Open Research Day

9 April 2025

13:50-14:20

Parallel Sessions- *lightning talks followed by breakout session*

A108: Digitalized Built Environment II

Chair: Associate Professor Gyözö Gidofalvi, KTH

A123: Digitalized Health Care II

Chair: Professor Elena Gutierrez Farewik, KTH

A123: Digitalized Health Care II

- Lightning talk: Session chair: Professor Elena Gutierrez Farewik, KTH

1. BioAct: self-powered biodegradable pressure sensor for wireless post-surgical/cardiovascular patient management
2. OrganoFeed: Feedback-enhanced organoid maturation towards higher reproducibility for in-vitro drug
3. PelvicMIM -A Multimodal Imaging Matrix for enhanced diagnosis and understanding of childbirth-related Pelvic floor muscle injuries
4. Digital Twins of Human Neuromusculoskeletal System: Challenges and Future Perspectives in Personalized Neuro-rehabilitation (RP)

– BioAct –
Self-powered biodegradable pressure sensor for wireless post-surgical patient management

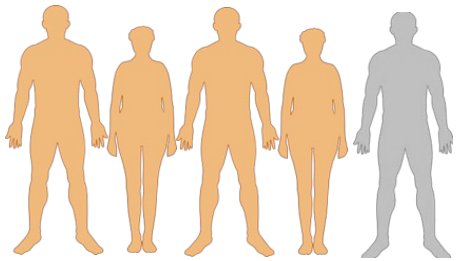
Seraina Dual & Erica Zeglio

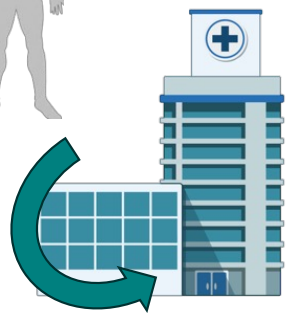
KTH Royal Institute of Technology

Motivated by clinical need

High numbers of readmissions after heart surgeries

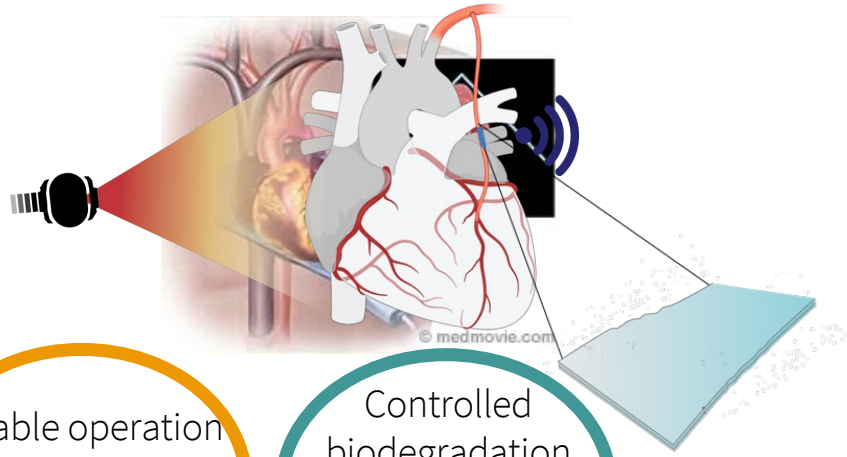
82'000 people/year operated in Sweden





10-20% readmissions

Continuous post-surgical monitoring for timely intervention



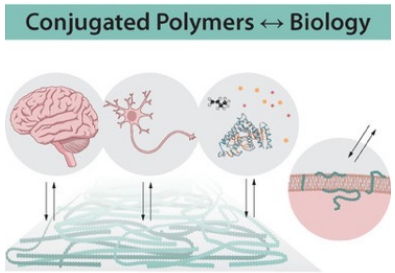
Stable operation
High performance
Wireless

Controlled biodegradation
Non-toxic products

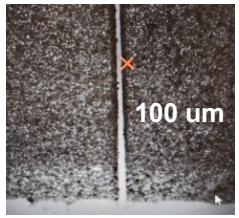
Self-powered biodegradable pressure sensor

