

The use of ADAMS in lower limb prosthetics

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- 1 Multibody dynamics in the field of biomechanics
- 2 Problems of lower limb prosthetics / company "Otto Bock"
- 3 ADAMS-models for optimization of swing phase
 - 3.1 Types of models
 - 3.2 "Model I"
 - 3.3 "Model II"

Biomechanics



Sports

Van Soest et al. 1992
SPACAR

Mc Guan et al. 1994
ADAMS

Gerritsen et al. 1995
DADS

Orthopaedics

Mc Guan et al. 1994
ADAMS

Mc Guan 1996
ADAMS



**only a few applications
in (exo-)prosthetics !**

Industrial science

Deuretzbacher 1995
RASNA/MOTION

many applications
in car industry
(ADAMS/ANDROID)

Main aim of rehabilitation (in lower limb prosthetics):

Optimal recovery of amputee's gait

Problem of treatment (mechanical formulation):

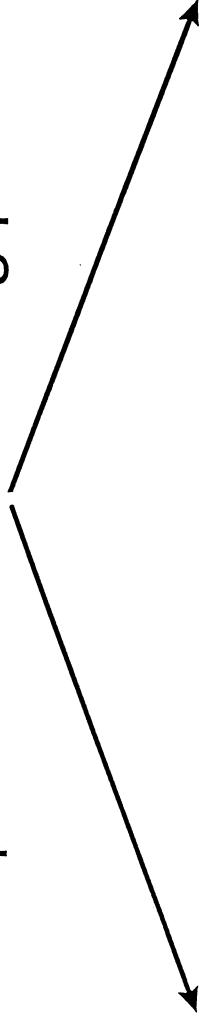
Exact mechanical reproduction of torques in the artificial joints

→ properties of prosthetic components

→ prosthetic alignment

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Optimisation of swing phase



“Model I”

Elements of
inverse and
forward dynamics



optimization of
constructive
equipment

“Model II”

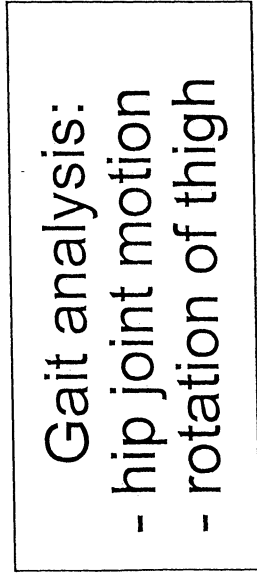
Elements of
inverse dynamics



load analysis

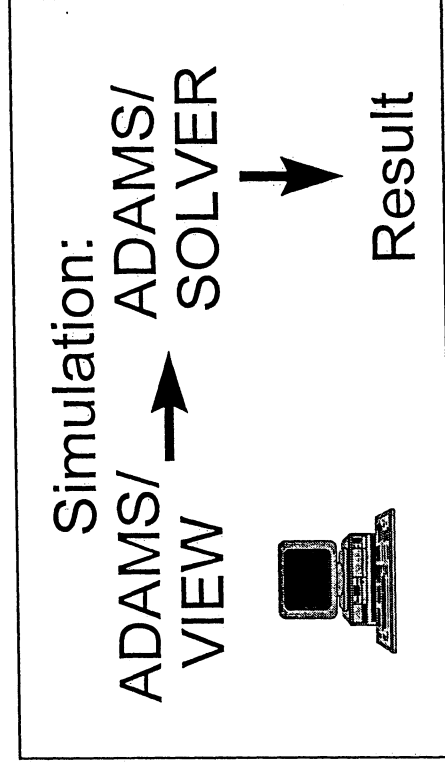
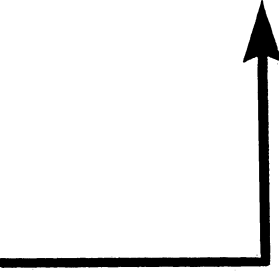
Optimisation of swing phase

