

# Anwendungsorientierte Forschung im Bereich Medizin-Informatik mit Schwerpunkt Radiologie

Michael Buchberger

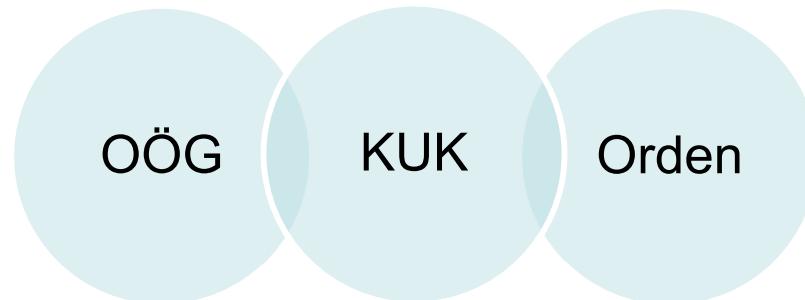
## Die FH Gesundheitsberufe OÖ steht für

- 8 Bachelor-Studiengänge,
- 3 Master-Programme und
- 8 Hochschullehrgänge
- im Vollausbau knapp 2.100 Studierenden.

Der Erwerb umfassender Kompetenzen ist Garant für eine erfolgreiche Zukunft im Gesundheitswesen.

## Die Träger

- Oberösterreichische Gesundheitsholding GmbH (OÖG)
- Kepler Universitätsklinikum Linz GmbH (KUK)
- OÖ Ordensspitäler Koordinations-GmbH (OSKG)



# FH Gesundheitsberufe OÖ

## Allgemein Studium

- Studiendauer: 6 Semester
- Studienart: Vollzeit
- Abschluss: Bachelor of Science in Health Studies (BSc)
- Standort(e): nachfolgende Folie ☺
- Studienplätze: variabel von 18 - 430 je nach Studiengang/Standort

# Standorte

- **Linz**
  - Neuromed Campus
  - Med Campus V.
  - Med Campus VI.
  - Campus Gesundheit am Ordensklinikum Linz
- **Ried**
  - Campus Gesundheit am Krankenhaus der Barmherzigen Schwestern Ried
- **Steyr**
  - Campus Gesundheit am Pyhrn-Eisenwurzen Klinikum Steyr
- **Vöcklabruck**
  - Campus Gesundheit am Salzkammergut-Klinikum Vöcklabruck
- **Wels**
  - Campus Gesundheit am Klinikum Wels-Grieskirchen

## Bachelor-Studiengänge

Bachelor-Studiengänge	am Standort
■ Biomedizinische Analytik	Linz, Steyr
■ Diätologie	Linz
■ Ergotherapie	Linz
■ Gesundheits- und Krankenpflege	Linz, Ried, Steyr, Vöcklabruck, Wels
■ Hebamme	Linz
■ Logopädie	Linz
■ Physiotherapie	Linz, Steyr, Wels
■ Radiologietechnologie	Linz, Steyr

# FH Gesundheitsberufe OÖ

## Studiengang Radiologietechnologie

Radiologietechnologie verbindet  
Medizin, Mensch und Technik.

Angewendet wird sie

- in der Diagnostik
- zu therapeutischen Zwecken
- und in der Wissenschaft



Wissen.schafft.Gesundheit

Bachelor-Studiengang

**Radiologie-  
technologie**

# Medizin-Informatik in der Forschung und Entwicklung

- Simulation medizinischer Prozesse
- Methoden und Werkzeuge für...
  - Informationssysteme im Gesundheitswesen
  - medizinische Dokumentation und wissensbasierte Entscheidungsunterstützung
  - Simulation therapeutischer Eingriffe
  - medizinische Bildverarbeitung
- Ziel:
  - Entwicklung neuer Computer-basierter Methoden/Werkzeuge
  - Quantitative und/oder qualitative Verbesserung hinsichtlich Verfahrensweisen in medizinischen Prozessen im Umfeld von Gesundheitssystem, Forschung und Patientenversorgung.

# Medical-Informatics systems

Information systems in  
healthcare  
(EMR)

Protocol-based systems  
(EBM)

**Intelligent clinical  
decision support  
systems**

Language, coding and  
classification systems

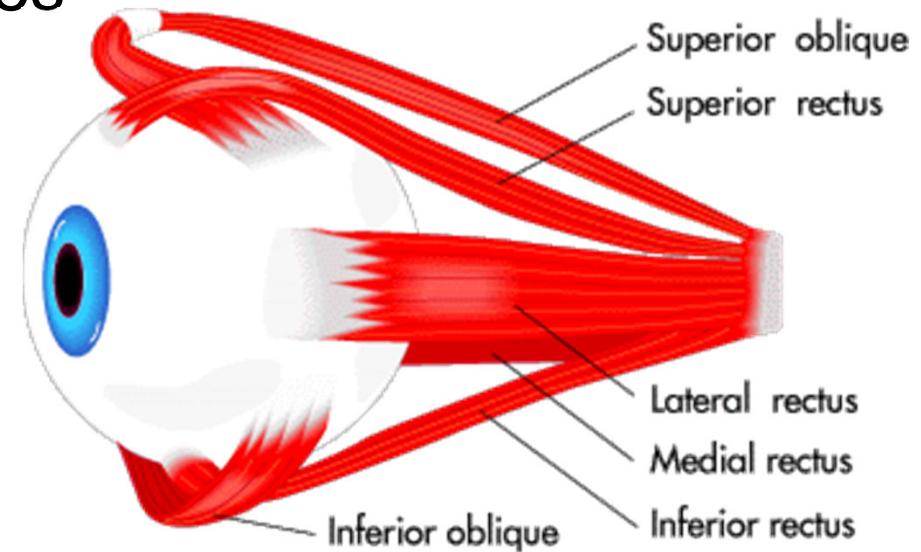
Communication systems  
in healthcare

# Interdisziplinäre Forschungsprojekte als Beispiele

- SEE-KID
  - Interaktive, virtuelle Simulation von Augenmuskeloperationen
  - Lehr- und Ausbildungssystem, klinische Operationsplanung
- Visu
  - 3D-Rekonstruktion von Augenmuskulatur aus MR-Daten
  - Interpolation von verschiedenen Innervationszuständen
  - Pre- und Postoperatives Diagnosewerkzeug für orbitale Chirurgie
- X-Ray
  - Mobile App zur Unterstützung bei der Lagerung von Patienten in der Radiologie
  - Wissensdatenbank mit best practice Dokumentation
- MevisLab
  - System für Prototyping in der med. Bildverarbeitung
  - Einsatz in Lehre und Forschung
- Lehrarchiv für radiologische Bildverarbeitung
  - PACS Server für die Bereitstellung von Datensätzen
  - Einsatz in Lehre und Forschung um einfach Daten zur Verfügung zu stellen
- DSpace
  - Wissensdatenbank als Datenquelle sämtlicher Dokumente, Lehrunterlagen, BAC und Masterarbeiten, Publikationen etc.

# Extraocular Eye Muscles

- For moving eye within its socket.
- 6 muscles per eyeball
- Innervated by 3 Cranial nerves



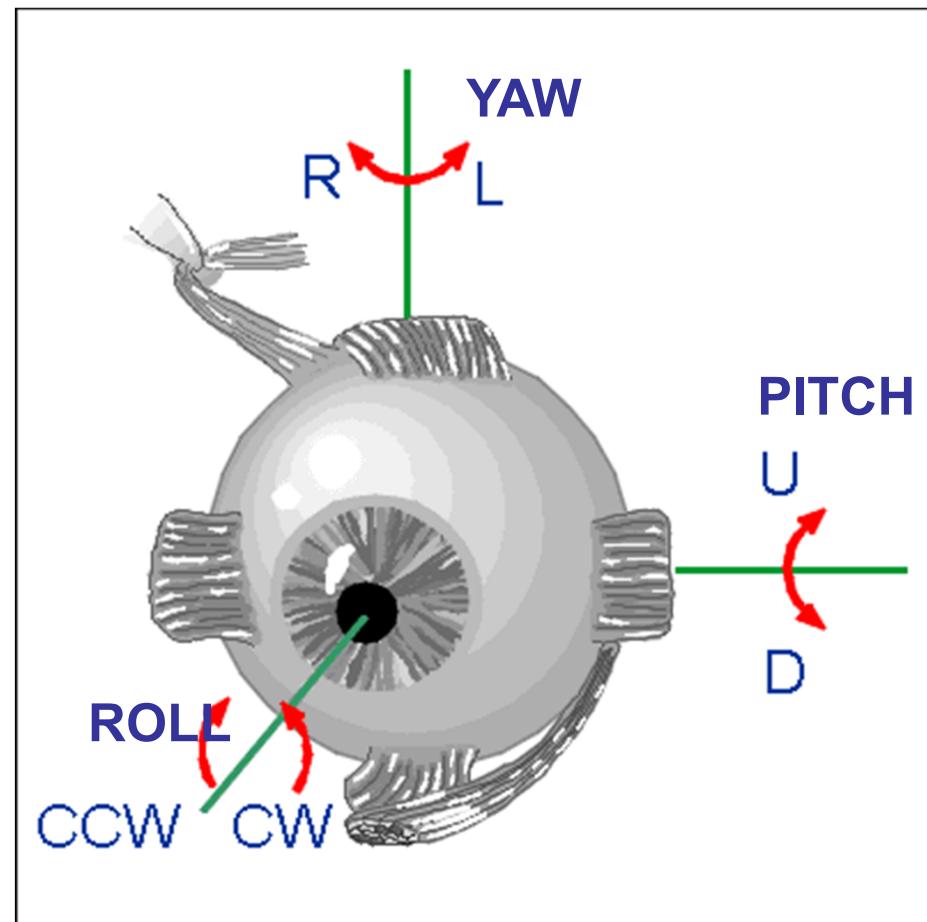
# Eye Movements

**Yaw:** gaze shifts L/R

**Pitch:** gaze shifts up/down

**Roll:** eye rotates around  
line of gaze (torsion)

- **Adduction:** shifting gaze toward midline (Nose)
- **Abduction:** shifting gaze laterally (from Nose)
- **Elevation:** shifting gaze upwards
- **Depression:** shifting gaze downwards
- **In-/Extorsion:** rolling the eye around the line of sight

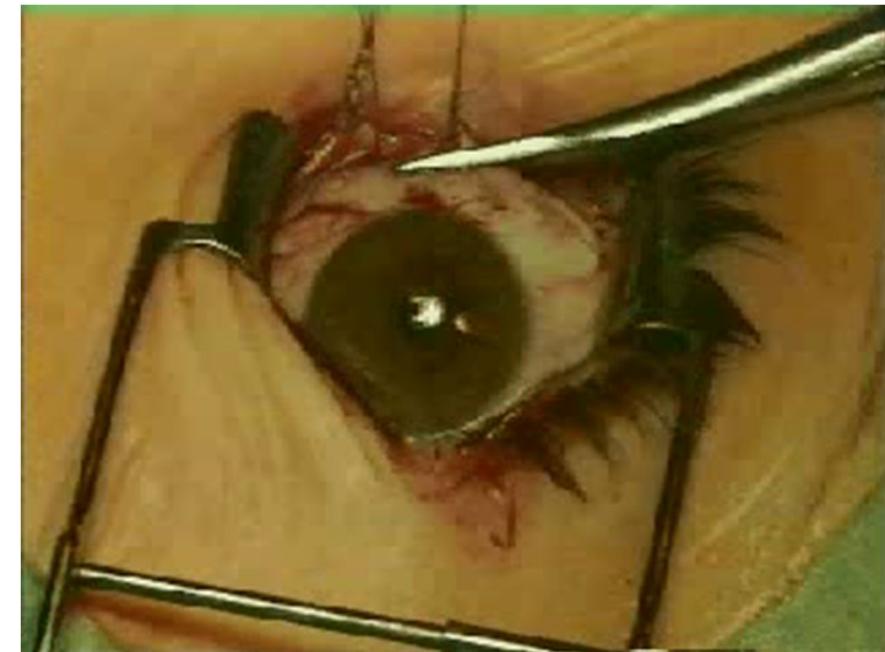


# Limitations of Purely Mechanical Models

- Muscles are reduced to single strings
- Muscle forces cannot be simulated
- Connective tissues are not modelled
- Parameterization is very difficult
- Pathological situations cannot be simulated
- Binocular control of the eyes is missing

