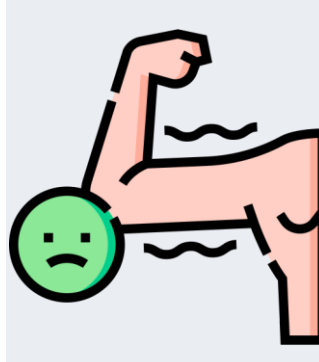


Towards Fully Wearable Muscle Fatigue Assessment with A-mode Ultrasound

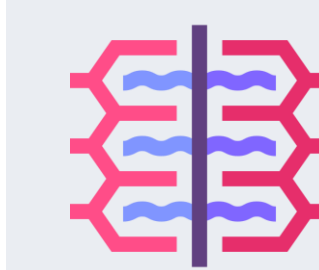
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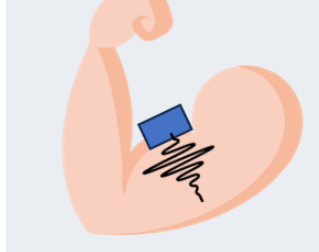
INTRODUCTION



Muscle fatigue: transient reduction or complete loss of voluntary force-generating capacity, leading to decreased performance during physical tasks or exercise [1].

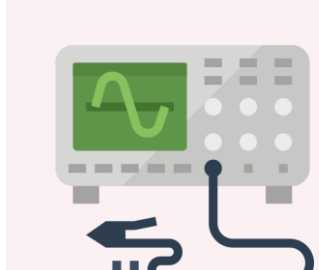


Muscle thickness as a fatigue indicator: increases during fatiguing conditions (e.g. weight-holding [2])




A-mode US: enabler for wearable muscle thickness tracking with **low compute** and **power** requirements [3, 4].

Prior works:



Laboratory equipment or portable systems

→ **Lack wearability**



Offline computation

→ **Limits for real-time operation**

Objectives



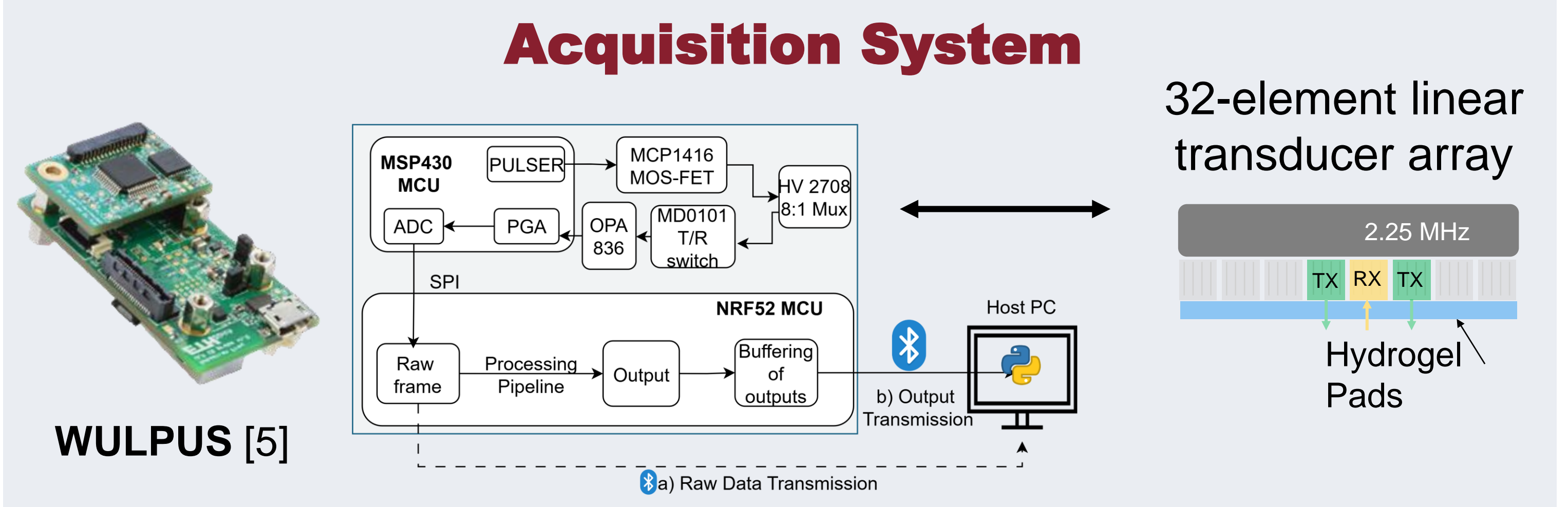
Wearable muscle thickness tracking for fatigue monitoring with A-mode US



