IMPROVED TRACKING OF MUSCLE TENDON JUNCTIONS IN ULTRASOUND IMAGES USING SPECKLE REDUCTION

Bernhard ENGLMAIR[1]

Christoph LEITNER[1,2] and Christian BAUMGARTNER[1]

[1] Institute of Health Care Engineering with European Testing Center of Medical Devices, Graz University of Technology, Graz, Austria

[2] Institute of Sport Science, University of Graz, Graz, Austria

www.dHealth.at

Introduction and Motivation

Goal: Biomechanical model for physiological movements

Problem: How can we quantify movements?

in vivo

[https://www.1zoom.me, 2019]

in silico

[Chang et al., 2017]

common indirect approaches....

- Force measurements
- Motion capturing
- EMG
- ...

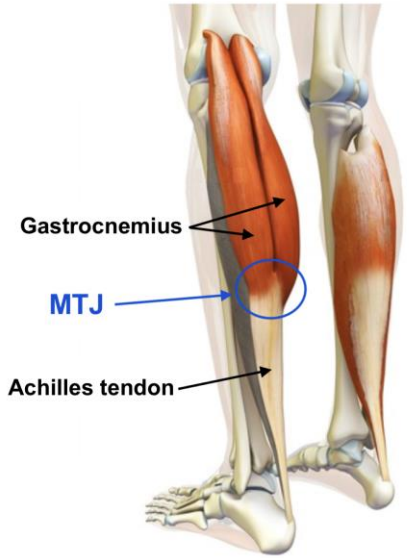
…new direct approach:

- Evaluation of **musculoskeletal US recordings**

➢ Requires methods for **despeckling US images**

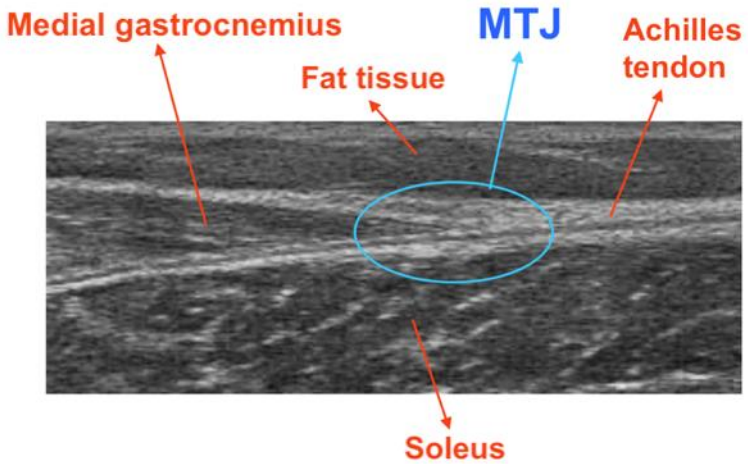
Introduction and Motivation

Feature tracking: **Muscle Tendon Junction**



[https://runnersconnect.net, 2019]

- **US recording** in sagittal plane:



Objective

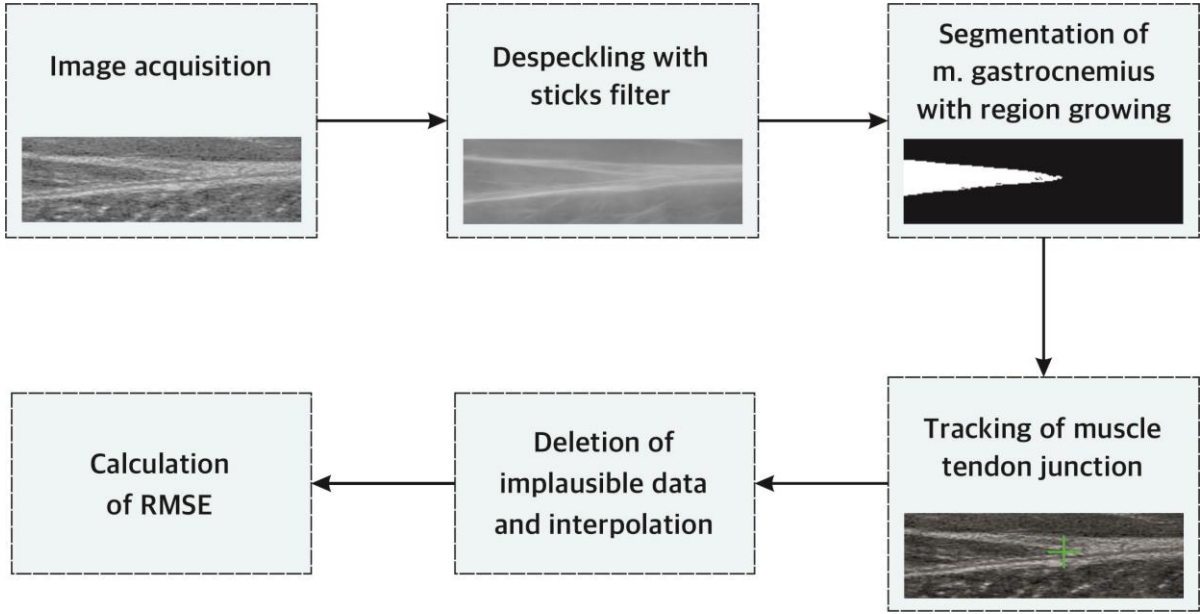
- **Case study:** Process one **US recording** consisting of 70 frames

