BIOMECHTOOLS: CONSTRUCTING PATIENT SPECIFIC MUSCULOSKELETAL ANALYSIS OF THE LOWER EXTREMITY.

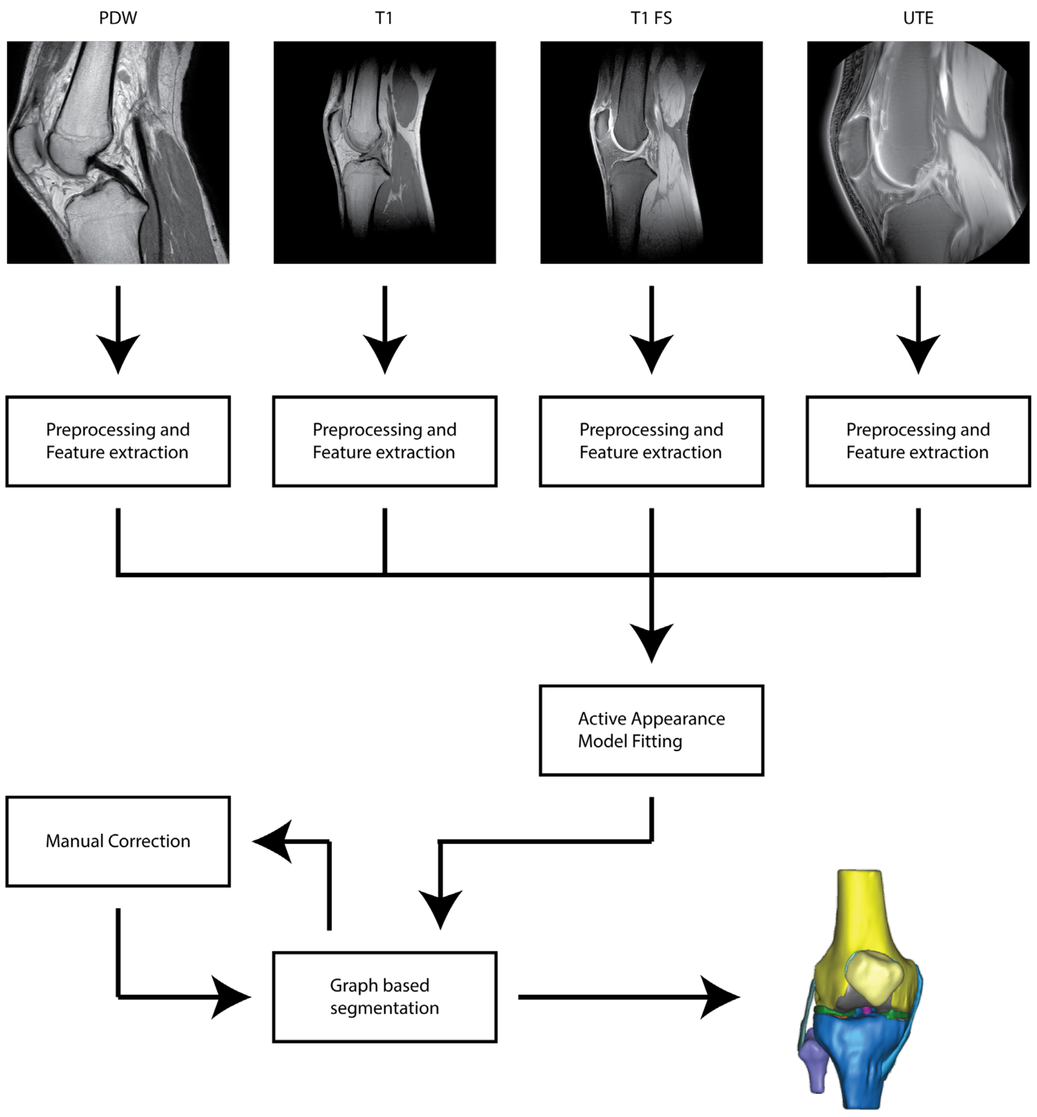
Wielingen G.V.F., Sprengers A.M., Janssen D.W., Verdonschot N.J.J.