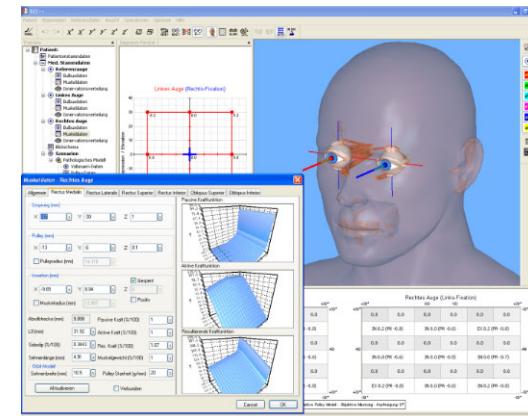
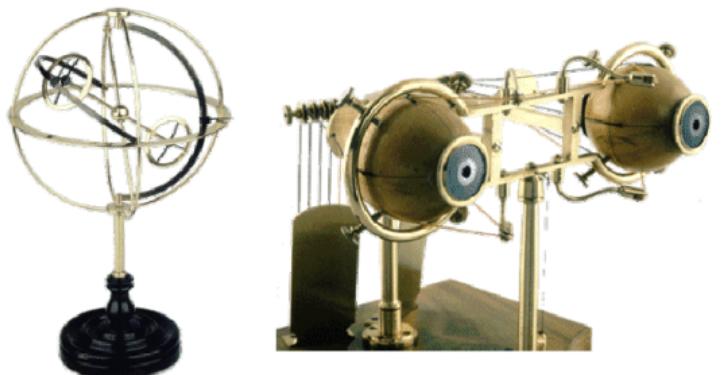
# SEE-KID Software System (SEE++)

- SEE-KID (Software Engineering Environment for Knowledge-based Interactive eye motility Diagnostics)
  - Simulation and optimization of strabismus surgeries
  - Biomechanical 3D-model of the human eye
  - Interactive “virtual” treatment planning
  - Simulation of various pathological cases and surgical correction
- Primary Goals
  - → Training of medical personnel
  - → Support exploration of the oculomotor plant
  - → “Aid” surgeons to preoperatively plan surgeries



# SEE++ - a Virtual “Ophthalmotrope”

- Interactive simulation of eye motility
- Realistic visualization of muscle morphology
- Surgery simulation with a “virtual patient”
- Simulation of clinical tests (Tangent-Screen, Hess, Parks-Bielschowsky)

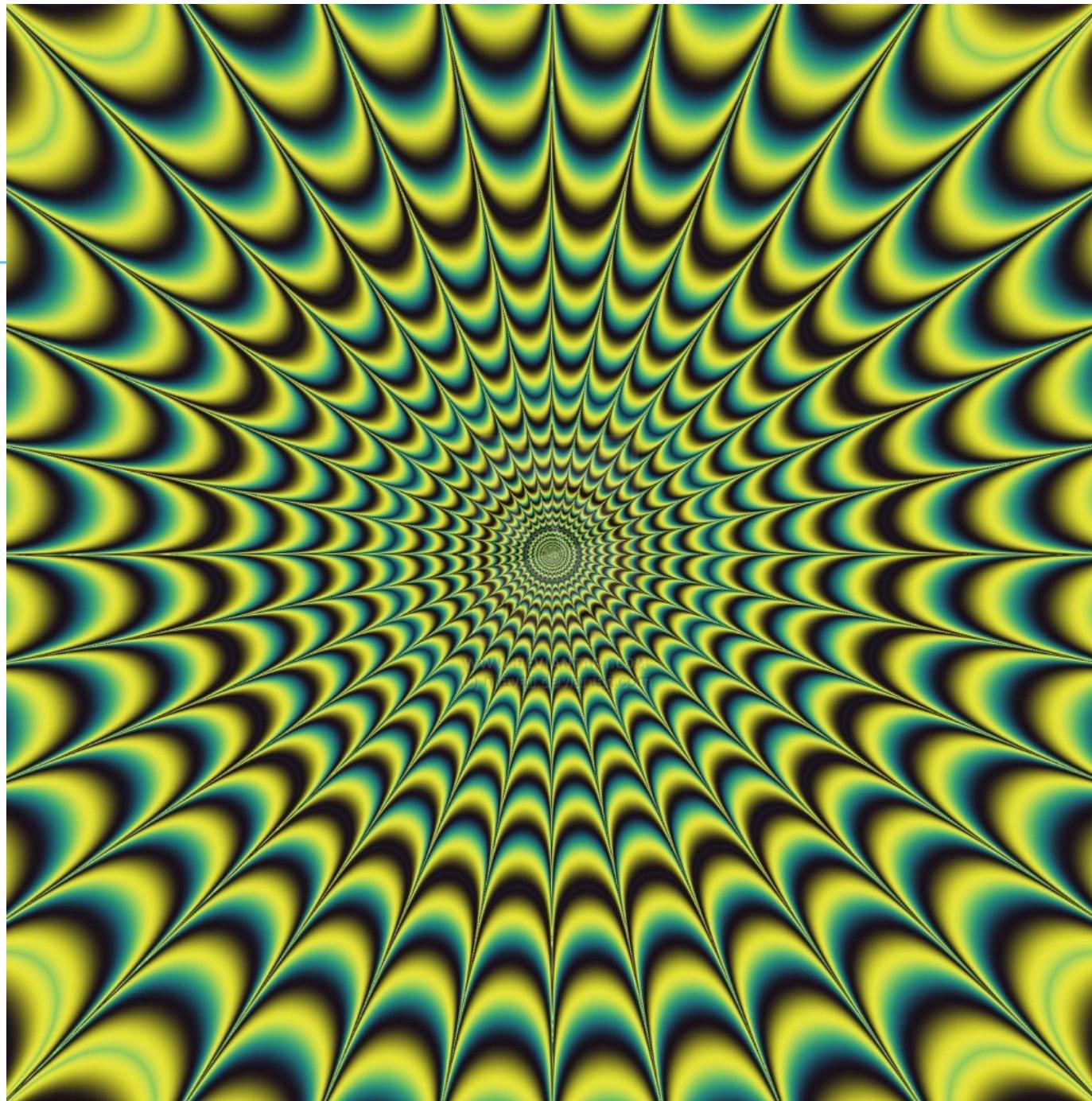


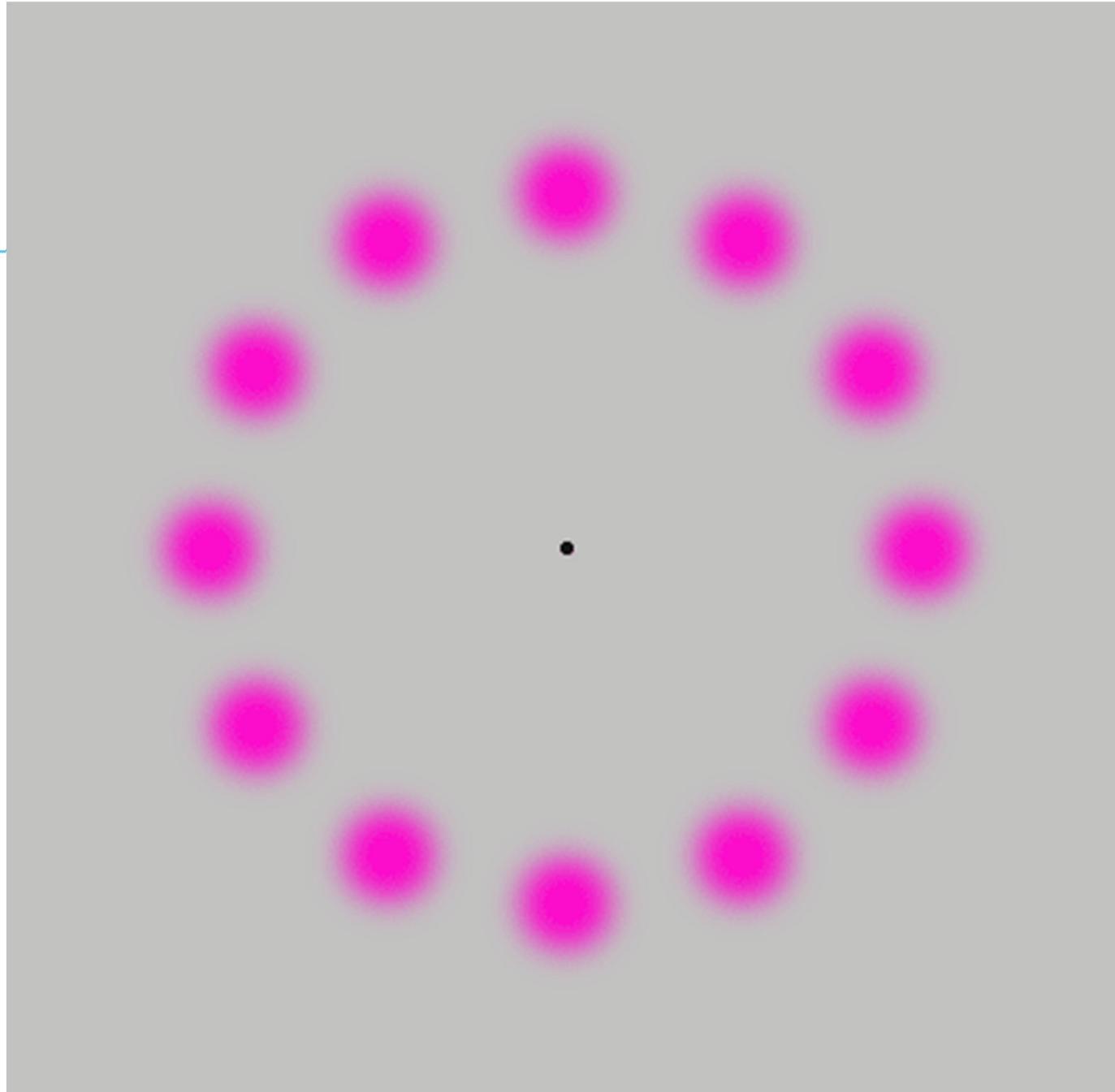
# Eye Movements - Micro-Movements

- When looking at a target, our eyes make very small movements, in order to keep the perceived image sharp.
- Nerve stimulus will decrease after a certain period of time, therefore small movements keep up the stimulus on the retina
- See some examples...

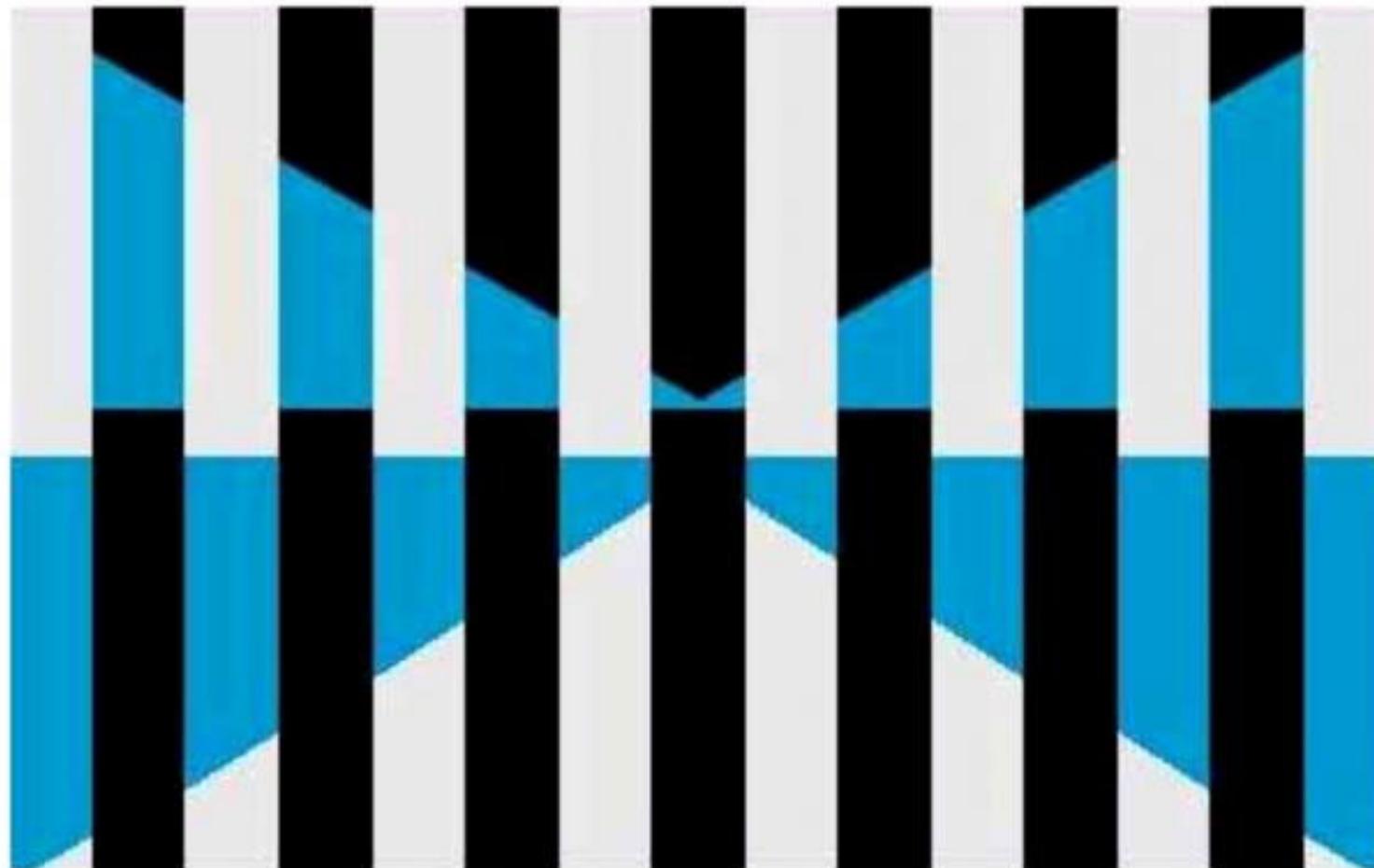


rehtestbilder.de





# Contrast-Perception



Sind beide Blau gleich?