Model I : input-data

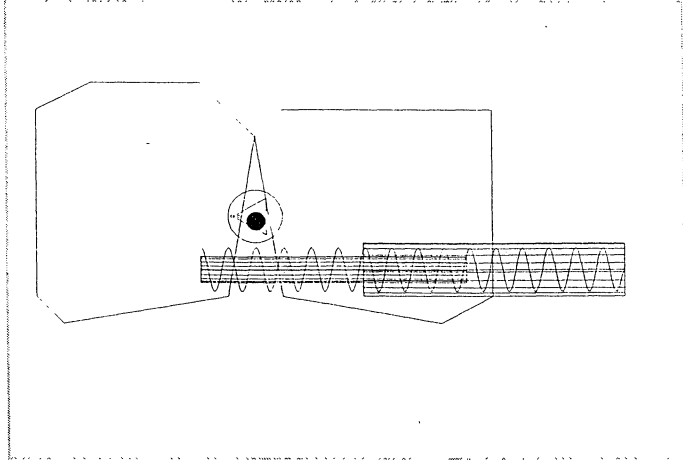


$x(t)$
 $y(t)$
 $\varphi(t)$

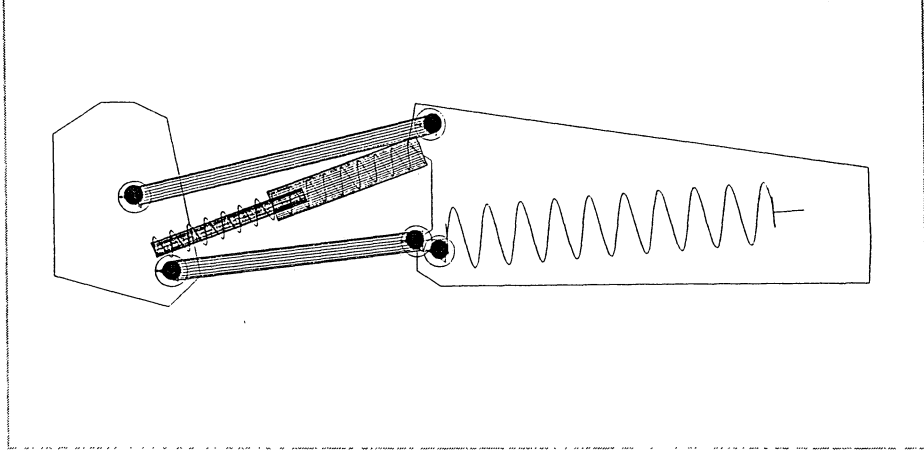
→ Data file



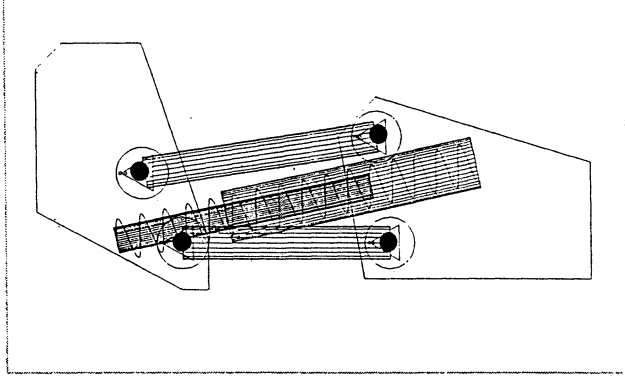
Elements of the model library (examples)