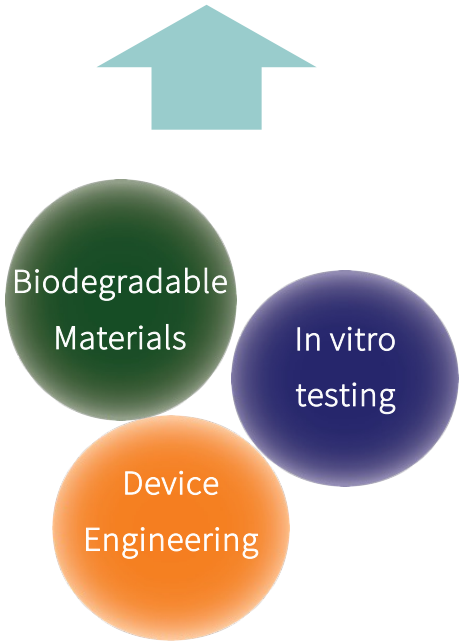
Organic Bioelectronics

Bioelectronic materials



Microfabrication

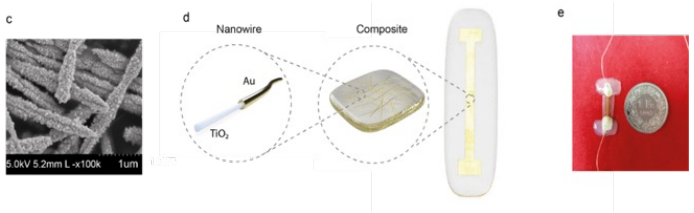




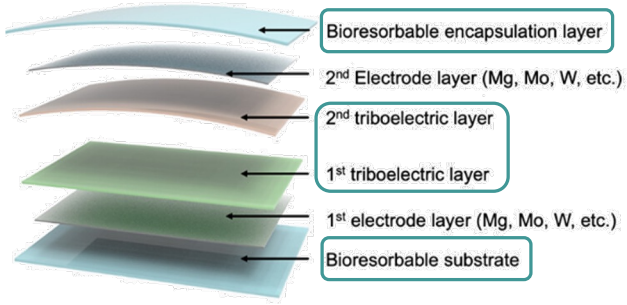
Biomedical Engineering

In-vitro testing of cardiovascular devices

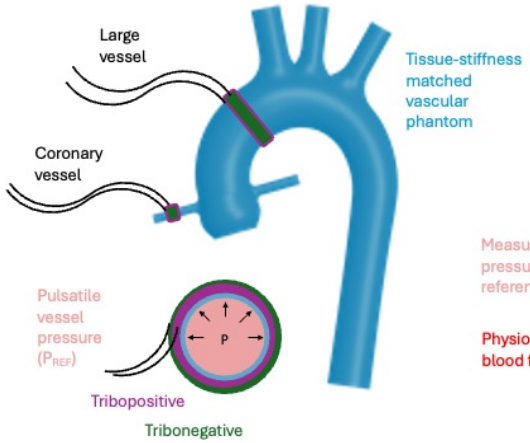
Implantable sensors systems

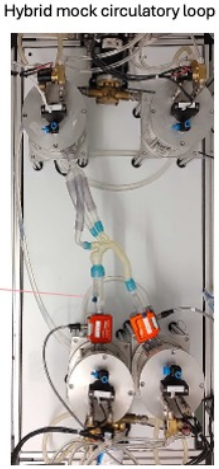


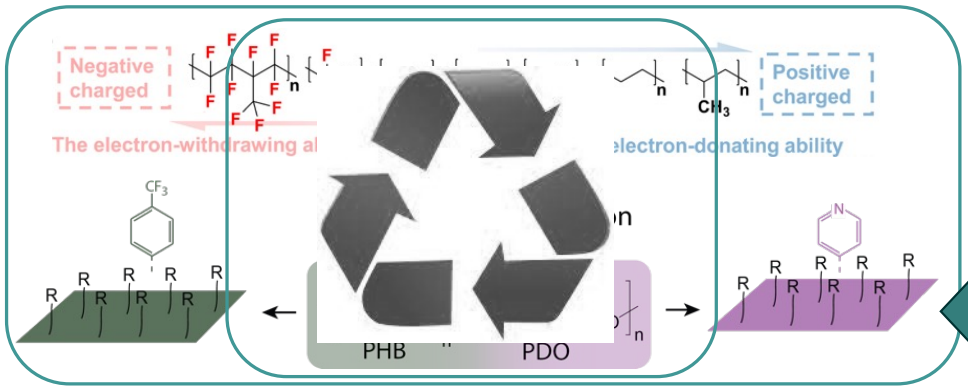
Cooperative device development



Device

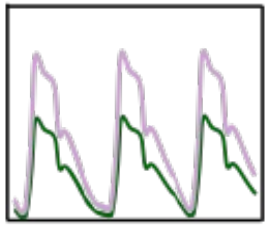






Physio-logical viability

TENG-recorded blood signal



Thank you

OrganoFeed:

Feedback-enhanced organoid maturation towards higher reproducibility for in-vitro drug

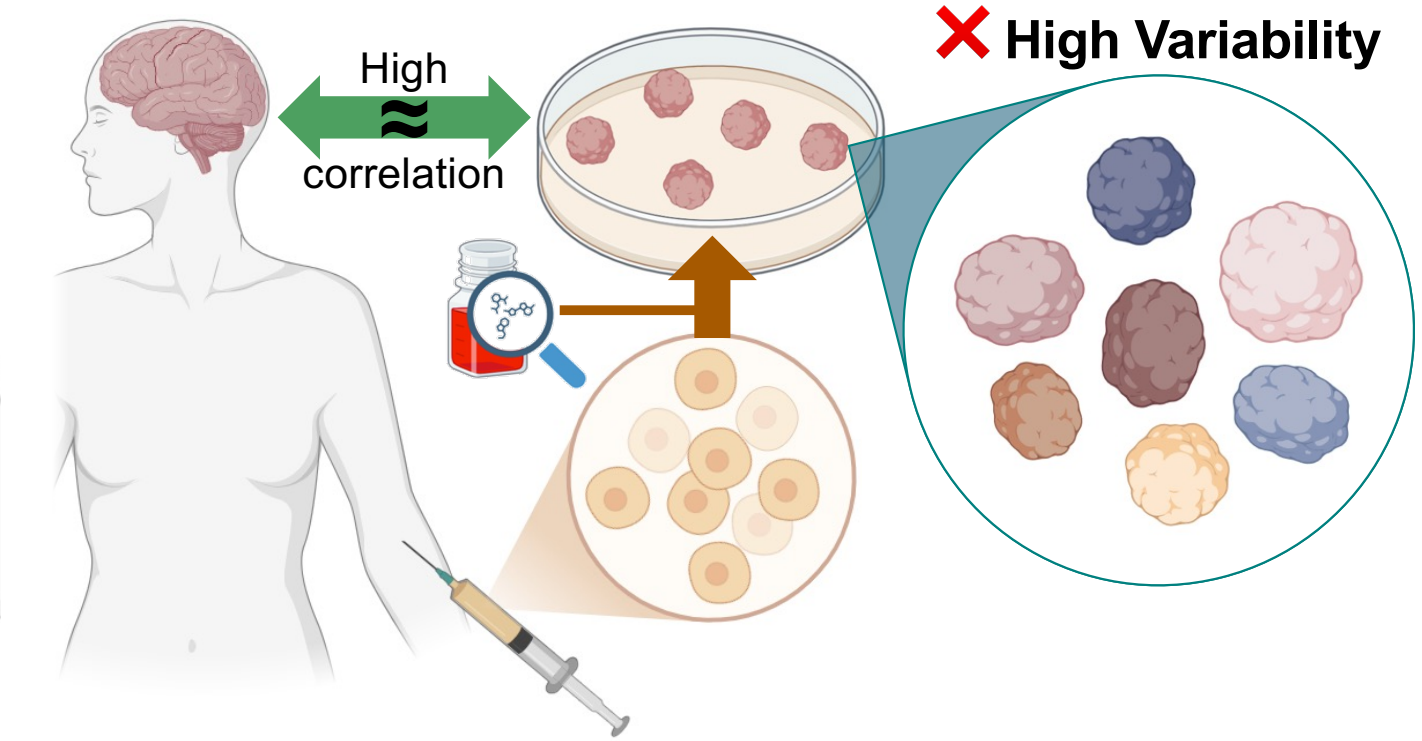
Assoc.Prof. Ioanna Miliou

Data Science Group
Stockholm University

Assoc. Prof. Thomas E. Winkler

Micro- and Nanosystems
KTH Royal Institute of Technology