# Components of a Biomechanical Model (I)

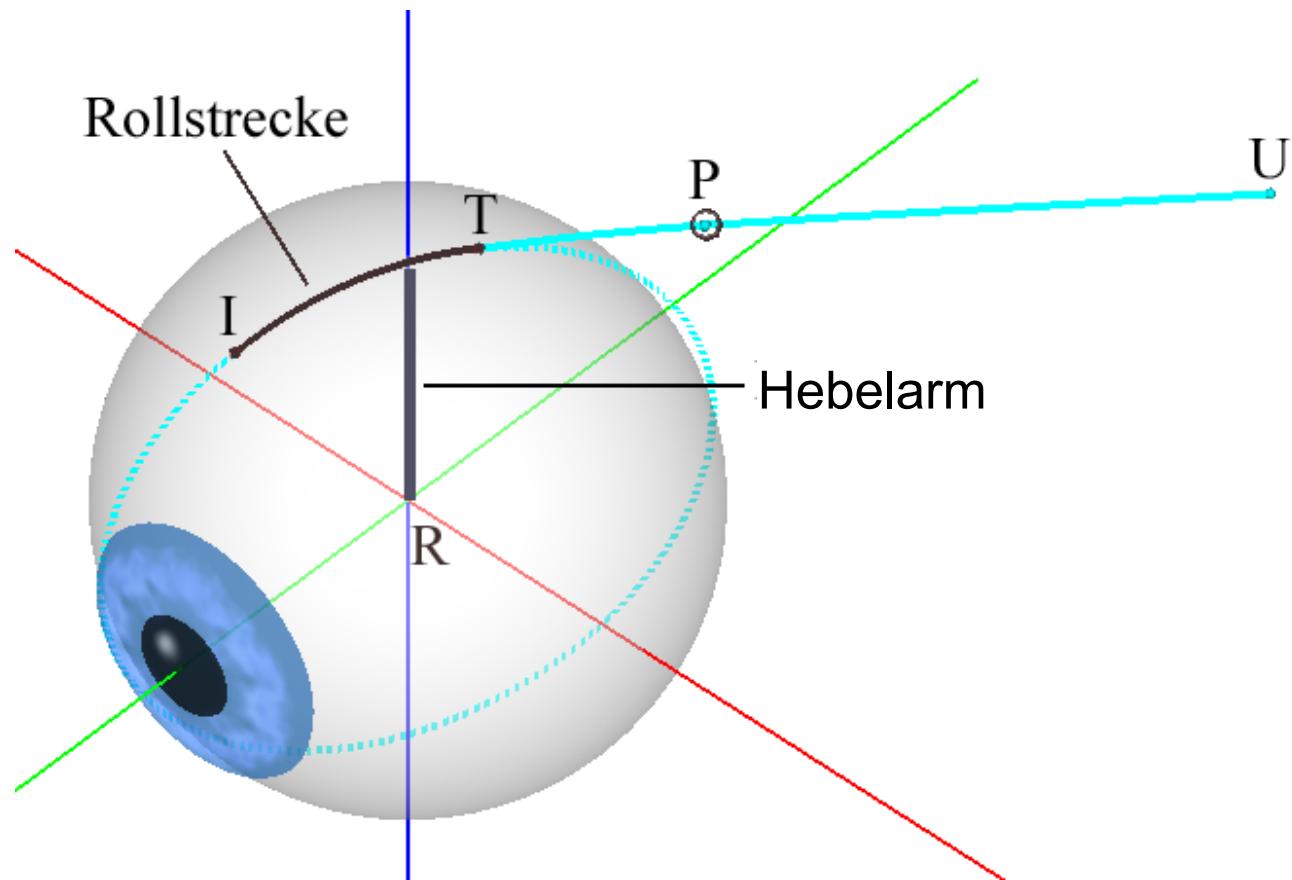
## ■ Geometrical Model

- Muscle action
- Distribution of muscle force

## ■ Muscle Force Simulation

- Length-Innervation-Force relationship
- Elastic (passive) force
- Contractile (active) force

# Geometrical Properties of Eye Muscles



# Muscle Actions

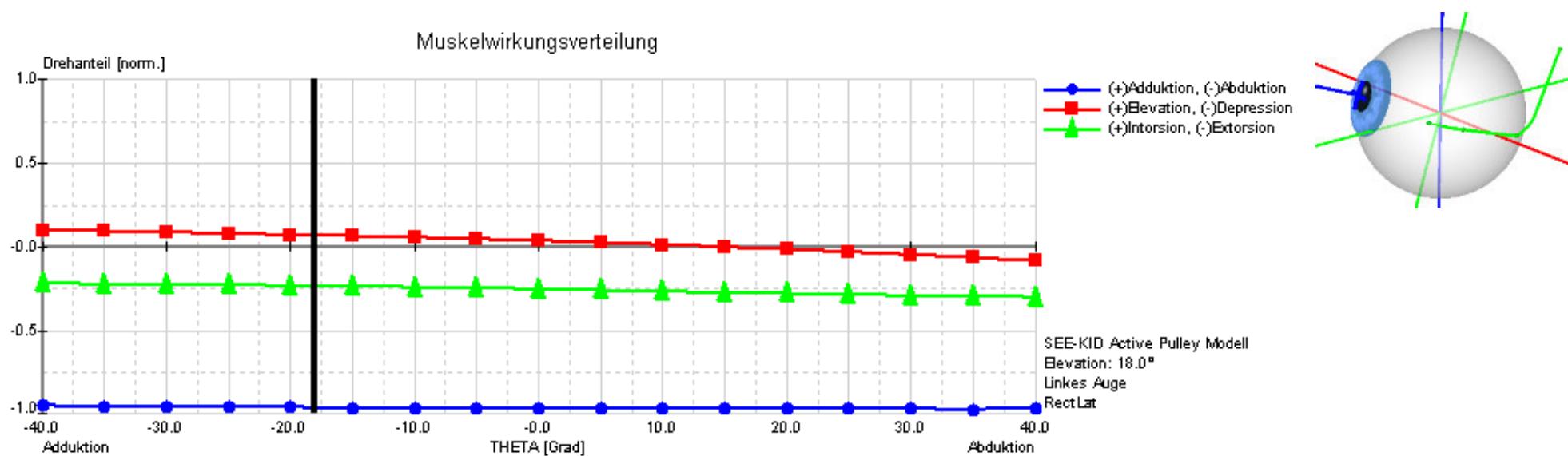
TABLE 68-1

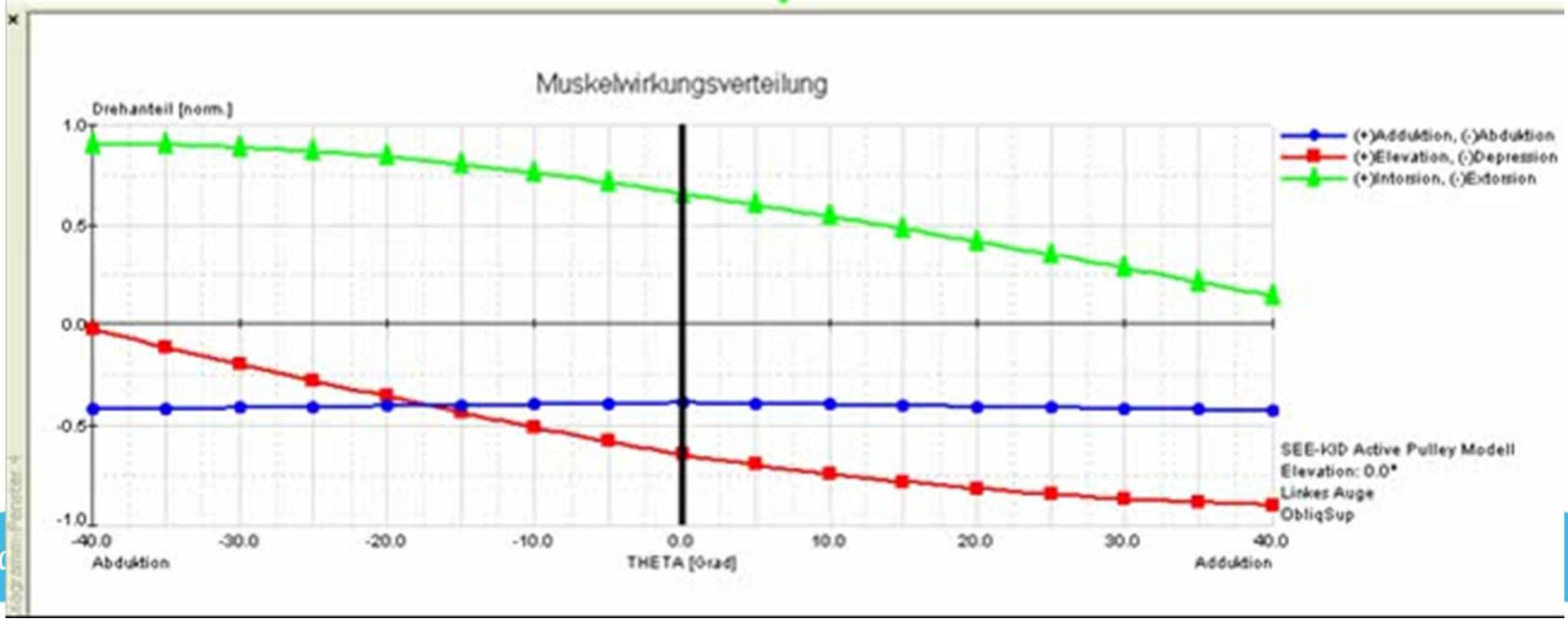
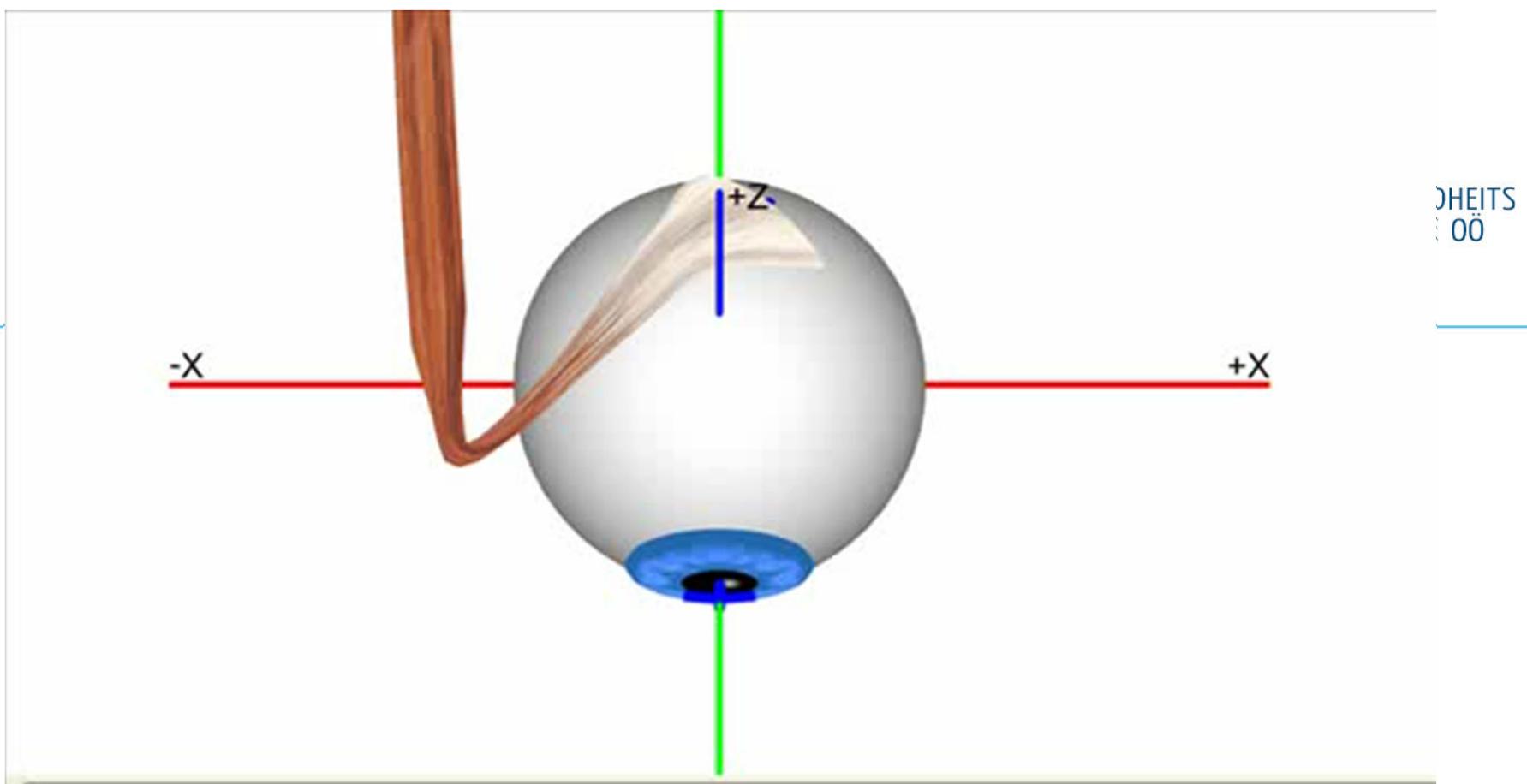
CHARACTERISTICS OF EXTRAOCULAR MUSCLES