single axis



five bar polycentric



may be defined parametrically

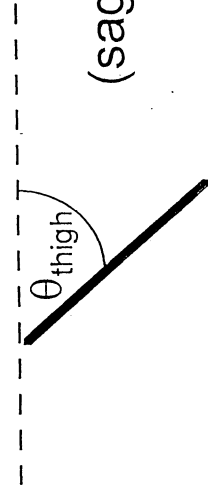
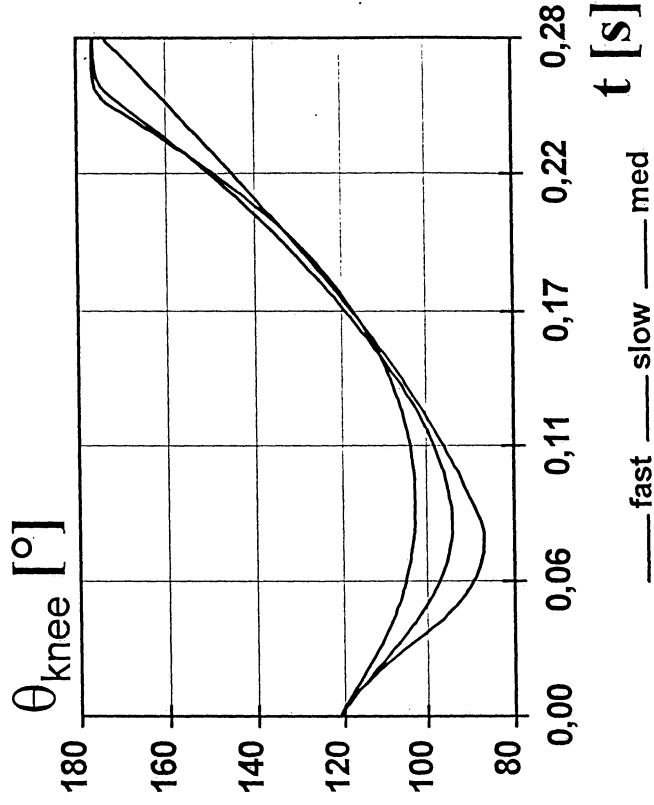
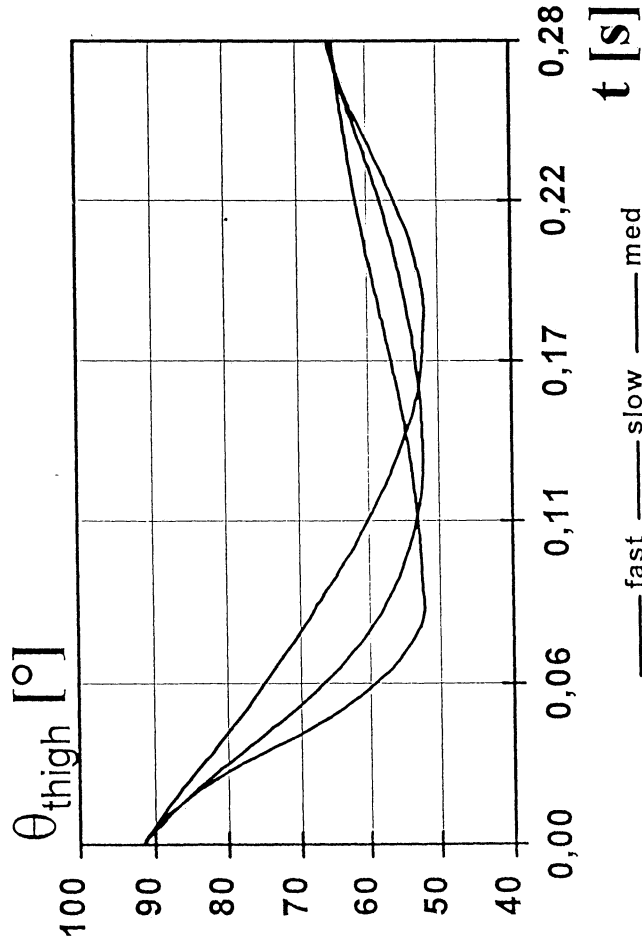
Chao Pook

Effect of stump motion variation:

Variations of stump motion
(hip flexors, hip extensors)