OrganoFeed: Motivation

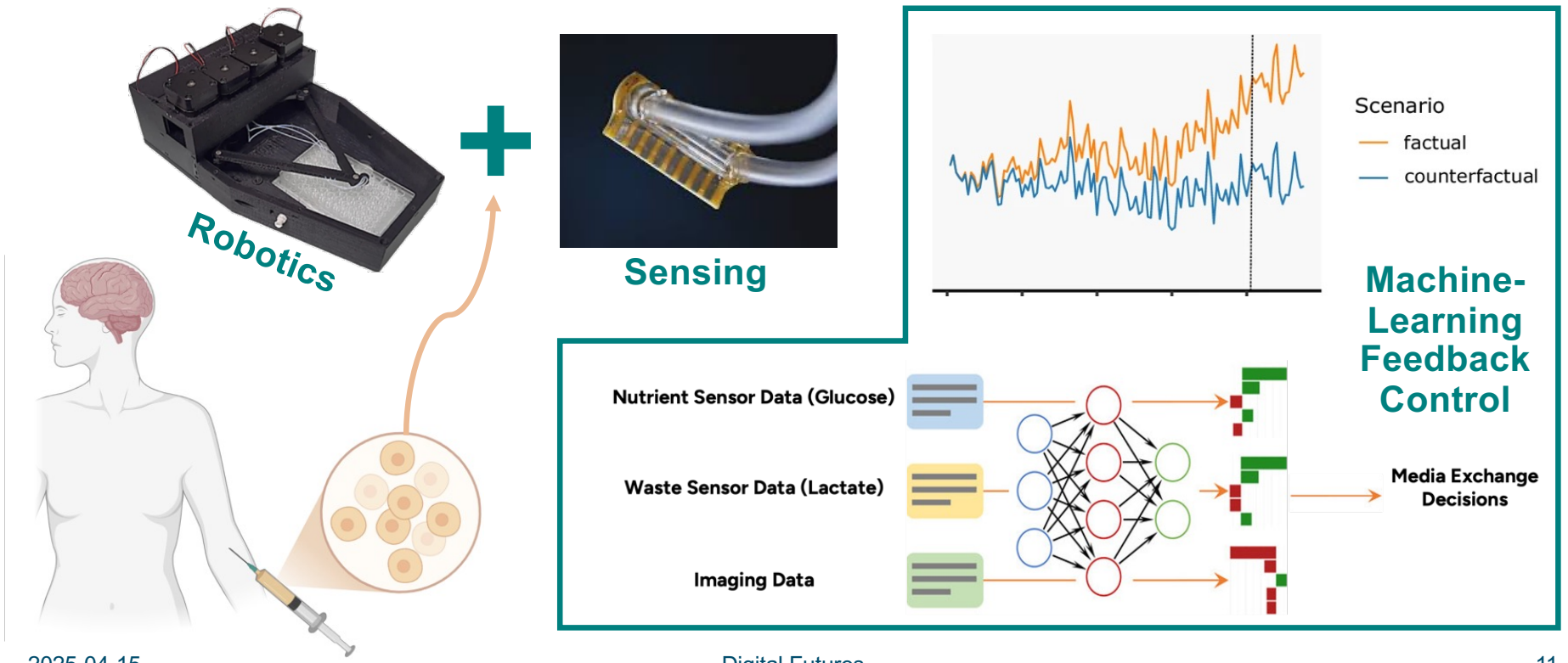


Mitigation?

To date: Homogenized chemical environment

Our hypothesis: "Digitized" environment

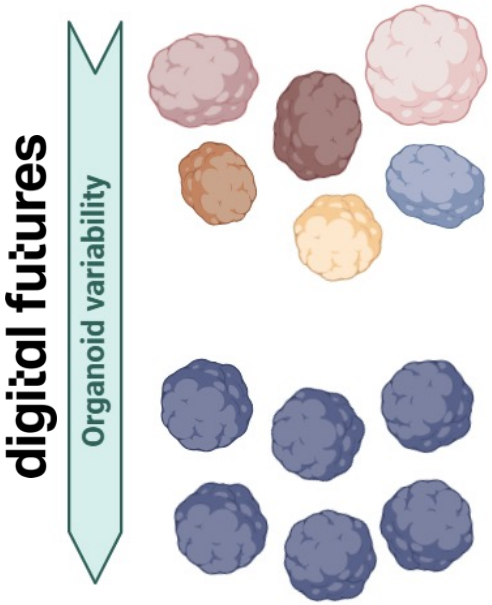
OrganoFeed: Approach



OrganoFeed

Ioanna Miliou

Thomas Winkler



Thank you for your Attention!