Muscle	Origin	Insertion	Muscle Length (mm)	Tendon Length (mm)	Width of Insertion (mm)	Direction of Pull From 1° Position (°)	Action: i. Primary ii. Secondary iii. Tertiary	Innerva (Crana Nerve)
Medial rectus	Annulus of Zinn	5.5mm behind nasal limbus	41	3.5	10.3	90	i. Adduction	Inferior II
Lateral rectus	Annulus of Zinn	6.9mm behind temporal limbus	41	8	9.2	90	i. Abduction	VI
Superior rectus	Annulus of Zinn	7.7mm behind superior limbus	42	5	10.6	23	i. Elevation ii. Incyclotorsion iii. Adduction	Superior
Inferior rectus	Annulus of Zinn	6.5mm behind inferior limbus	40	6	9.8	23	i. Depression ii. Excyclotorsion iii. Adduction	Inferior II
Superior oblique	Frontoethmoidal suture above annulus of Zinn	Posterior, lateral, superior quadrant	32	26	10.8	51	i. Incyclotorsion ii. Depression iii. Abduction	IV
Inferior oblique	Posterior to lacrimal fossa	Posterior, lateral, inferior quadrant	35	1	9.6	51	i. Excyclotorsion ii. Elevation iii. Abduction	Inferior II

# Muscle Force Distribution (II)

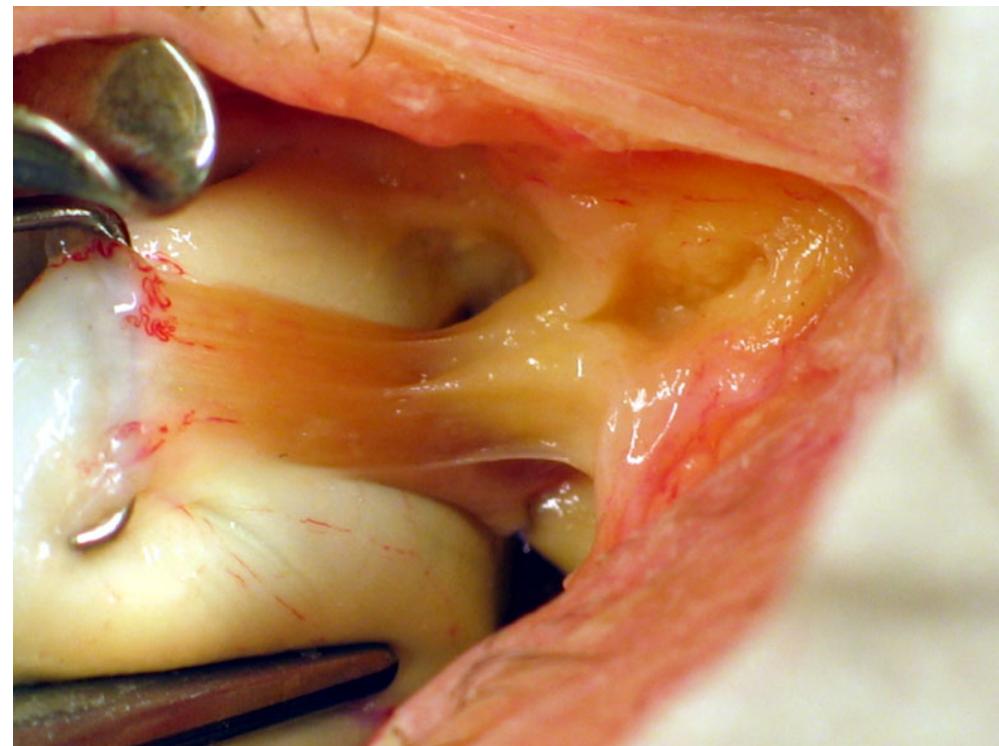
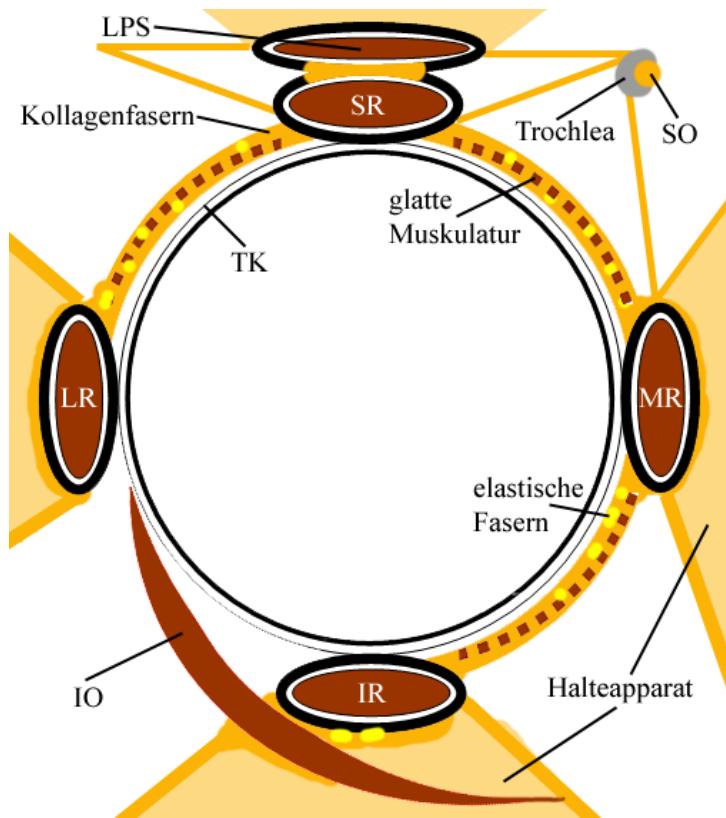
- The Muscle Force Distribution (MFD) shows all 3 components of muscle action (horizontal, vertical, torsional) as curve within a certain range in a specified elevation of the eye
- The MFD can also show combined actions for selected muscles





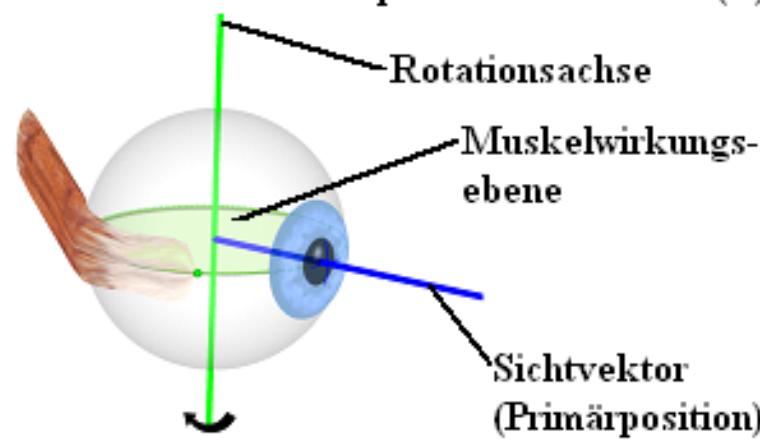
# Discovery of „Pulleys“

- Pulleys are stabilizing tissues that encircle the muscles and make the rotational axis dependent of eye position

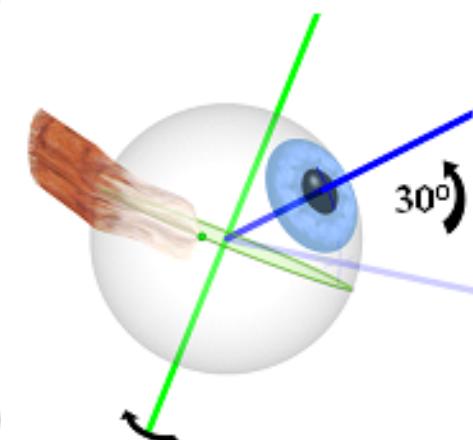


# „Pulley“ Geometry (I)

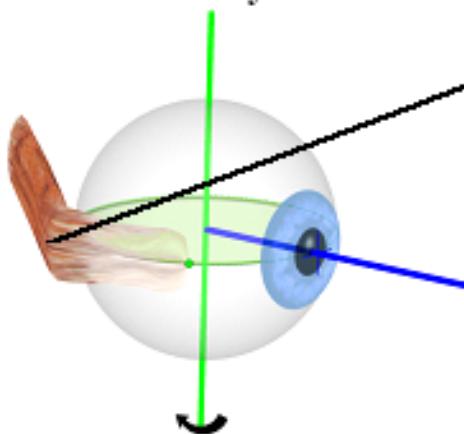
(A) Fadenmodell in Primärposition



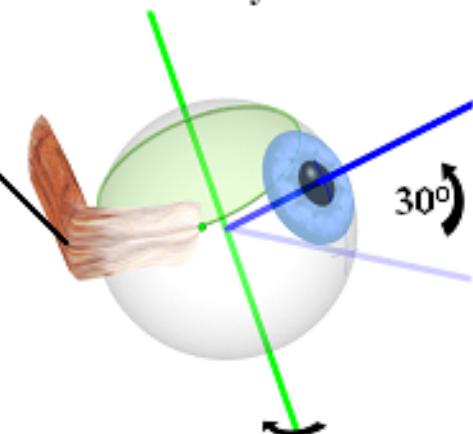
(B) Fadenmodell in 30° Elevation



(C) Modell mit "Pulleys" in Primärposition



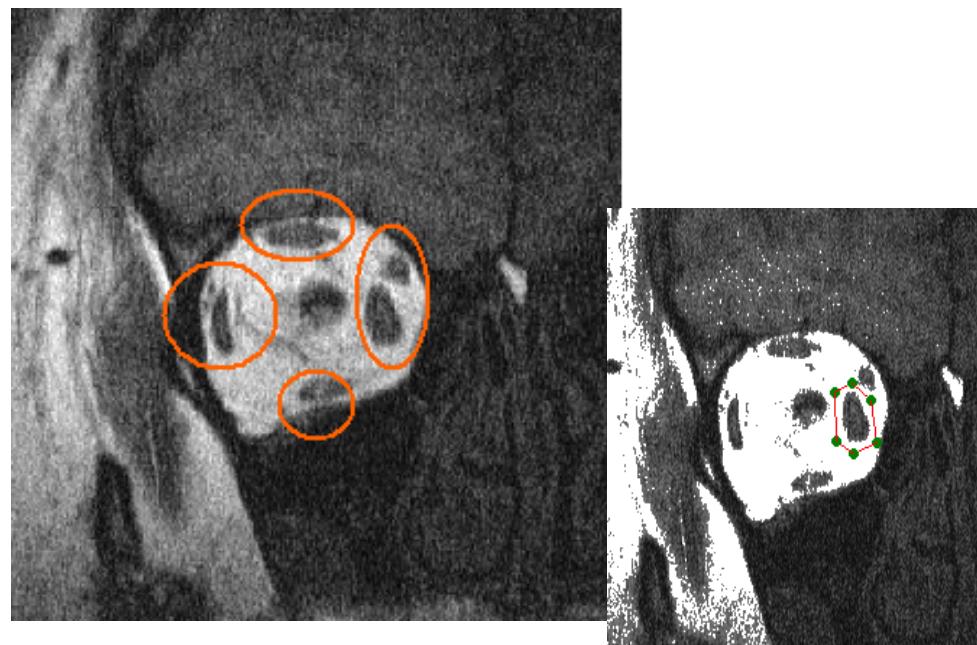
(D) Modell mit "Pulleys" in 30° Elevation