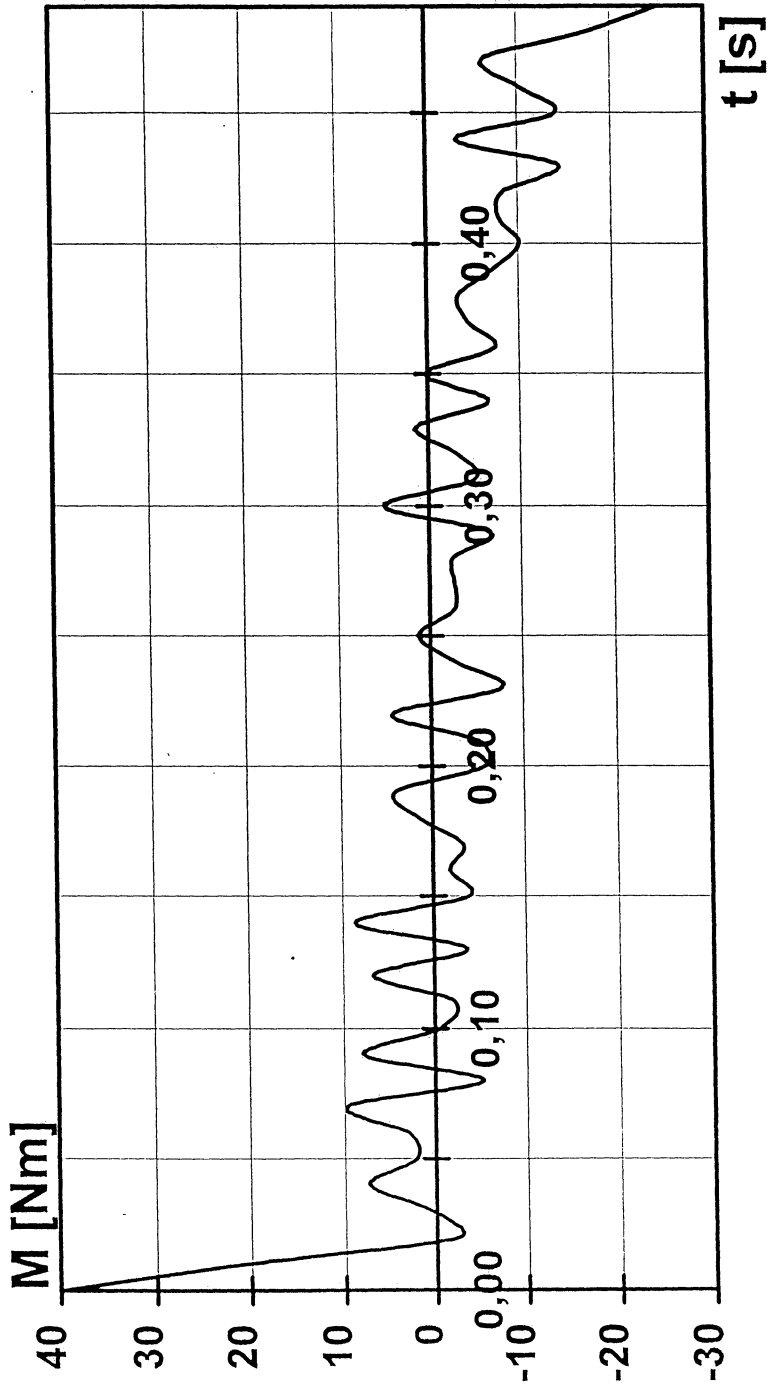
Knee motion results



(sagittal plane)

Ollo Bock

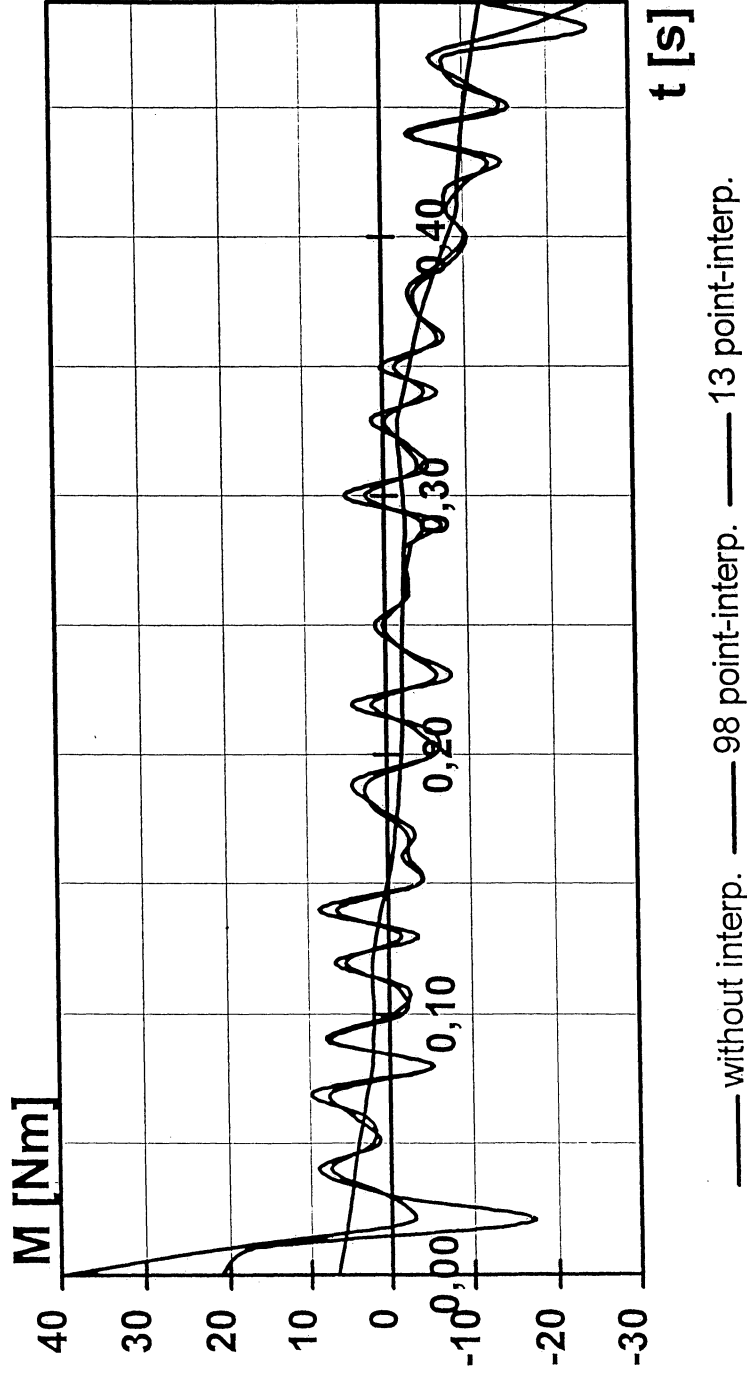
Load analysis: Torque vs. swing time single axis knee joint



