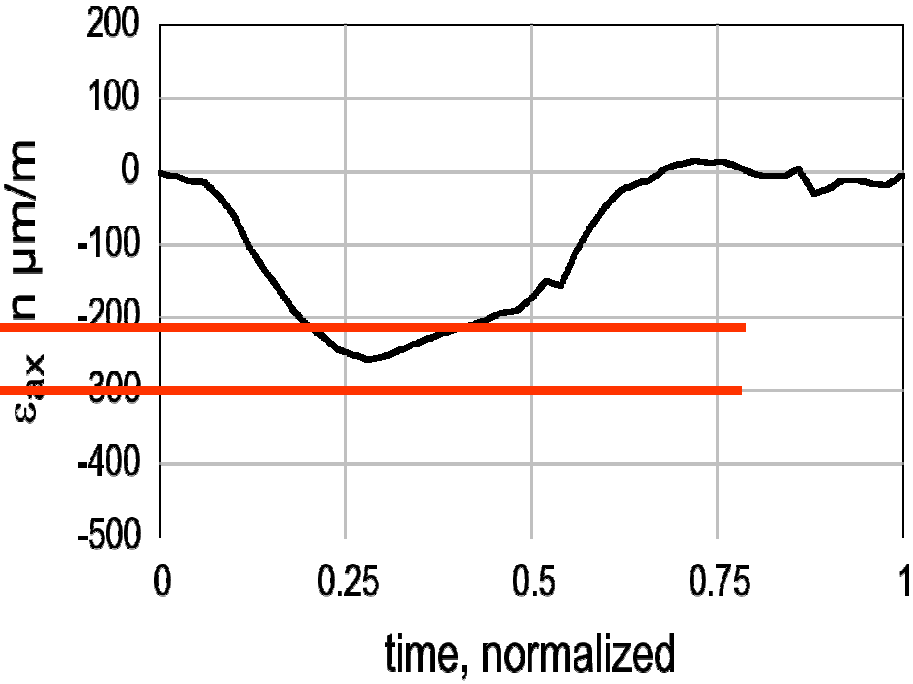
In vivo data
(Keller and Spengler, J Biom 1989)



Numerical model

Validation





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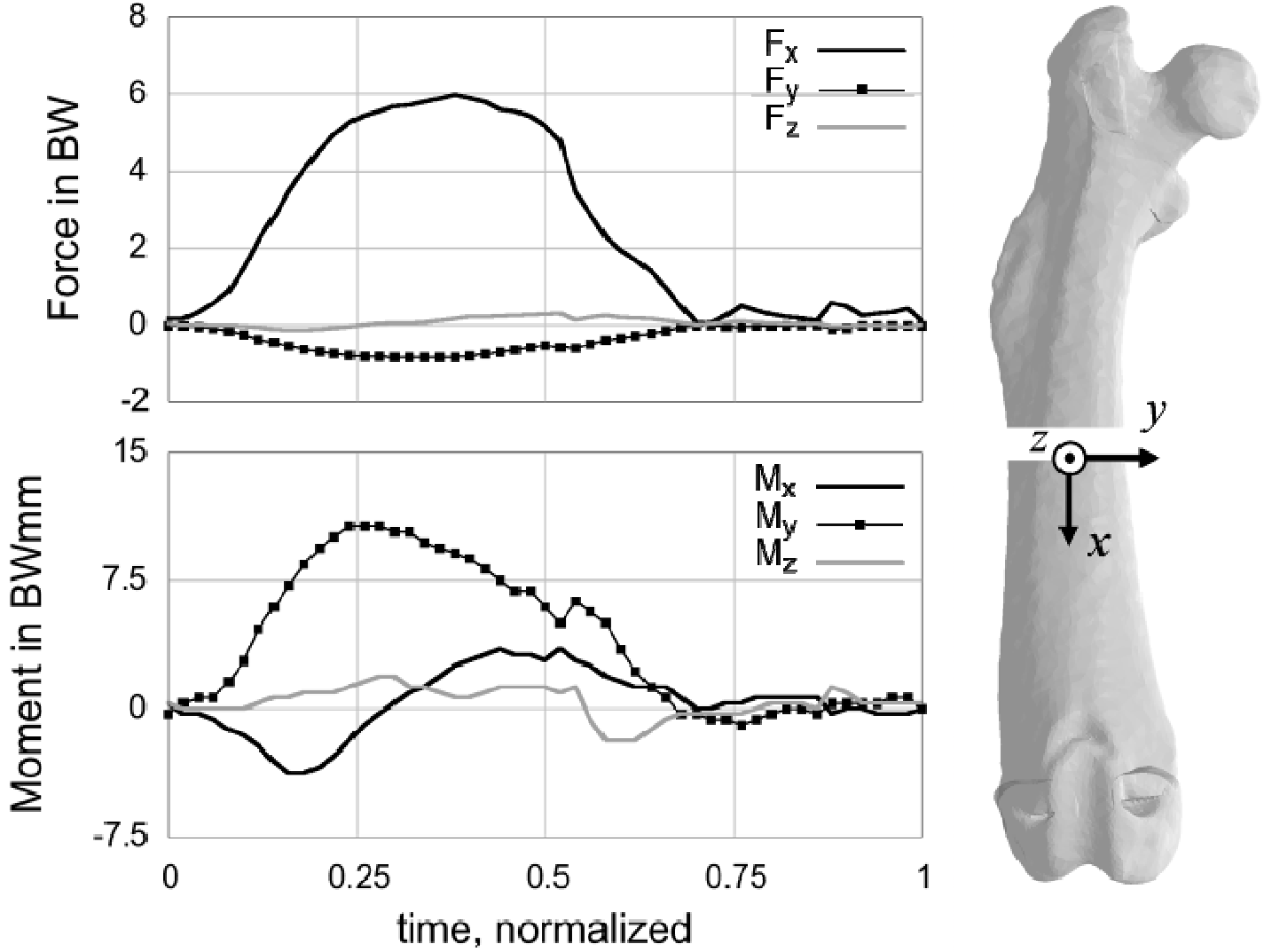
Numerical model