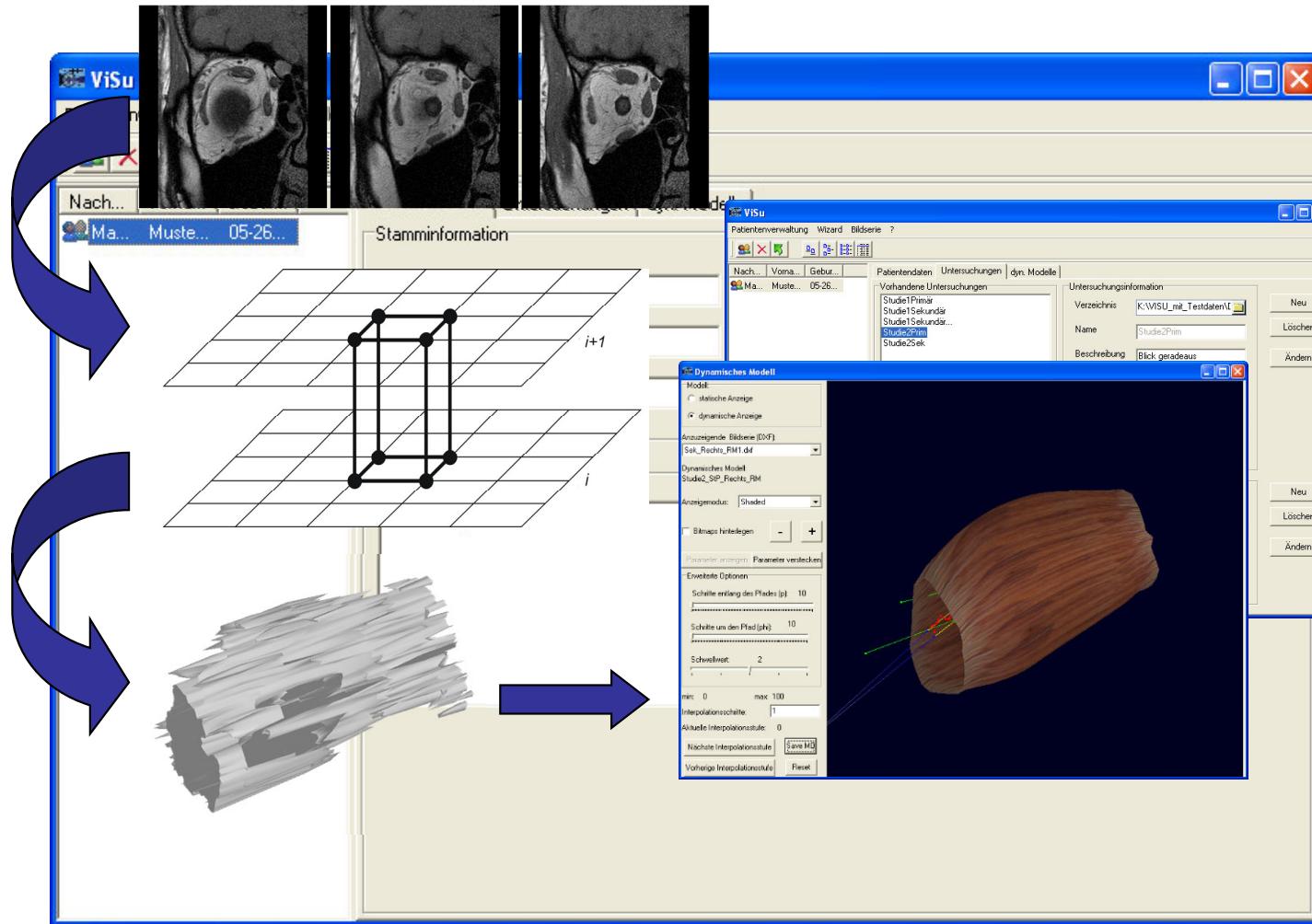
# VISU - Software

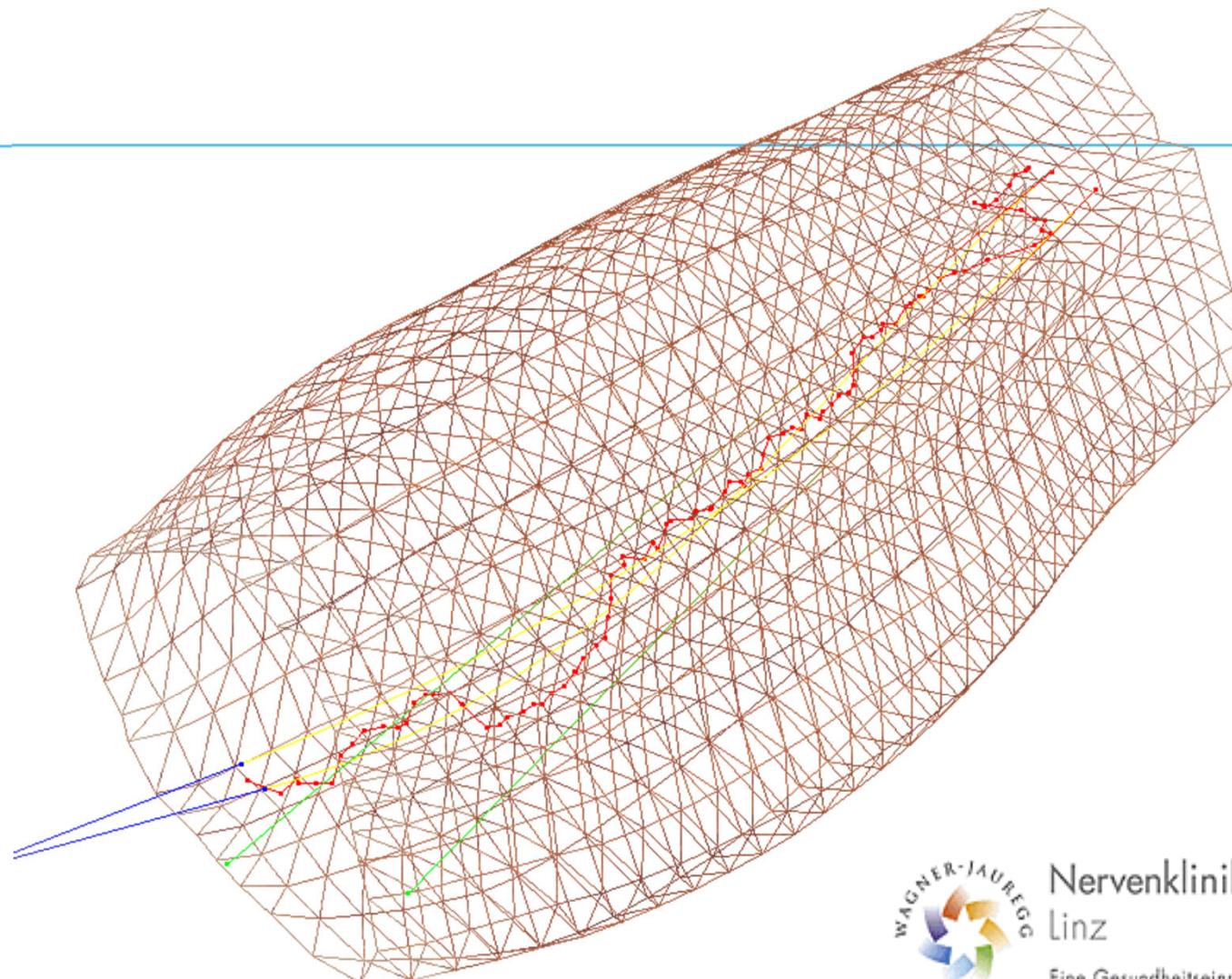
Funktionsweise:

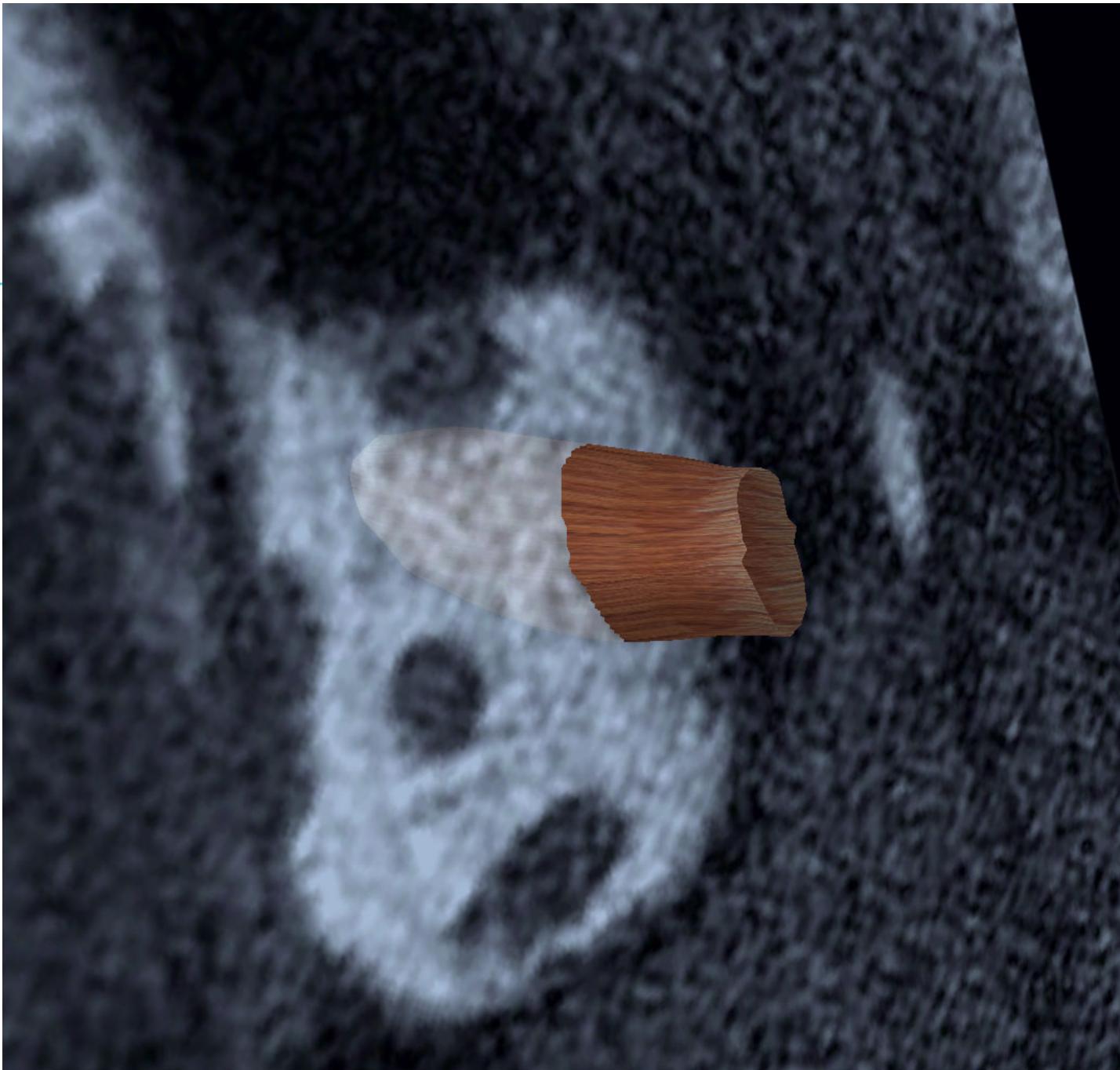
- Akquisition geeigneter MR-Bilder (coronar)
- Vorbereiten der Bilder
- Generieren von Oberflächenmodell (DXF)
- Geometrische Rekonstruktion der Muskeloberfläche
- Optimierung der rekonstruierten Oberfläche durch math. Verfahren (z.B. Spline-Interpolation)
- Interpolation zwischen verschiedenen Zustände



# VISU - Software









# PACS Lehrarchiv Studiengang RT

Lookup Plugins FHG-Lehrarchiv » Lookup studies Upload Query/Retrieve Jobs

## ORTHANC

Patient ID:

Patient Name:

Accession Number:

Study Description:

Study Date: Any date

All patients All studies Do lookup

Über 500 anonymisierte Studien werden hier gehostet, > 100 000 Bilder

<https://lehrarchiv.rt-fhgooe.at/>

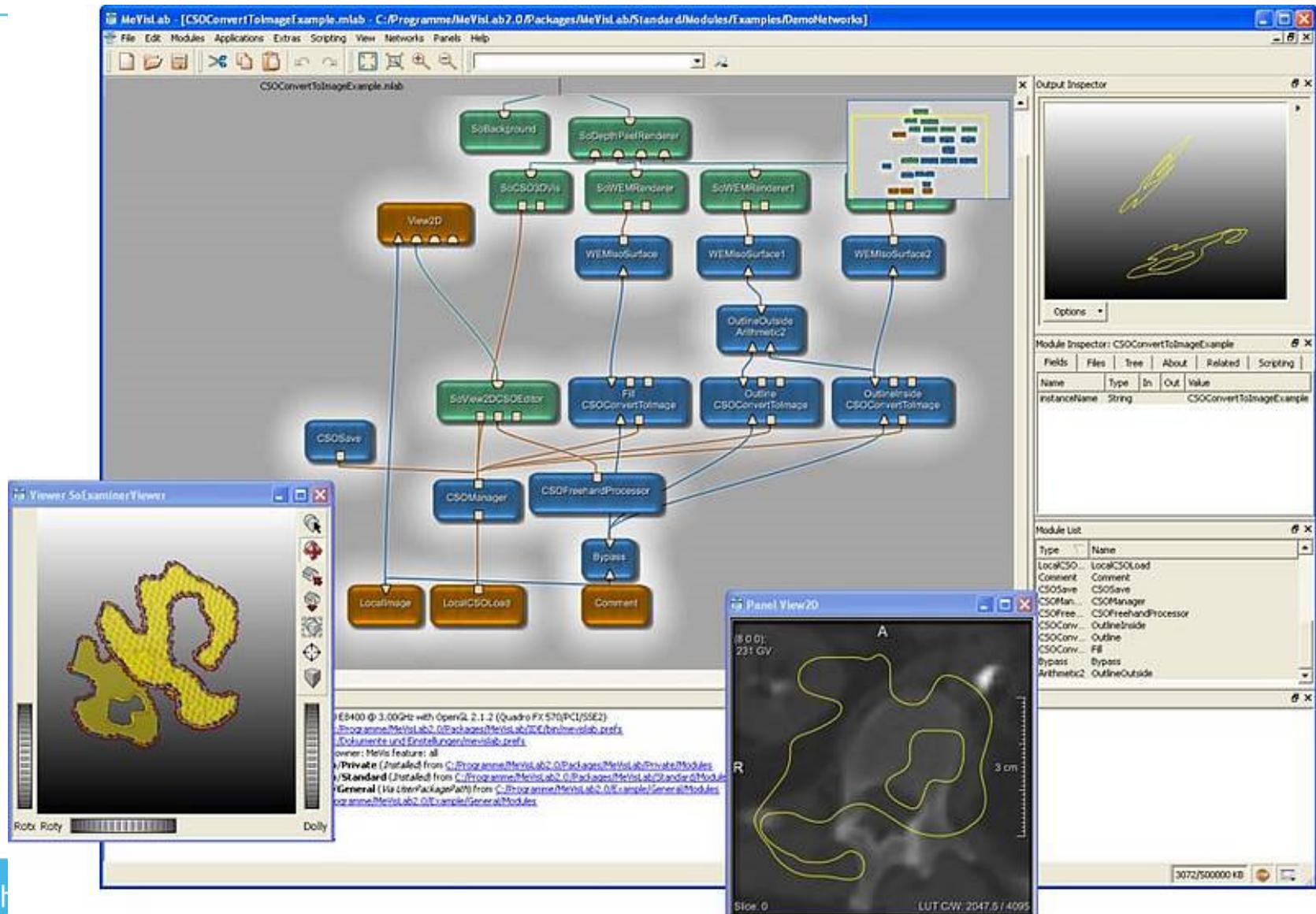
# RT-Lehrarchiv Zugriff

 Knie ap stehend 1-2013 - MicroDicom viewer (64 bit) unlicensed for commercial use