    1. **Track** position of **MTJ**
    2. Calculate **RMSE** between computed and true position
    3. **Despeckle** US recording and repeat experiment

➢ How does the speckle filter affect the **tracking accuracy**?

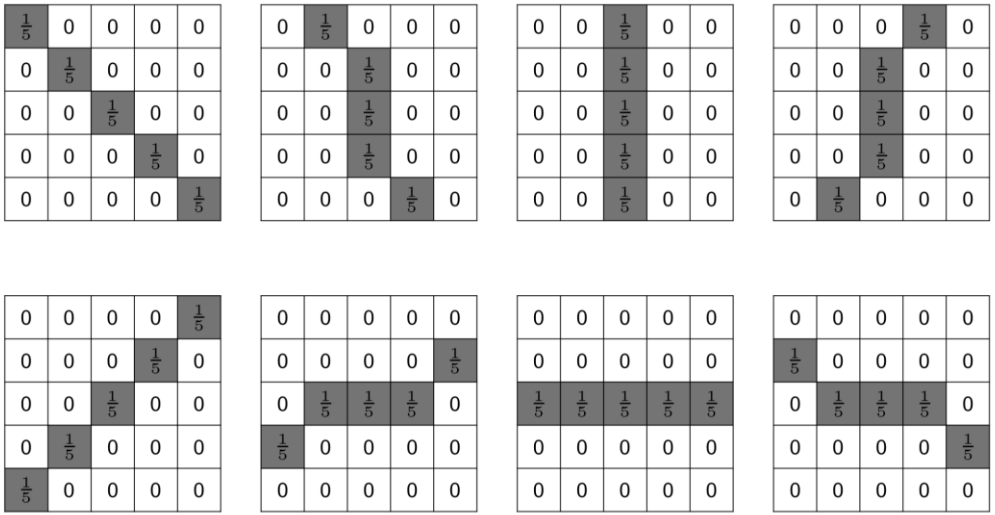
Methods

Image processing



Methods

Speckle reduction with **Sticks Filter**

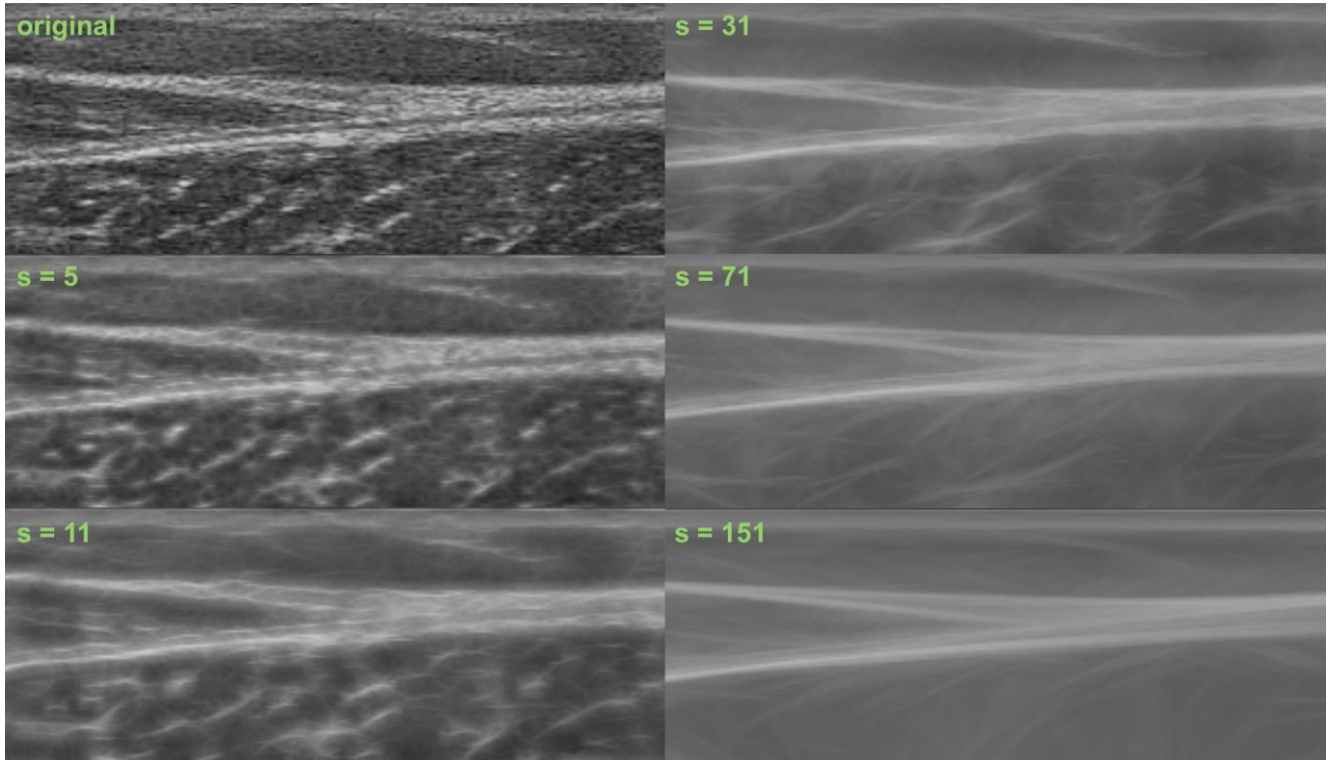


[Rusnell et al., 2008]

- Adaptive weighted directional mean filter
- Weights are shaped like “sticks”
- Stick with highest sum is chosen
- Mainly **oriented along bright objects**
- **Preserves edges**