Questions? Come see us after!

Rich & Healthy Life

Thank you

PelvicMIM

– A Multimodal Imaging Matrix for enhanced diagnosis and understanding of childbirth-related Pelvic floor muscle injuries

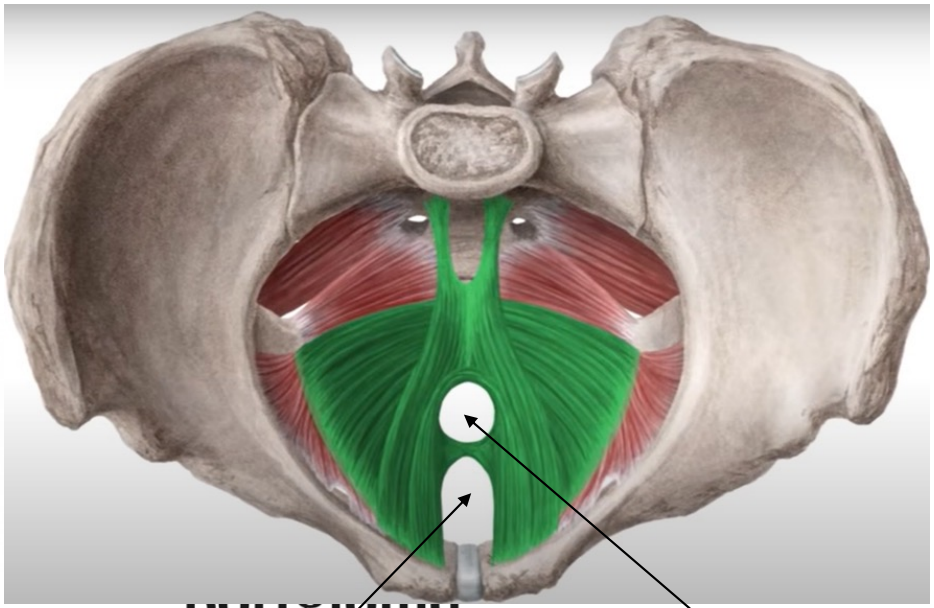
Matilda Larsson
KTH – Biomedical Engineering and Health System

Ruoli Wang
KTH - Engineering Mechanics

Pelvic floor muscle injury due to childbirth

- **10%** of women **injured during childbirth**
- **Pelvic floor dysfunction** affects **50%** of middle-aged women
- Levator ani muscle injuries – not surgically oparable
- **Diagnostic codes introduced in 2020**
- Conventional ultrasound - no assessment of **mechanical** or **structural** properties