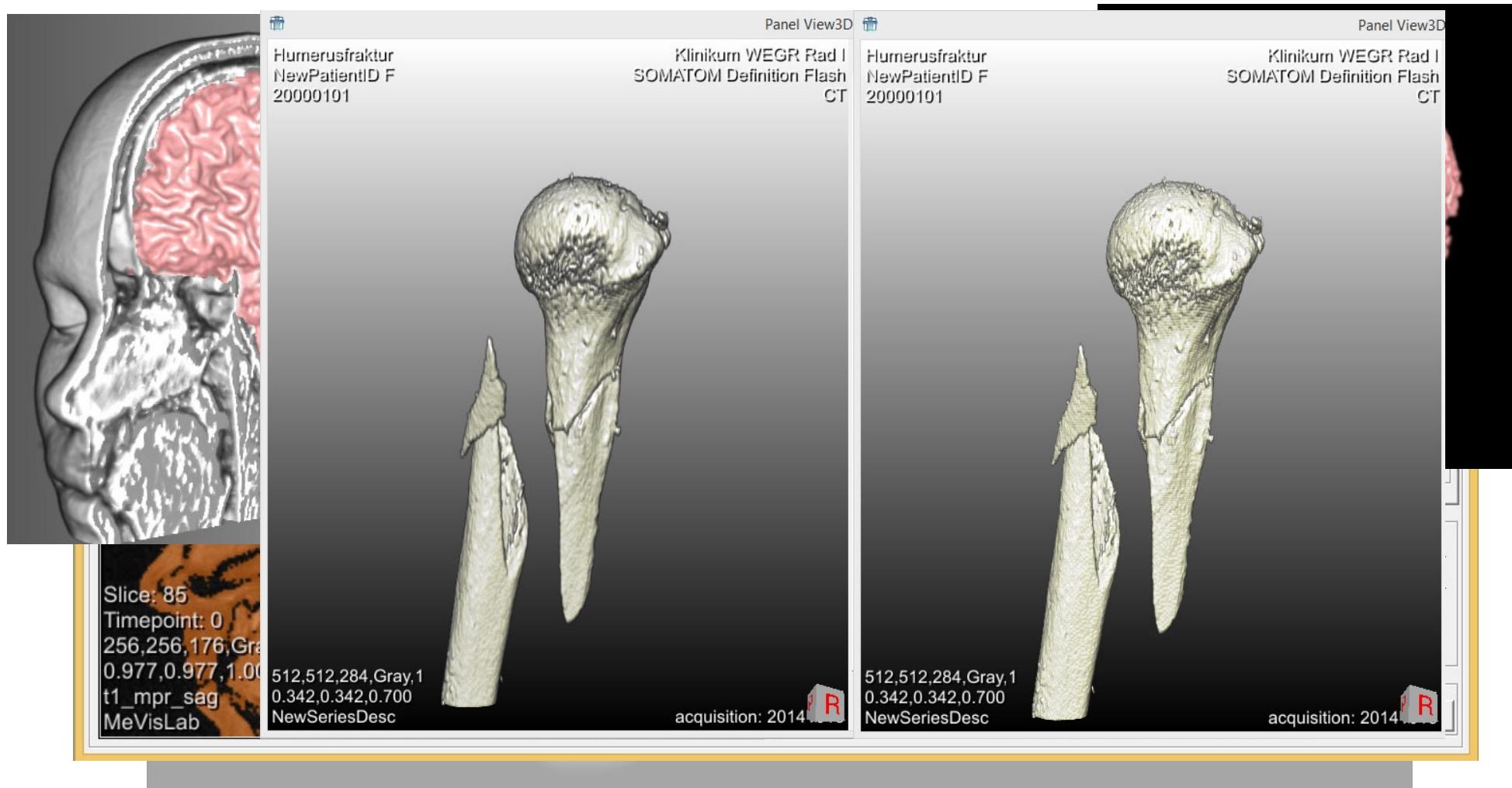
The screenshot shows a DICOM viewer application with the following interface elements:

- Top Bar:** File, Network, View, Image, Measure and annotate, Tools, Help.
- Toolbar:** Includes icons for file operations (New, Open, Save, Print, Import, Export, Find, Zoom, etc.), measurement tools (Ruler, Angle, Area, etc.), and DICOM browser.
- DICOM browser:** Shows a tree view of downloaded patients. One node is expanded to show series like "AAHead\_Scout\_MPR\_sag" with multiple image files.
- Patient Information:** Displays the patient's name as "Knie ap stehend 1-2013", gender "F", and acquisition date "24-December-2018 7:14:11".
- Download from DICOM server:** A modal dialog box with the following fields:
  - Patient:** Search bar for patient name.
  - Time Range:** Radio buttons for "All date", "Last month", "Last 3 months", "Last 1 hour", "Last 2 hours", "Last 3 hours", "Last 6 hours", "Last 8 hours", "Last 12 hours", "Last 24 hours", and "Custom Date". The "All date" option is selected.
  - Modality:** Checkboxes for All modalities (CR, CT, MG, XA, RF, NM, DX, ES, PT, SR, SC, MR, AU, OT, RG, DR, XC, VL, US, PX), with CR, PT, SR, VL, SC, US, MR, AU, NM, OT, RG, DR checked.
  - Address:** Table with one row: "lehrarchiv.it-fhgooe.at" (Address), "1045" (Port), "FHG-Lehrarchiv" (AE title), and "FHG-Lehrarchiv" (Description).
  - Search and Clear buttons:**
- Table of Studies:** A grid showing 574 studies found, with columns for Patient name, Patient ID, Date of Birth, Description, and Modality. Examples include "Oberschenkel ap/s gesamt verschraubt 4-2016" (CR), "MR Schädel KM 1 2019" (MR), and "Thorax ap 1-2013 P" (CR).
- Bottom Status Bar:** Plane: 1/1, 162x162, Measured size: Calibrated, Zoom: 410%, WL: 383 WW: 833, Patient information, All Tags, Favorite Tags, 410%, 11:45, 07.06.2022.
- Taskbar:** Icons for various applications including Windows, File Explorer, Task Manager, and others.

# MevisLab für Bildverarbeitung



# MevisLab Beispiele



# Dspace Server als Wissens-datenbank



Communities & Collections All of DSpace ▾

Log In ▾

Home • Search

All of DSpace xray Search

Filters

Author +

Date +

Has files +

Reset filters

Search Results

Now showing 1 - 10 of 102

**Item**  
Entwicklung des konventionellen Röntgens im Hinblick auf die Dosisreduktion und Verbesserung des Workflows  
(FH Gesundheitsberufe OÖ / Radiologietechnologie, 2018-06-21) Mayrhofer  
is a literature review with which the main innovations from the discovery of x-rays to the modern technology of today is described. These facts are then connected with the reduction of the radiation dose and the improvement of the workflow... inve  
▼ Show more

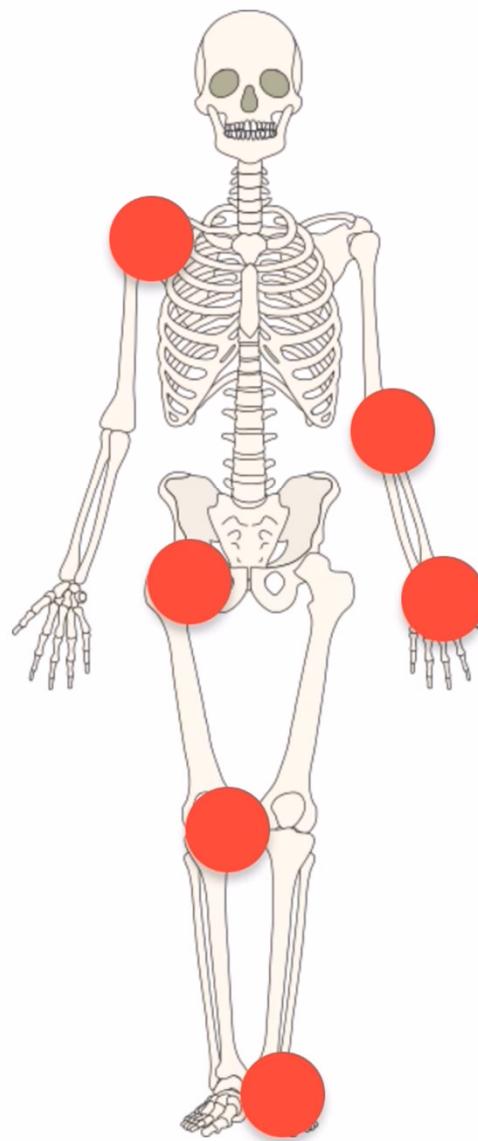
**Item**  
Alternative Anwendung radiologietechnologischer Verfahren: Alters- und Echtheitsbestimmung kunst- und kulturhistorischer Objekte  
(FH Gesundheitsberufe OÖ / Radiologietechnologie, 2017-05-26) Miesenberg  
Hintergrund  
Durch Anwendung radiologietechnologischer Verfahren können in der Medizin und der Industrieerfolgreich, mit nicht bis minimal invasiven Methoden, Diagnosen e  
▼ Show more