On-device tracking
→ **low-latency**
→ **long-term monitoring**

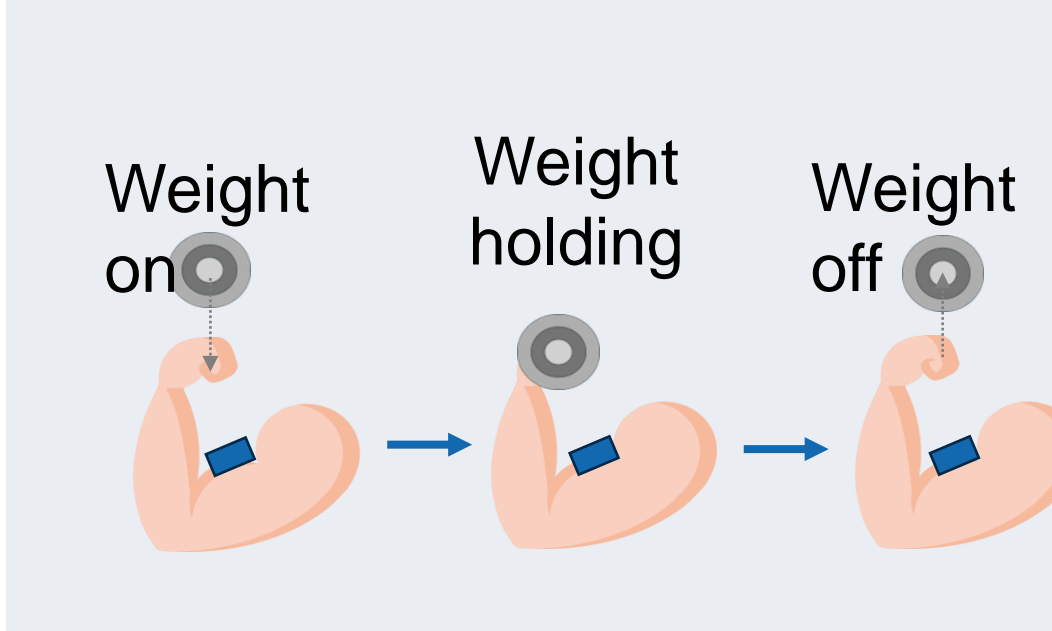
