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

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Introduction and Motivation

**Goal:** Biomechanical model for physiological movements

**Problem:** How can we quantify movements?

*in vivo*  

*in silico*

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**common indirect approaches:**
- Force measurements
- Motion capturing
- EMG
- ...

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**new direct approach:**
- Evaluation of musculoskeletal US recordings

➢ Requires methods for despeckling US images

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[https://www.1zoom.me, 2019]  
[Chang et al., 2017]
Introduction and Motivation

Feature tracking: **Muscle Tendon Junction**

- **US recording** in sagittal plane:

  [https://runnersconnect.net, 2019]
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

1. Image acquisition
2. Despeckling with sticks filter
3. Segmentation of m. gastrocnemius with region growing
4. Calculation of RMSE
5. Deletion of implausible data and interpolation
6. Tracking of muscle tendon junction
Methods

Speckle reduction with Sticks Filter

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

[Rusnell et al., 2008]
Results

Speckle reduction

- Original
- $s = 5$
- $s = 11$
- $s = 31$
- $s = 71$
- $s = 151$
Results
Segmentation and tracking

• Medial gastrocnemius muscle via region growing:

• MTJ tracking:
Results

Tracking accuracy

- RMSE [mm]:
  - 2.696 mm
  - 1.055 mm
  - ~ 5 mm
  - 0.591 mm

Filter size: 1 to 151
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!