**Item**  
Prä- und postoperative Röntgenaufnahmen bei

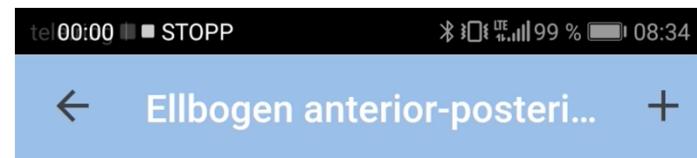




## ☰ Extremitätenauswahl



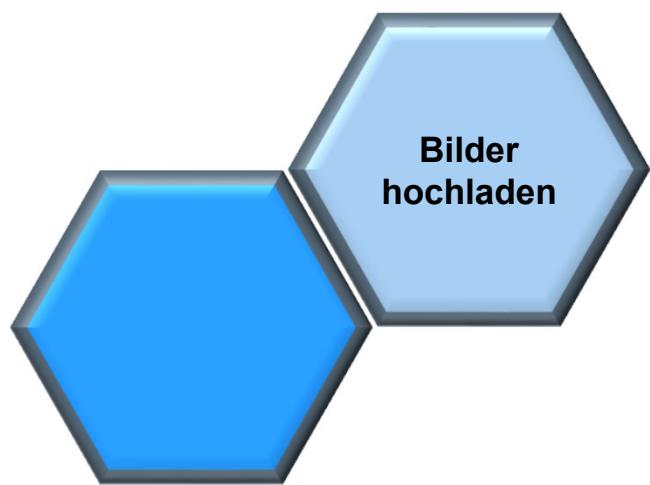




Lagerung

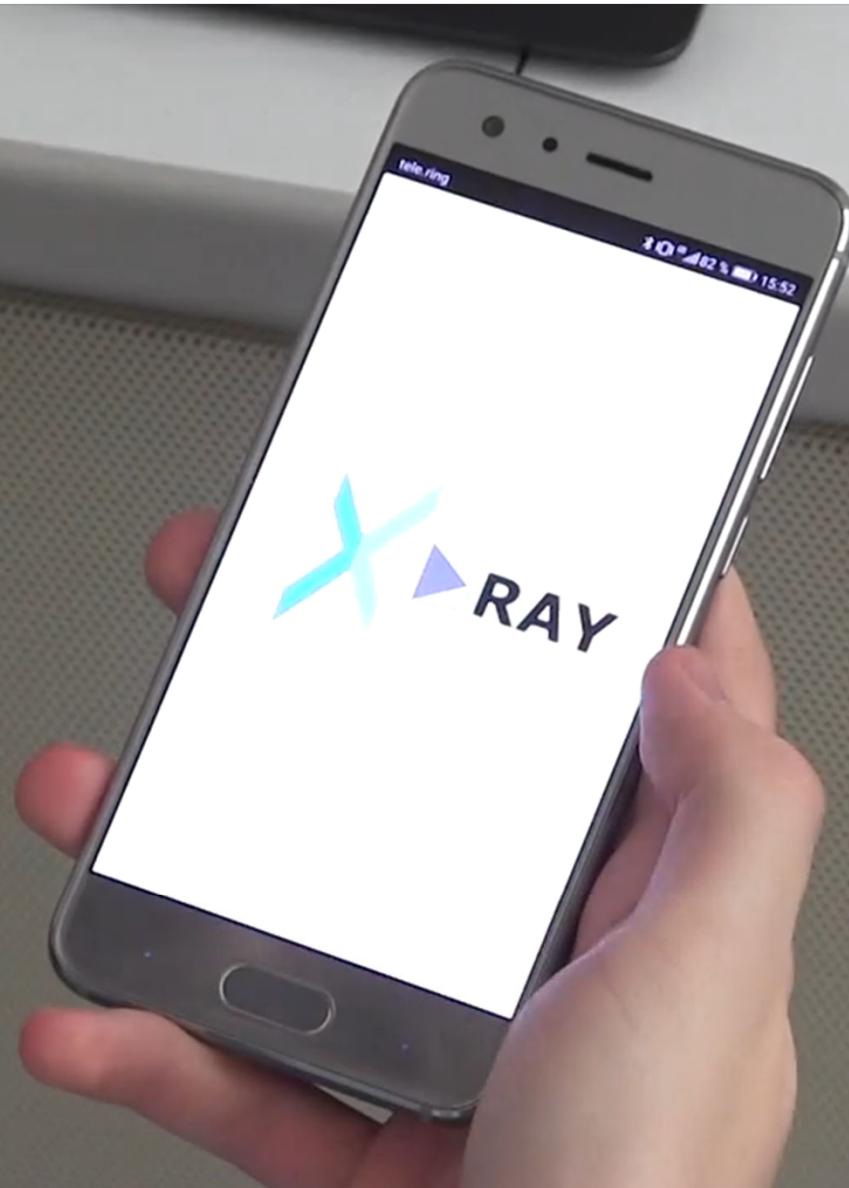
Bildkriterien

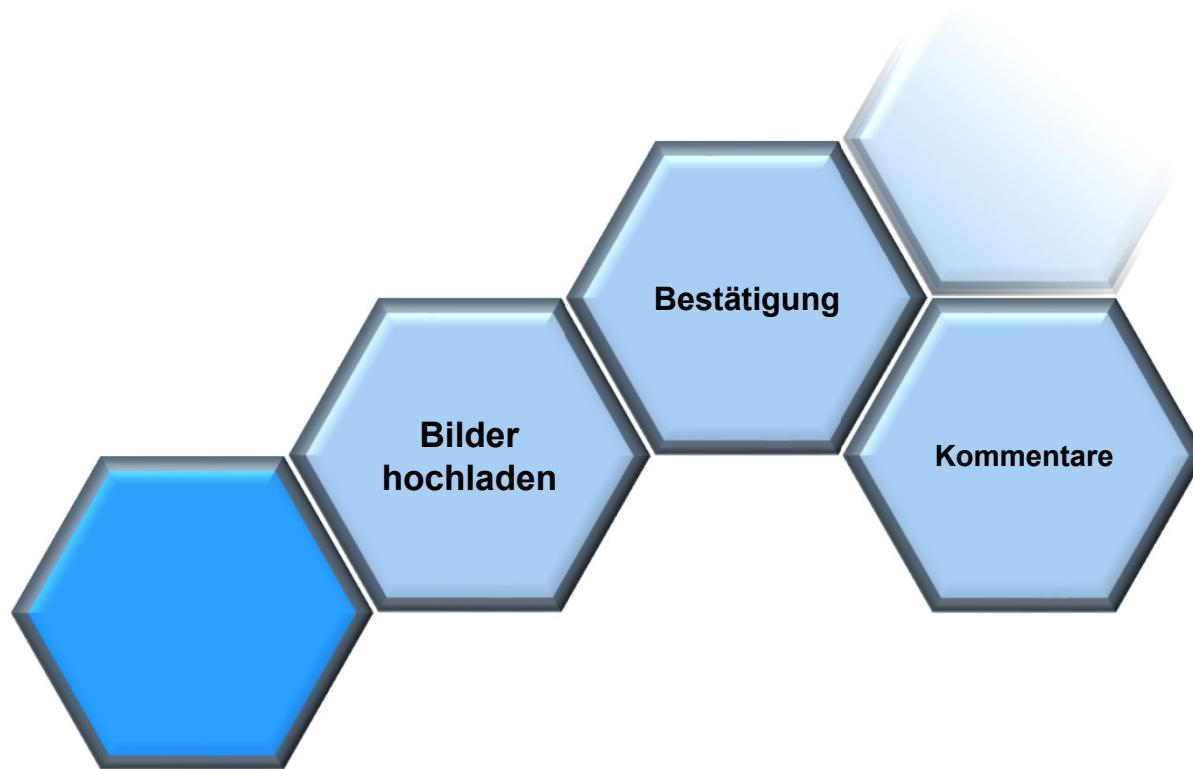
Fehleinstellungen

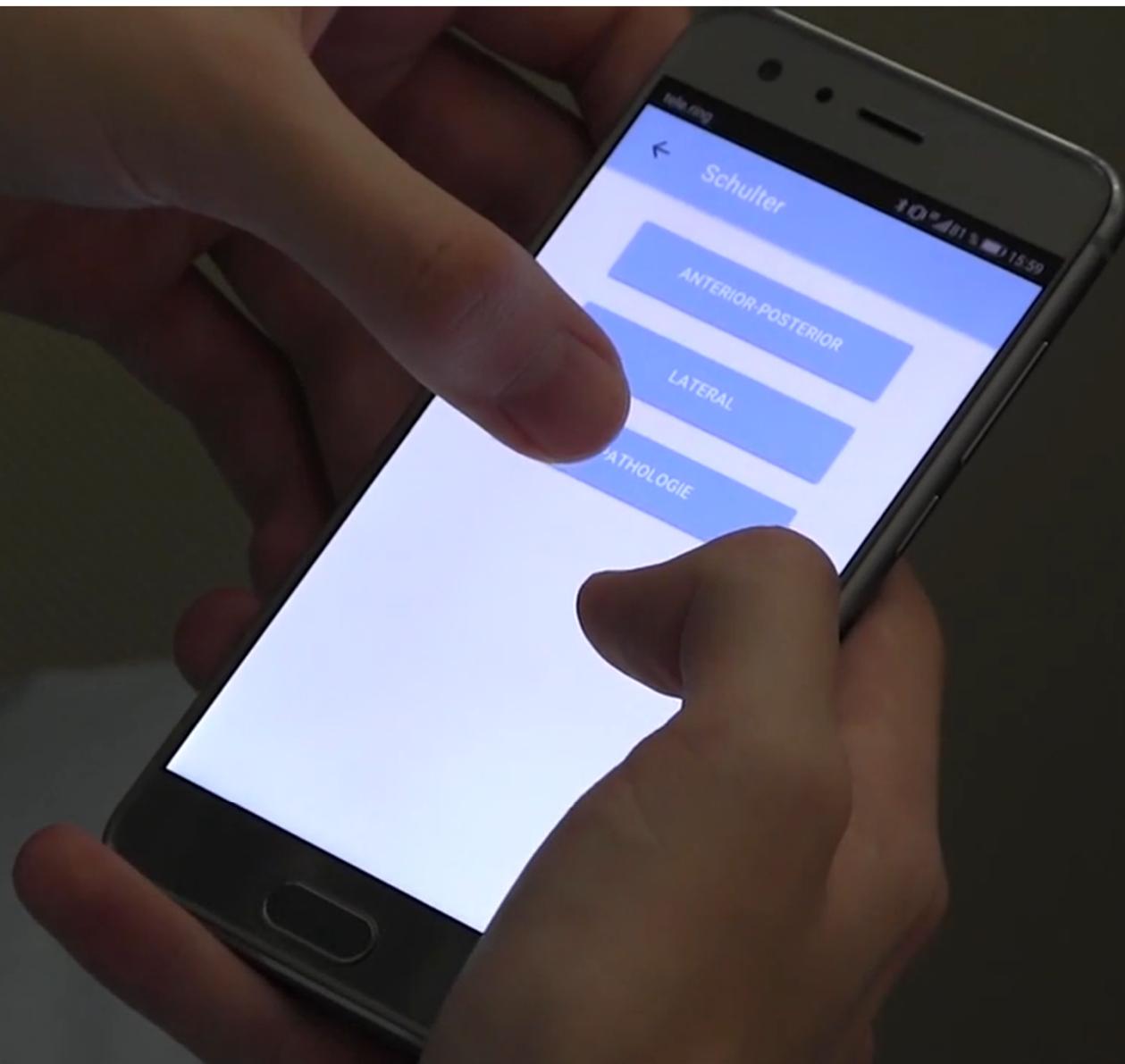


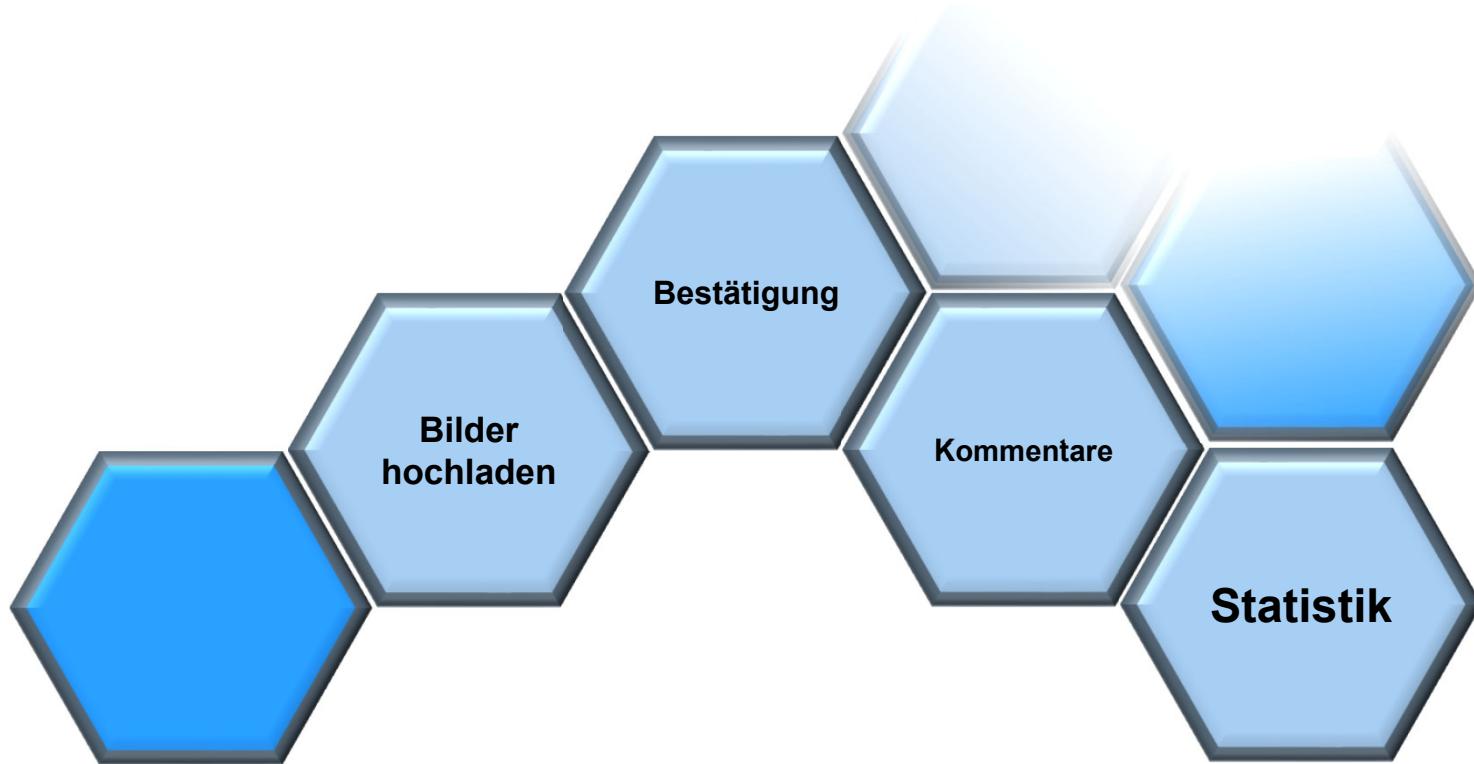












Menü

Extremitätenauswahl

Startseite

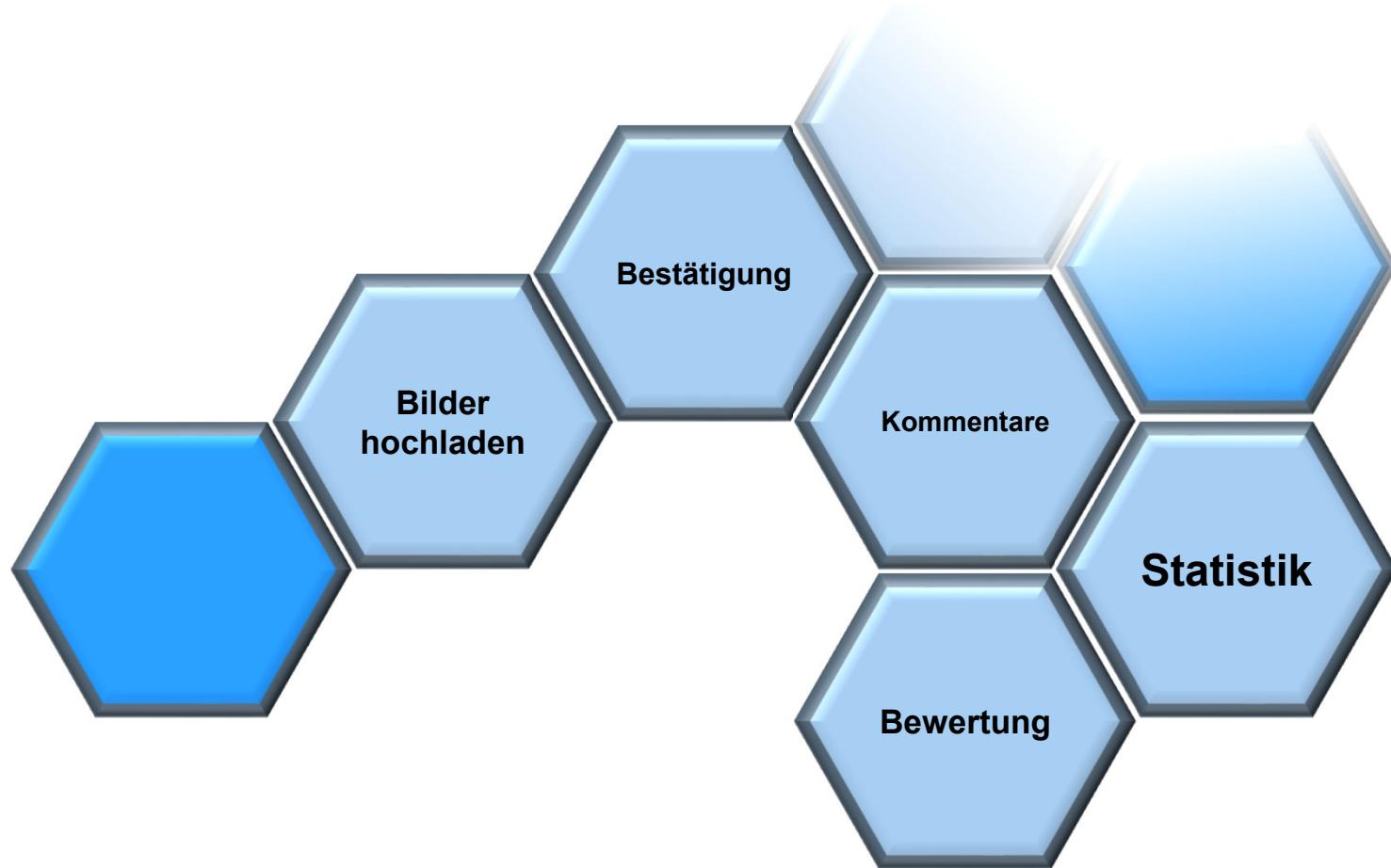
Bestätigungen 2

Reporting