METHODS

Acquisition System



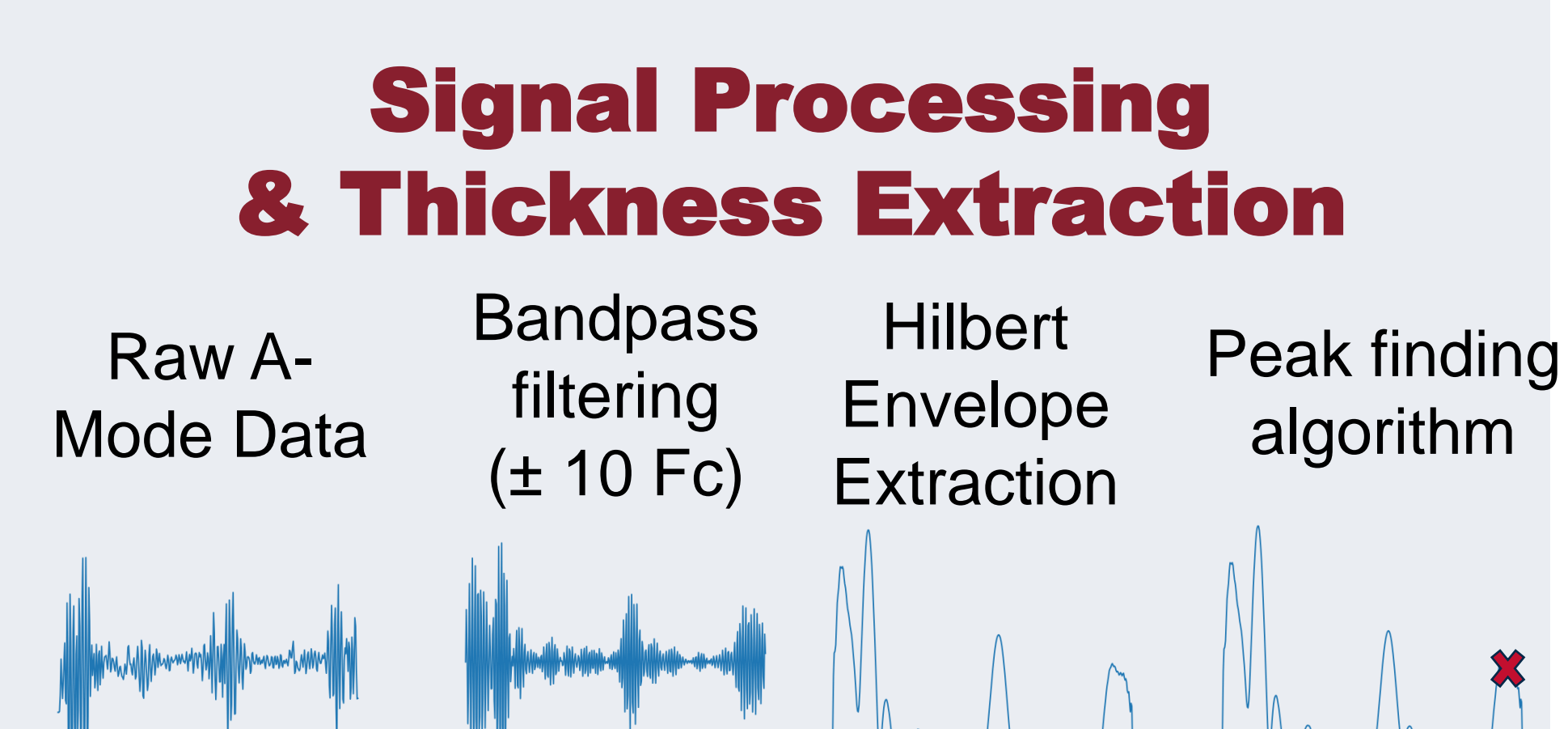
WULPUS [5]