Abstract

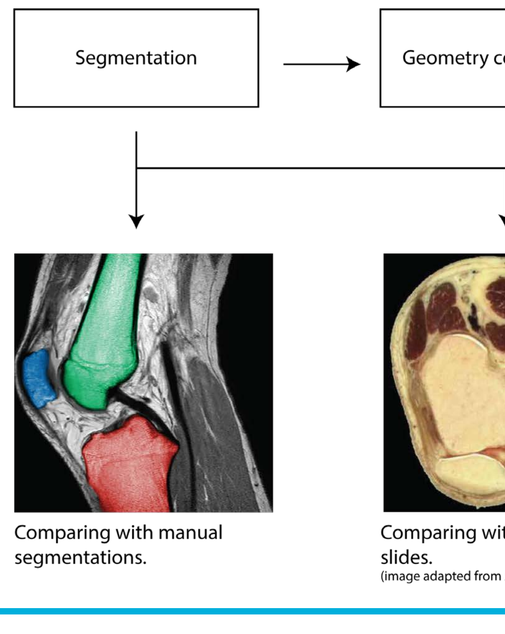
Current tools for assessing a patient's biomechanical condition are often crude and subjective, leading to suboptimal care. Enhancing biomechanical models with MRI data can yield more accurate and objective patient specific tools. For practical purposes, these tools require fast, robust and highly accurate segmentation of structures and consequent conversion to geometric objects, with minimal user input. To this end segmentation schemes for the lower extremities will be developed and validated.

Method

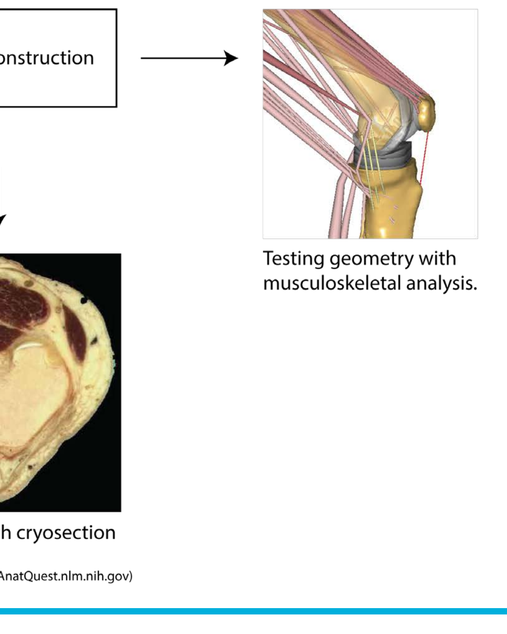
Biomechanical properties are obtained from Magnetic Resonance Images. The knee will be imaged in 3D with several contrasts (T1 and Proton Density Weighted, Fat suppressed and Ultra Short Echo Time), in quasistatic and dynamic fashion. Results of the knee segmentation Grand Challenge Workshop (www.ski10.org) suggest that active appearance models can provide a good starting point for the segmentation process. Robustness against pathology might be increased with graph based segmentations with user interaction.



Segmentation Goals



(image from wikipedia.org)



The methods that will be developed should be able to accurately segment bones, cartilages, menisci, ligaments and muscles in both static and dynamic images. Segmentation and the consequent geometry generation must be fast, since an analysis of the patient's biomechanical condition cannot begin before the geometric model is completed.

Validation Schemes

Comparing with manual segmentations.

Comparing with cryosection slides.
(image adapted from AnatQuest.nlm.nih.gov)

Testing geometry with musculoskeletal analysis.

Conclusion

Combining data from imaging modalities with biomechanical modeling can yield accurate, patient specific models. Clinical use requires fast model construction, thus fast and highly accurate segmentation. The purpose of this study is to achieve this goal by developing a pipeline of segmentation algorithms with thorough validation schemes.

Geoffrey Wielingen
Orthopaedic Research Laboratory Nijmegen
Geoffrey.Wielingen@radboudumc.nl

Institute for Health Sciences
Radboudumc