Results

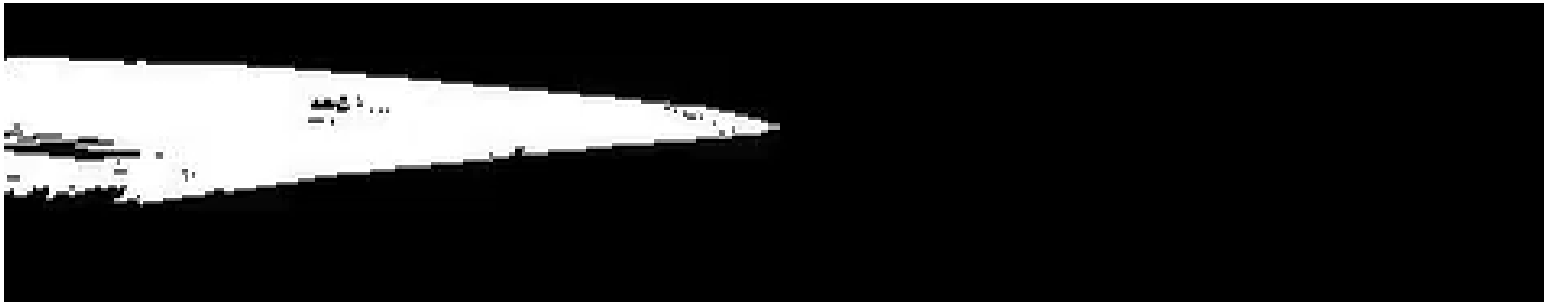
Speckle reduction



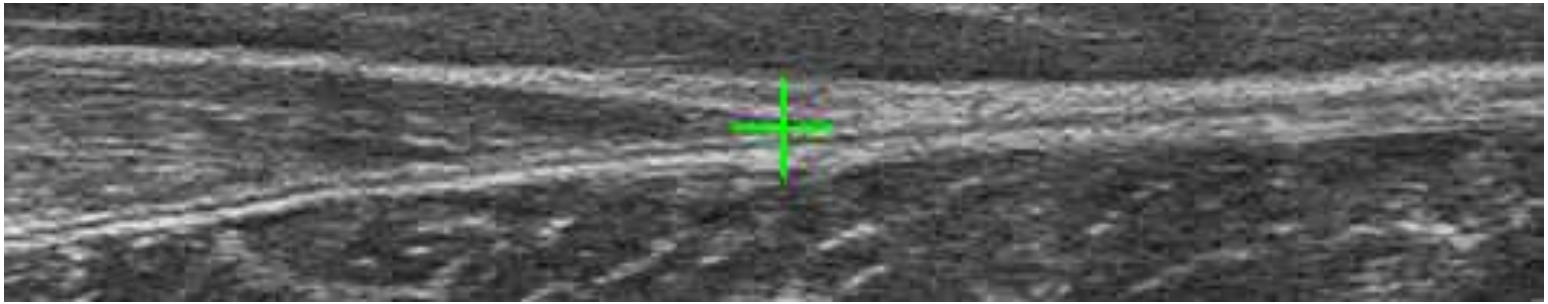
Results

Segmentation and tracking

- Medial gastrocnemius muscle via region growing:

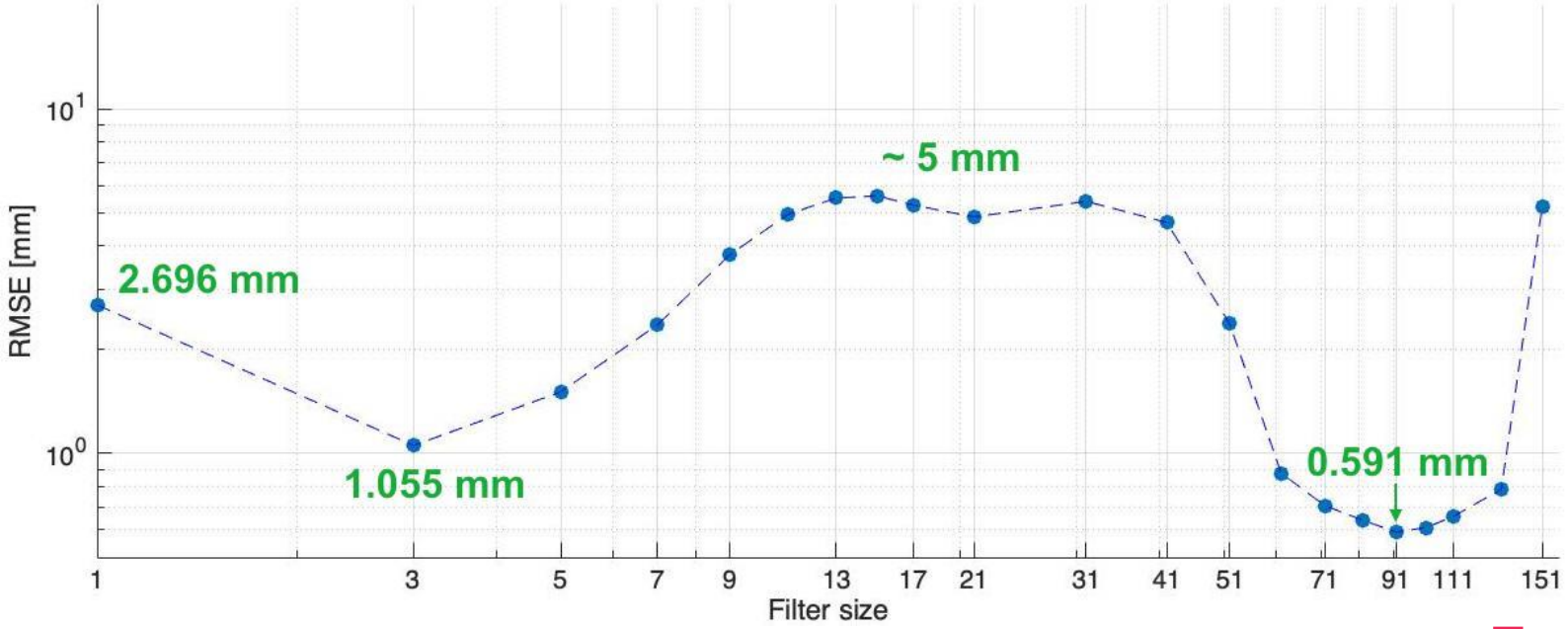


- MTJ tracking:



Results

Tracking accuracy



Conclusion

- Key results of measurements:
  - RMSE decrease of **60.9 %** with filter size of **3 pixel**
  - RMSE decrease of **78.1 %** with filter size of **91 pixel**
- Proposed sticks filter is capable of filtering speckle noise effectively while preserving edges
- “Sweet spot” where sticks are aligned along tendons and yield maximal edge preservation

Thank you for your attention!