Mostphotos

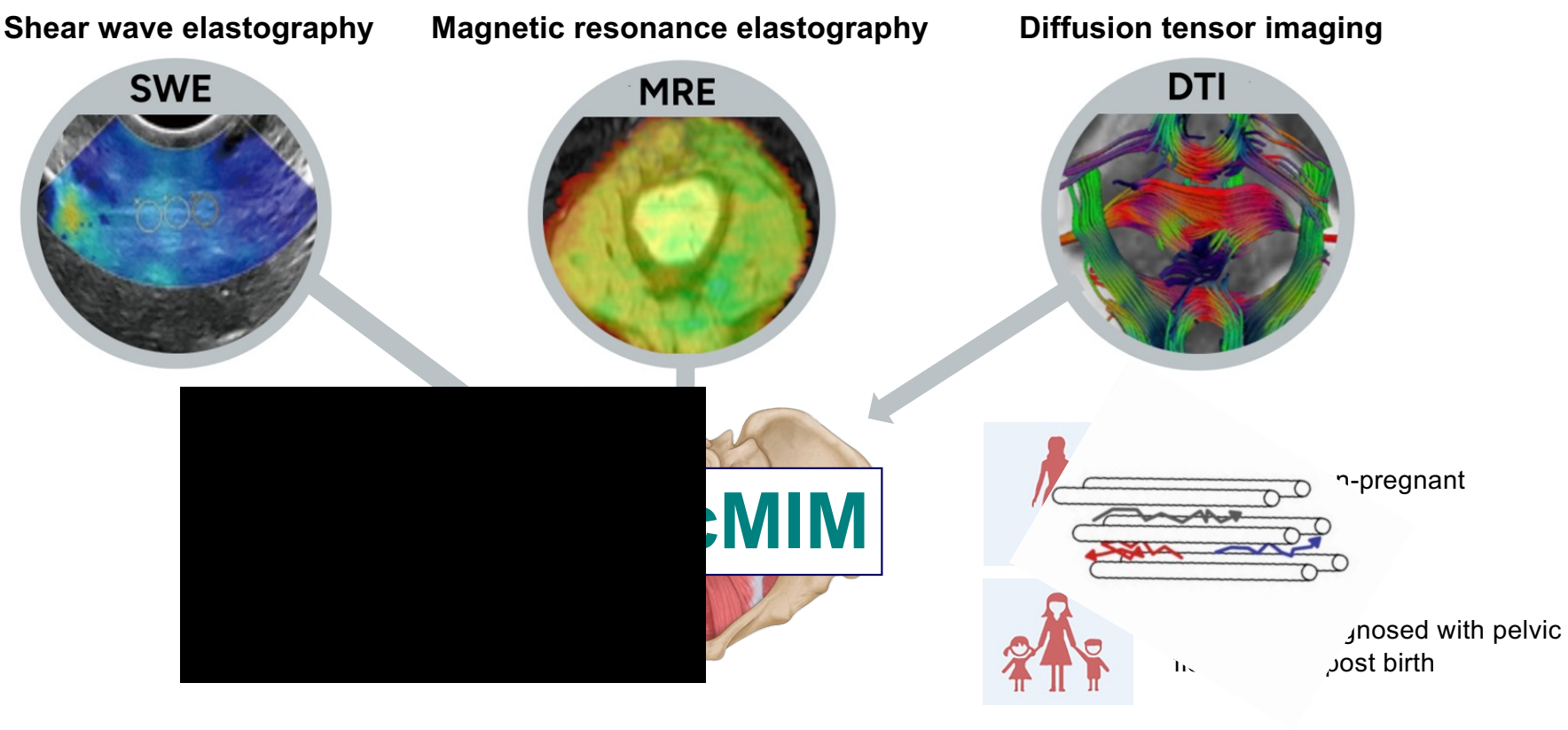


förlossningsskada kan bli diagnos

Bland Socialstyrelsens koder för skador, sjukdomar och hälsoproblem finns allt från alligatorbett till ovanliga hudbesvär. Men förlossningsskador på bäckenbotten är dåligt specificerat. Levatorskada finns inte ens som diagnos. Nu kan det bli ändring på detta.

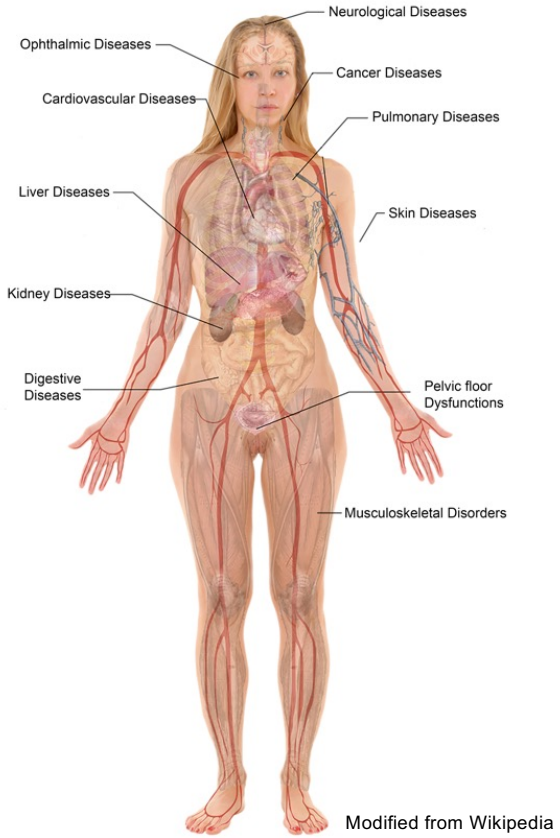
Jenny Kallin 9 APRIL 2019

Multimodal Imaging Matrix



Societal impact

- Multimodal imaging matrix to:
  - i) **<u>Improve understanding</u>** of pelvic floor muscle injuries
  - ii) **<u>Guide future development</u>** of clinical and research methods
- **<u>A multimodal imaging framework</u>** for broad application