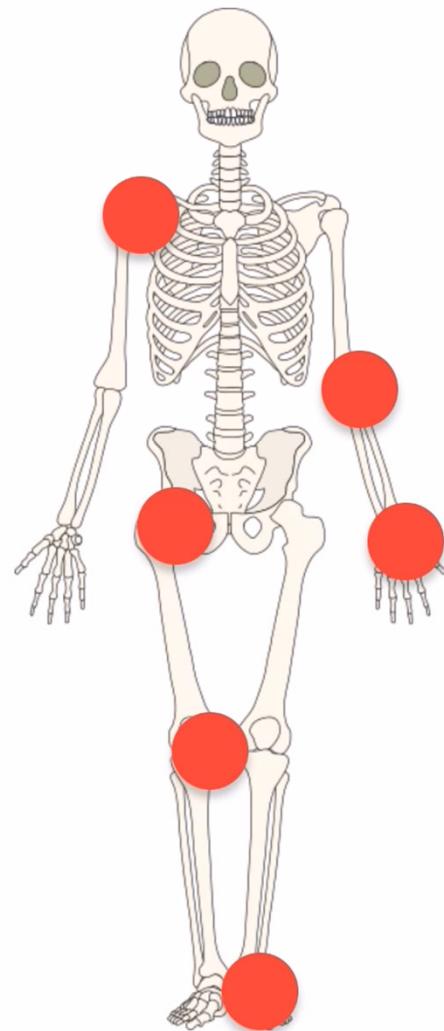
Statistik

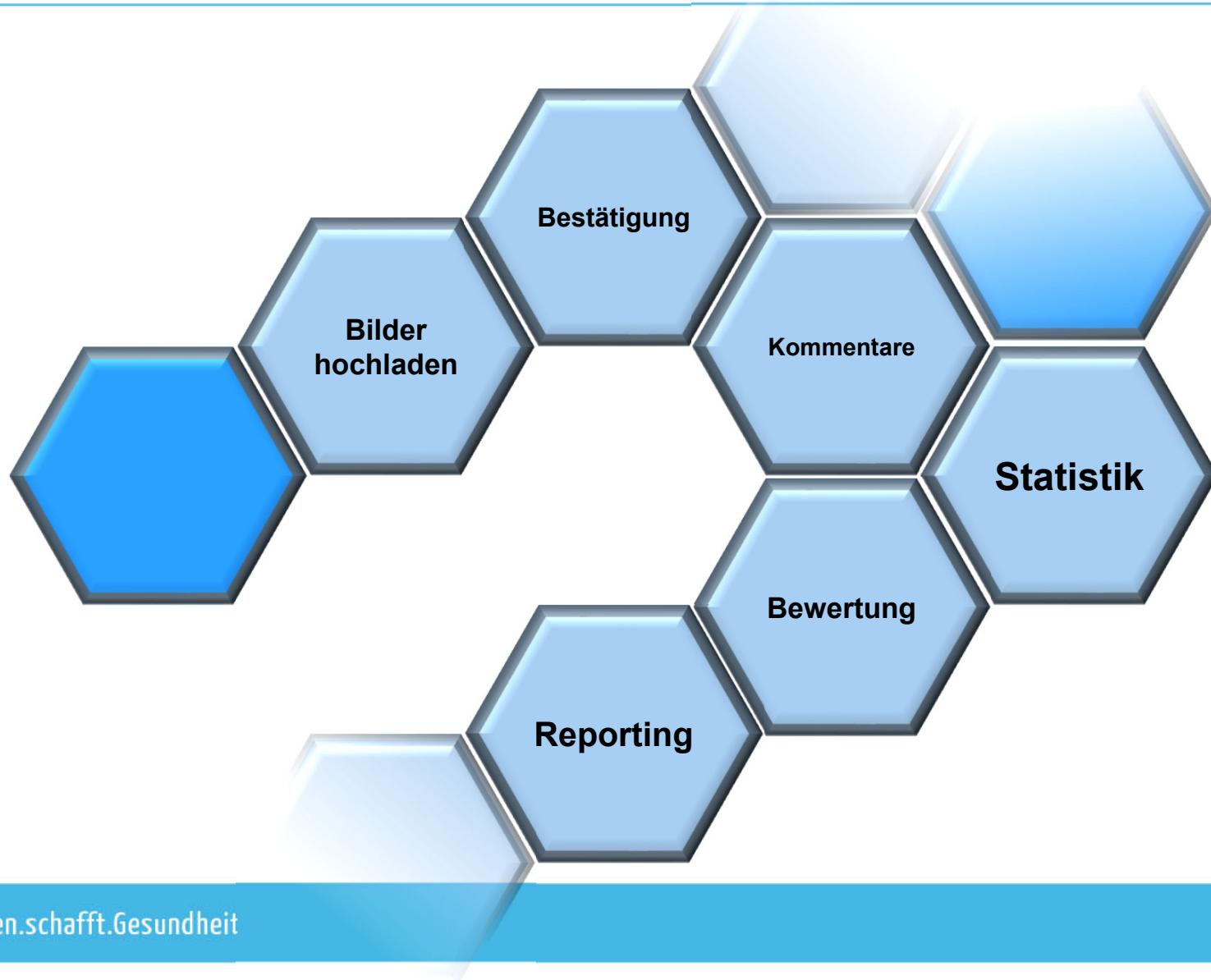
Abmelden

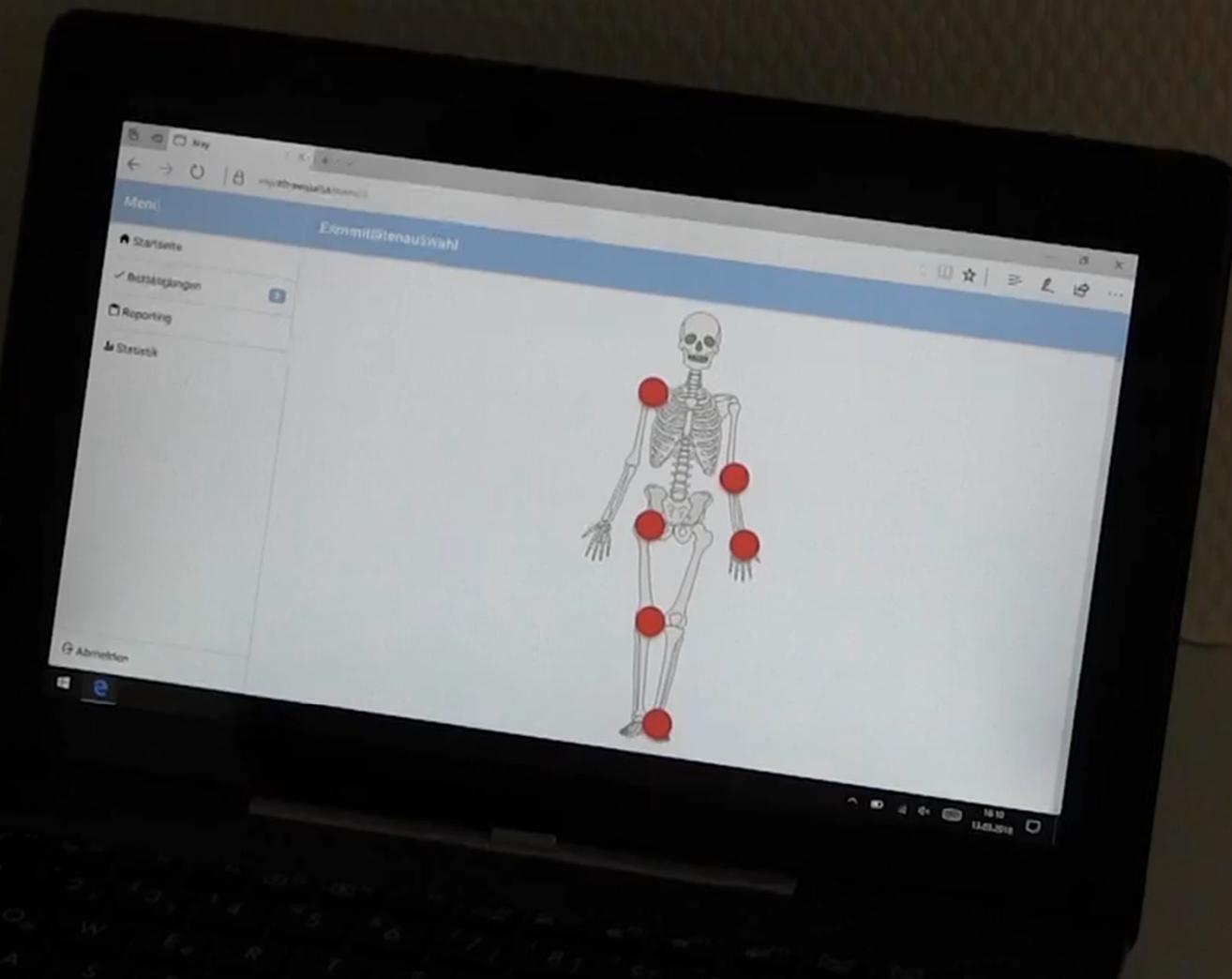
The diagram shows a full human skeleton from the front. Six specific joints are marked with red circles: the left shoulder, the right shoulder, the left elbow, the right elbow, the left knee, and the right knee. These points likely represent the areas of interest for an orthopedic assessment or treatment plan.



☰ Extremitätenauswahl







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