Data collection



- Isometric weight holding until failure
- 3 acquisition sessions

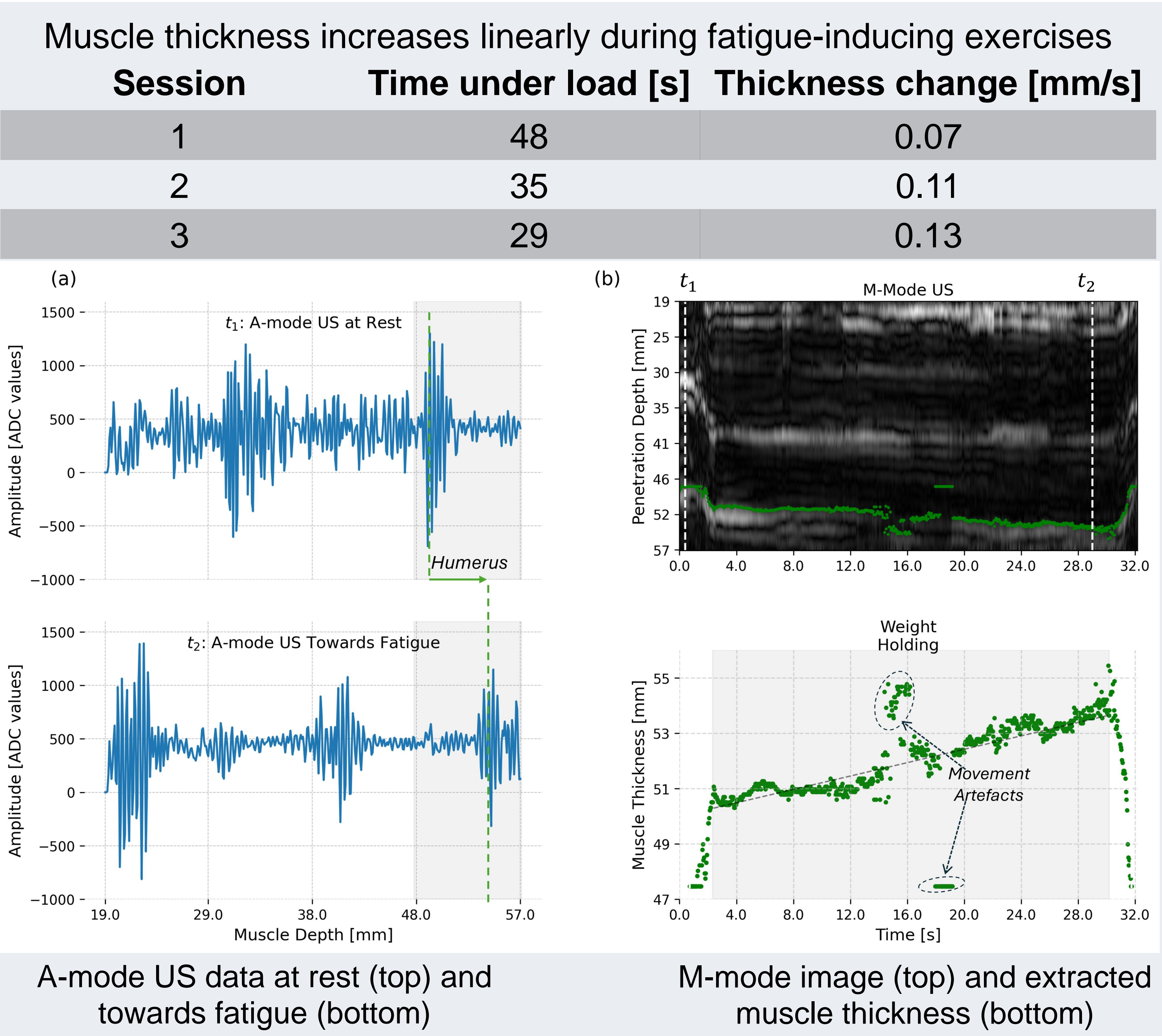
Signal Processing & Thickness Extraction