(input data set: cubic spline, no interpolation, standard integration)

Oliver Pöck

Torque - analysis: effect of input data - interpolation single axis - knee joint

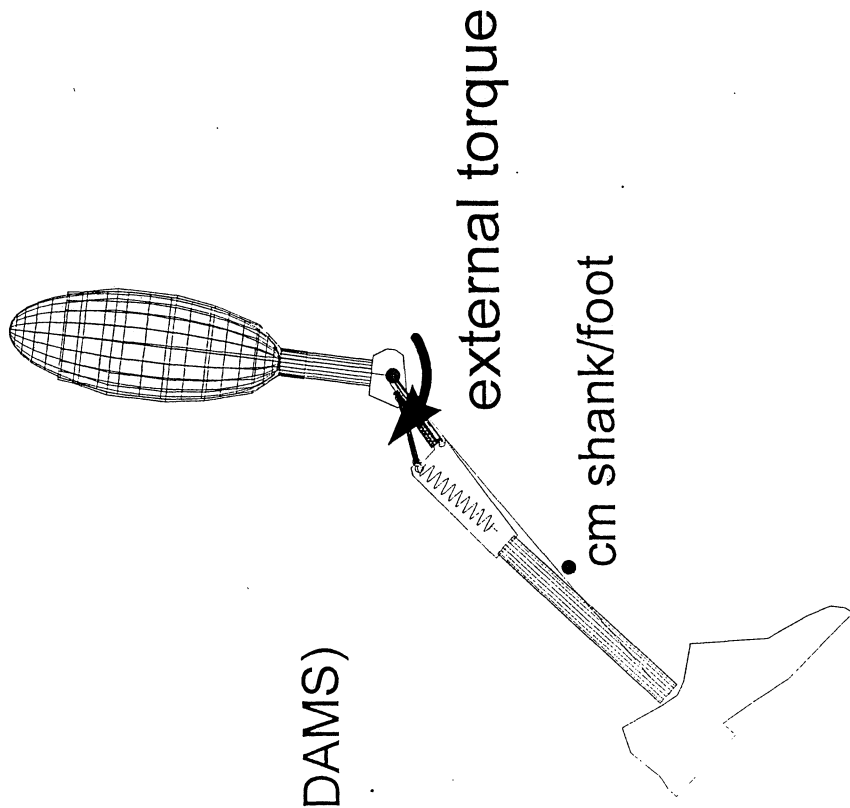


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initial condition polycentric system