Modified from Wikipedia

LEARN

- ➢ Improved wave tracking in SWE
- ➢ Improved inversion algorithms in MRE
- ➢ Improved tractogram filtering in DTI
- ➢ Multimodal image registration by cross-modality translation
- ➢ Learn between modalities: MRE→SWE, 3D→2D

Rich and Healthy Life

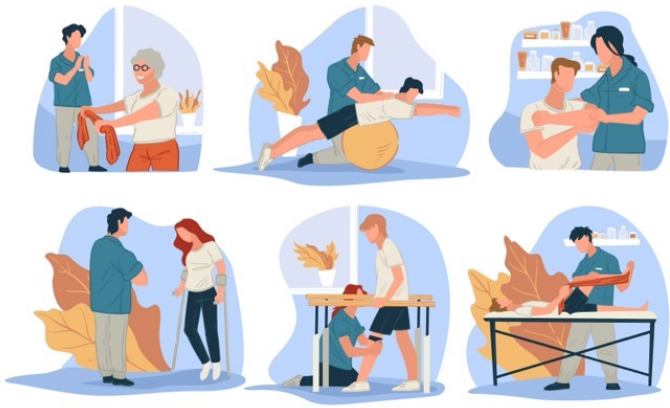
Thank you

Digital Twins of Human Neuromusculoskeletal System: Challenges and Future Perspectives in Personalized Neuro-rehabilitation

Ruoli Wang, Dept. of Engineering Mechanics, SCI, KTH
Yuanyuan Li, Dept. of Fiber and Polymer Technology, CBH, KTH

Motivation

- *Impaired motor function is one of the major disabilities [1].*
- *The management of complex disability largely relies on rehabilitation.*
- *Lack of biofeedback information about the effect of the rehabilitation motion on the individual human biological tissues and structures [2]*



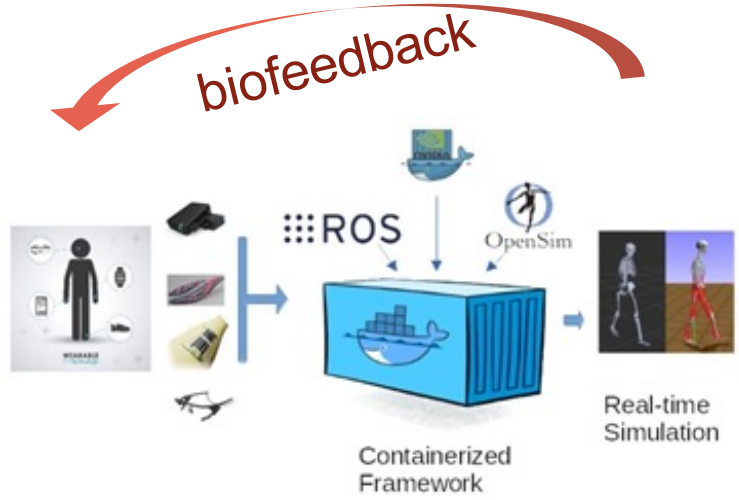
Goal

To create a DT framework of human neuromusculoskeletal system

- *real-time high-fidelity estimation of non-measurable individualized neuro-biomechanics quantities*
- *biofeedback in an actual clinical environment*

[1] Krahn G., WHO World Report on Disability: a review, 2011 [2] Dao, T.T., et al., Real-time rehabilitation system of systems for monitoring the biomechanical feedbacks of the musculoskeletal system 2015