Internal loads in the femur



Discussion

- possible to estimate the internal loads during gait
(Wehner et al., J Biomechanics 2010, 43, 2473-2479)

- corroboration of the internal loads with in vivo data

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(Wehner et al., J Biomechanics 2010, 43, 2473-2479)

- corroboration of the internal loads with in vivo data

- possible to estimate the interfragmentary movement

- possible to adjust the stability of the fixation device

→ possible to better control the mechanical factors in experimental fracture healing studies

Acknowledgements:

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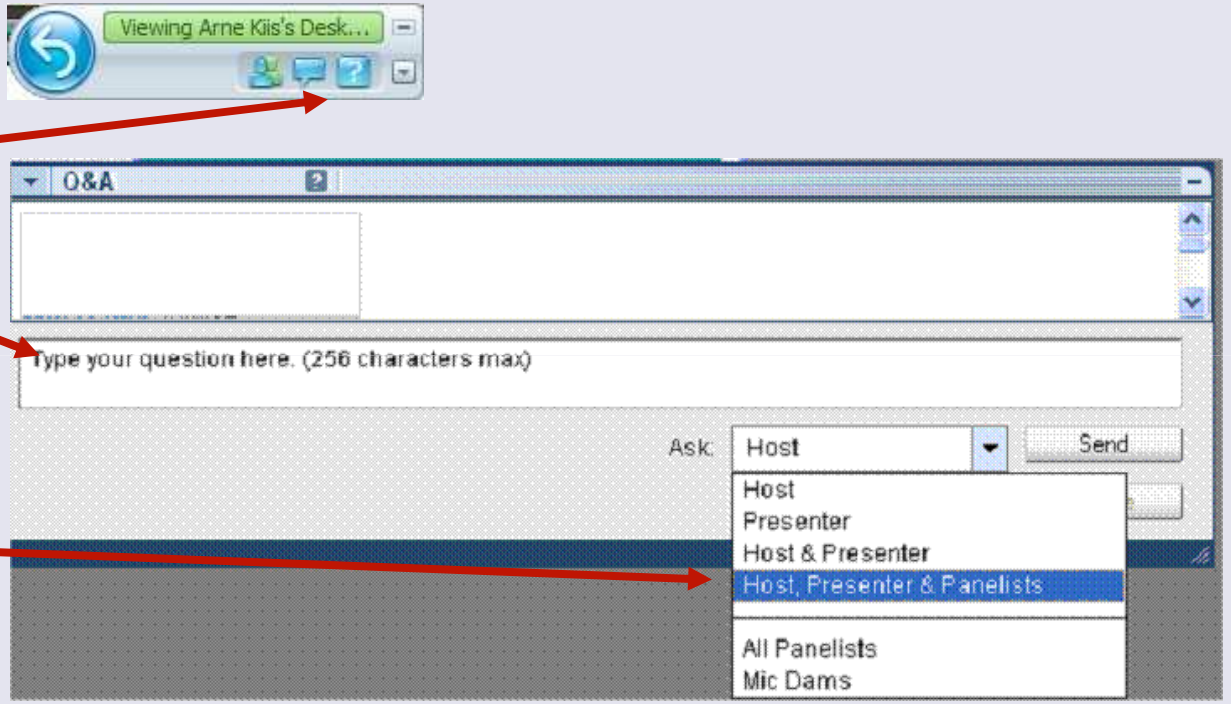
- Prof. Fischer, University of Jena
- Thanks for attention

Q&A Panel

- Launch the Q&A panel from the menu bar.
- Type in your question.
- Send your question to ”Host, Presenter & Panelists”



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