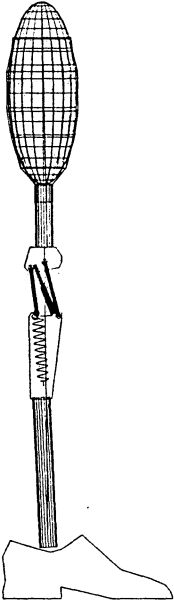
1. static analysis
variable mode
external torque
IF-function
(gait analysis \leftrightarrow ADAMS)

2. transient analysis
shank part velocity

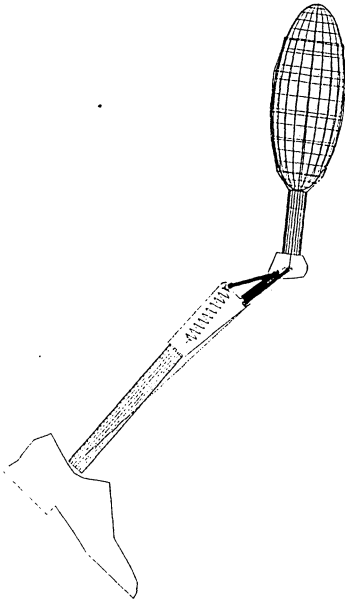


(J. Beuse)

prosthetic alignment position

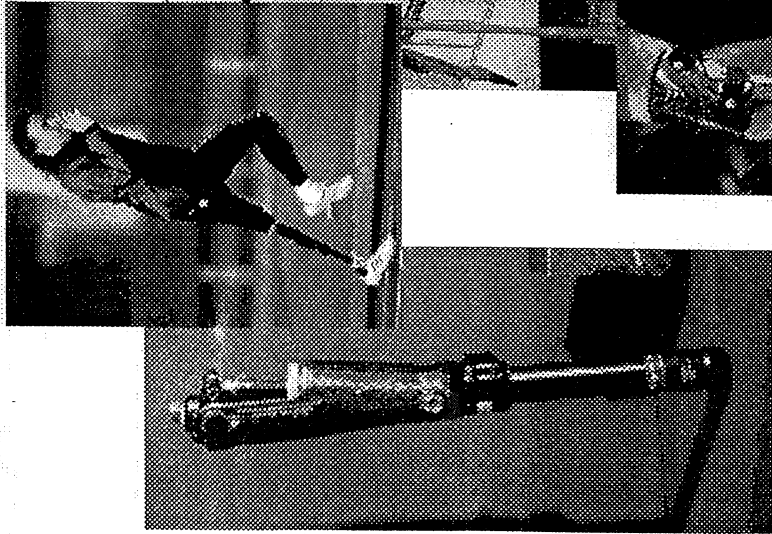


initial swing phase condition

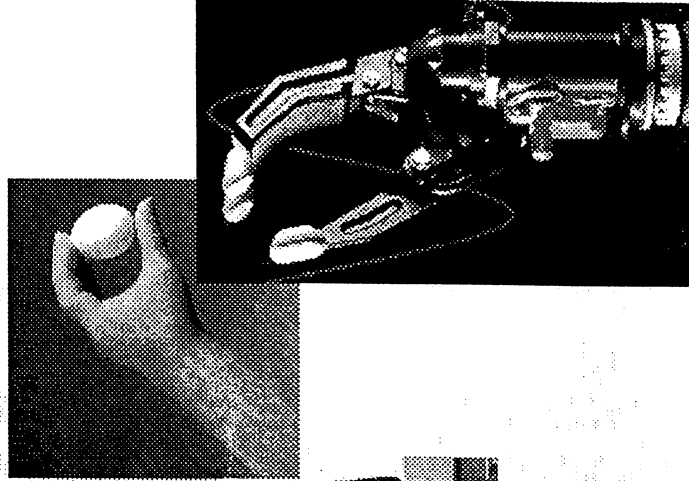


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Knee Joint Systems



Myoelectric Hands



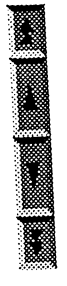
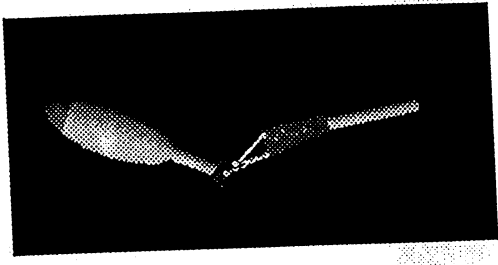
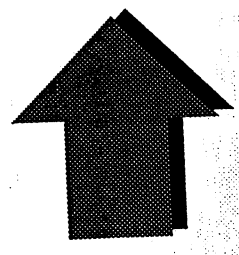
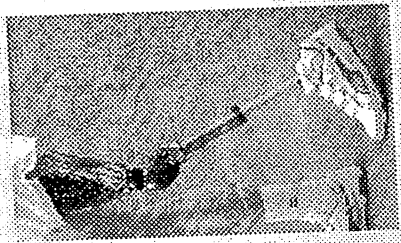
Orthotics