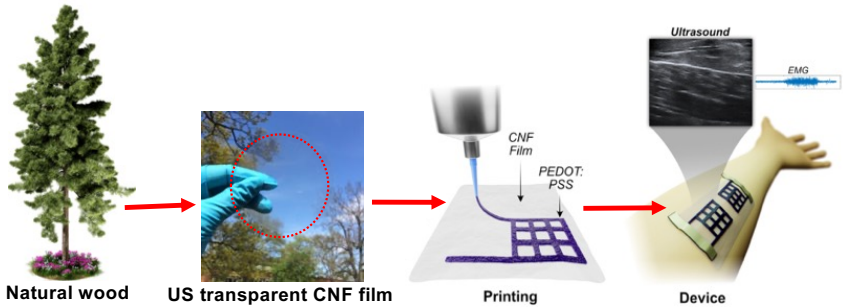
- Real-time
- Multiple sensor/sensor types synchronization
- Modulization and replicability



Real-time Neuro-musculoskeletal Modeling Framework

Ultrasound Transparent Electrodes
- Nanocellulose-based substrate

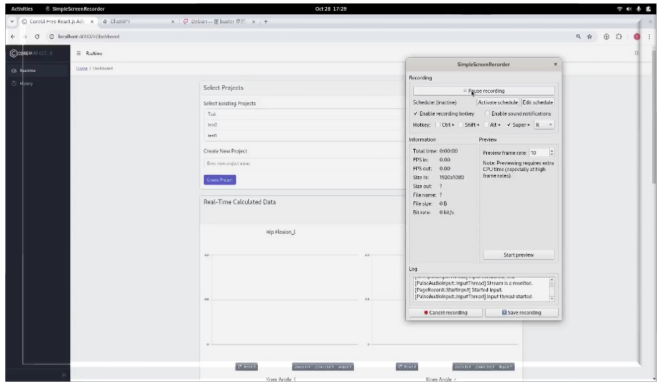
- Biomass based
- Ultrasound transparent
- Simultaneous EMG and US detection



Li L., et al., Synchronized ultrasonography and electromyography signals detection enabled by nanocellulose based ultrasound transparent electrodes, Carbohydrate Polymers, 2025

Klein F, et al., A real-time full-chain wearable sensor-based musculoskeletal simulation: an OpenSim-ROS Integration, Under revision

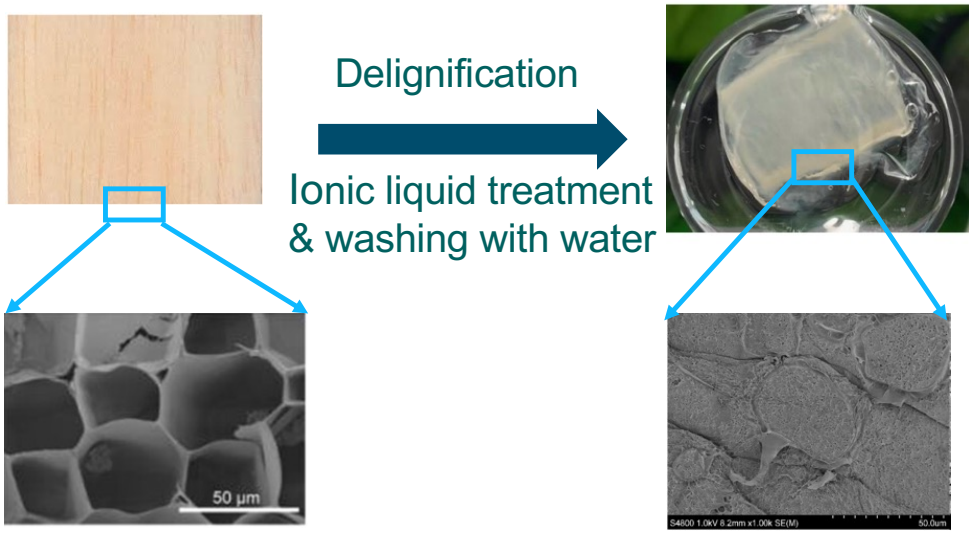
Real-time Neuro-musculoskeletal Modeling Framework



8 inertia measurement units (IMU)

Pressure insole

Wood Hydrogel Substrate-based Electrodes



- Energy efficient processing
- Ultrasound transparent

Team

Current Team

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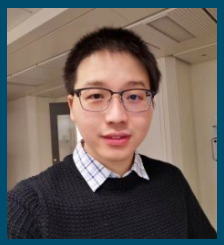
Frederico Klein, PhD



Lengwan Li, PhD

Thank you

digital futures

PARTNERS