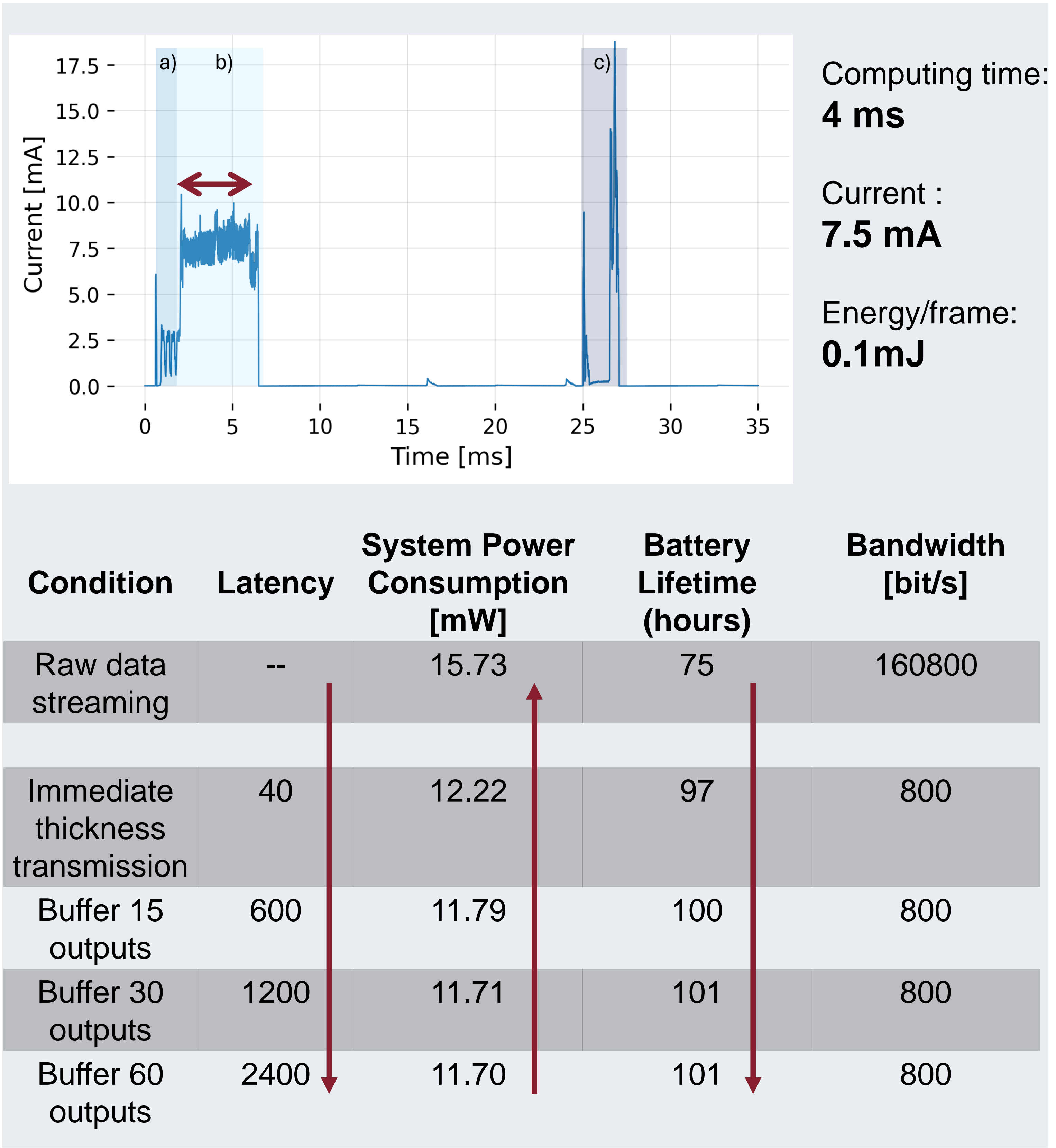
- Peak → Humerus bone → Bicep thickness
- Deployment** on WULUS NRF52 MCU
- BLE** muscle peak position transmission

RESULTS

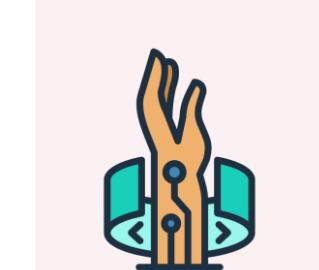
a) Muscle Thickness Tracking for Fatigue Monitoring




b) Embedded Implementation



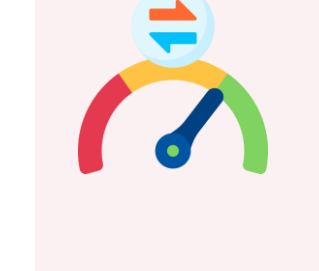
CONCLUSION




First-time demonstration of **wearable muscle thickness tracking** for fatigue monitoring using **WULPUS**



<4.1 ms for end-to-end muscle thickness extraction
→ enables real-time use



201x lower bandwidth



26% power consumption **improvement** with edge-computing → **4 days battery lifetime**

REFERENCES

[1] B. Bigland-Ritchie et al., *ClinSci Mol Med*, 1978
[2] J. Shi et al., *MedicalEngineering & Physics*, 2007
[3] X. Sun et al., *IEEE NER*, 2017
[4] M. Qu et al., *Sensors and Actuators A: Physical*, 2024
[5] S. Frey et al., *IEEE IUS*, 2022