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Biomechanical Simulation of Exoprostheses

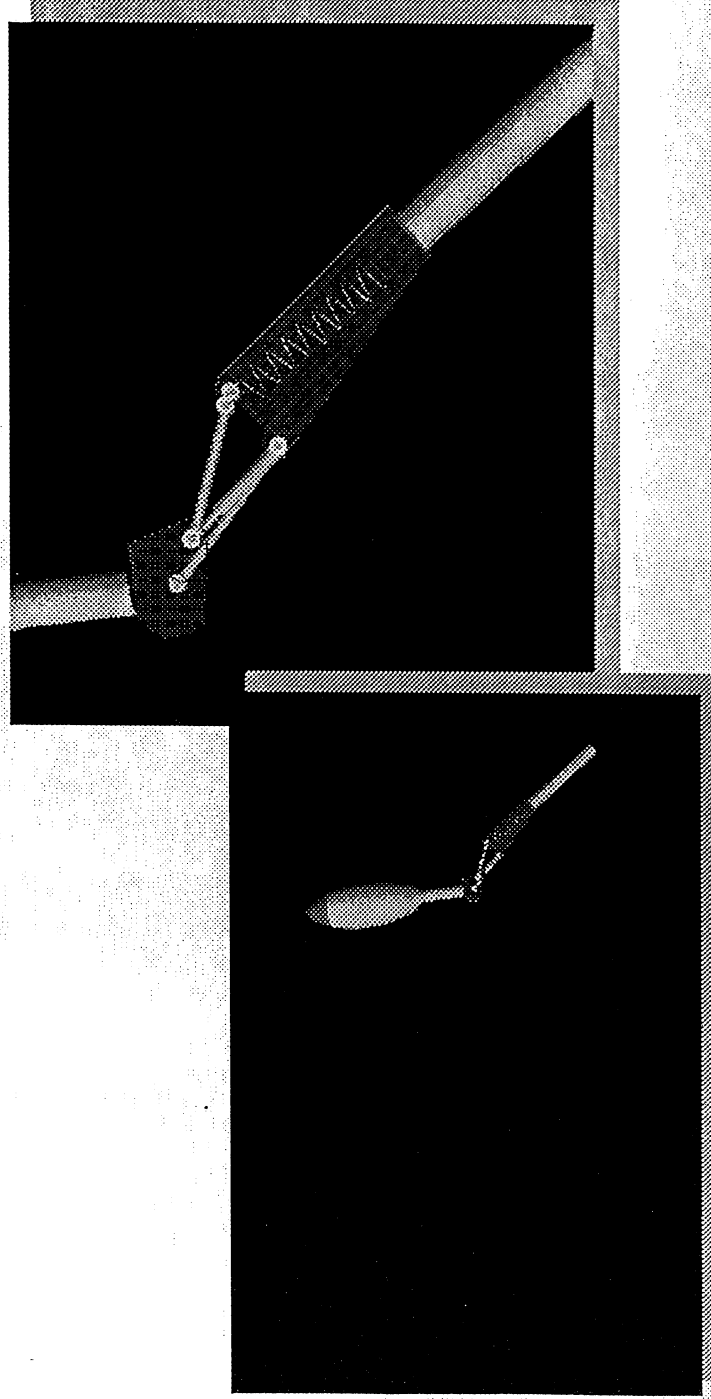
- Recovery of Natural Joint Functions
- Dimensioning of (passive) Control Elements
 - Force Generating Properties
 - Optimisation of Geometry
- Generating Input Data for Structural Analysis



A D A M S

Otto Bock – ADAMS Model

Optimization of Swing Phase



Mechanical
Dynamics

