Open Research Day

9 April 2025

13:15-13:50

Parallel Sessions- *lightning talks followed by breakout session*

A108: Digitalized Built Environment I

Chair: Professor David Broman, KTH

A123: Digitalized Health Care I

Chair: Professor Hercules Dalianis, Stockholm University

A123: Digitalized Health Care I

- Lightning talk: Session chair: Professor Hercules Dalianis, SU

1. DataLEASH in Action (CI)
2. Advanced Magnetic Resonance Elastography for the Brain (RP)
3. AI-based Positioning and Personalization Platform for Human Body Models – HBMs (previous Virtual Baby Platform) (RP)
4. AI-based Asthma App using Spirometer (SI)
5. AI-based Detection of Colorectal Cancer in Primary Care – AIDCCIP (SI)

DataLEASH in Action (CI)

LEArning and SHaring under privacy constraints

Presenter Hercules Dalianis
Department of Computer and Systems Sciences, DSV, SU

Team affiliated with KTH & SU

PI, Co-PI and Partners

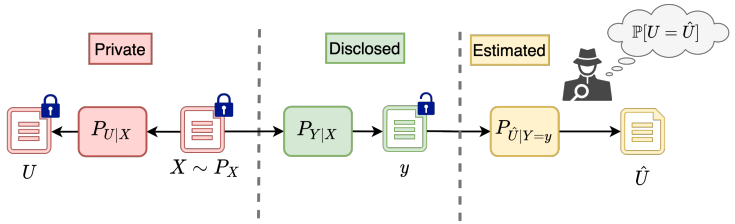
- PI Tobias Oechtering, KTH
- Co-PIs Hercules Dalianis DSV, SU
  Cecilia Magnusson Sjöberg, Juridicum, SU
- Partners: SEB bank, Region Halland, National Library of Sweden (KB) but also IMY, The Swedish Authority for Privacy Protection - Datainspektionen

- Authority for Privacy Prote

This project is the application of the DataLEASH results

- SEB Bank – synthetic data generation for privacy-preserving data sharing of financial data between departments within the bank
  - Design uses PML framework developed in DataLEASH
- Region Halland – De-identification and pseudonymisation of patient records for creating large language models
- IMY - The Swedish Authority for Privacy Protection)

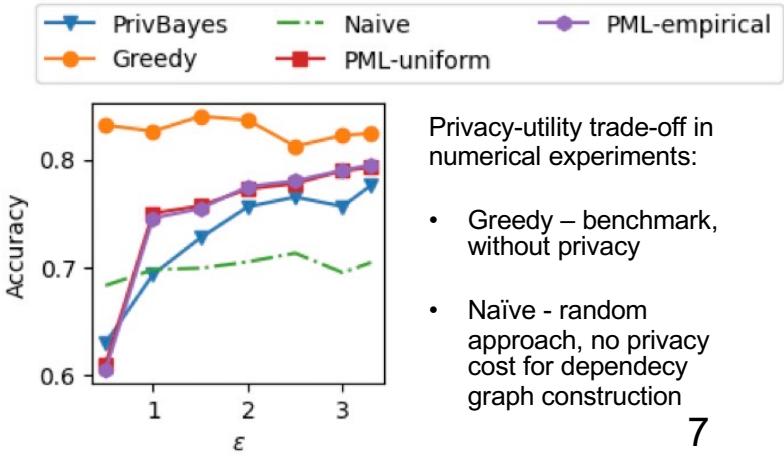
Synthetic Data (SEB)



$$\ell(X \to y) := \sup_{P_{U|X}} \ell_U(X \to y)$$

$$= \log \sup_{P_{U|X}} \frac{\sup_{P_{\hat{U}|Y=y}} \mathbb{P}\left[U = \hat{U} \mid Y = y\right]}{\max_{u \in \mathcal{U}} P_U(u)}.$$

- **Problem:** Reduce disclosure risk when sharing financial data *within* SEB!
  - Note, no legal requirement - risk minimization of unintentional leak!
- Approach follows PrivBayes method
  - PML approach promises higher utility than DP since PML guarantees take prior into account!



Privacy-utility trade-off in numerical experiments:

- Greedy – benchmark, without privacy
- Naïve - random approach, no privacy cost for dependecy graph construction

Saeidian, Yavuzyilmaz, Grosse, Schuppe, Oechtering, "A Tight Context-aware Privacy Bound for Histogram Publication," submitted to IEEE SP Letters, Feb'25.

Region Halland

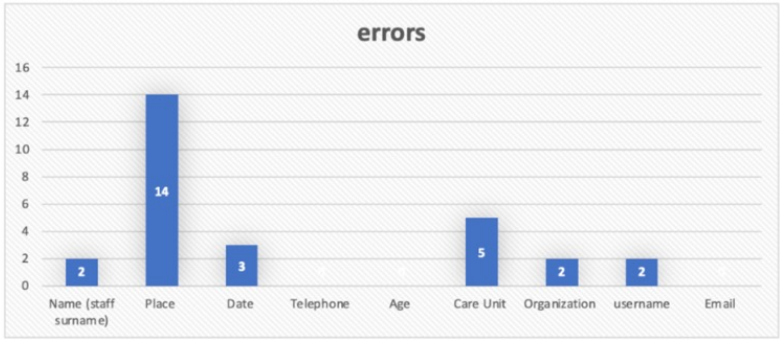
- Region Halland has used our de-identifier and pseudonymiser SweDeClinBERT-NER to de-identify and pseudonymise patient records for use in AI applications.
  - Area: Care wound
  - 14 patient, 397 Swedish notes
  - 10 000 words
  - No names revealed

De-identification preliminary result

case: WoundCare-CAISR Health

#patients: 14 #besök: 68 # notes: 397

Status OK	372	94%
Status Need Correction	25	6%
Notes with two corrections	3	



total words: 10557
fel genom antal ord: 0.0026

IMY - The Swedish Authority for Privacy Protection

- Distinguish clearly between legal and technical privacy
  - Ethical considerations call for specific attention
- Be sure to customise current AI application to surrounding organisational framework
  - Clarify the scope
- International infrastructures are important
  - Note the impact of rule of law in international digital framework

Conclusions

- PML design framework can be applied to concrete applications
- Transfering privacy preserving tools such de-identification between domains seems to work and critical to build Privacy Preserving LLM
- DataLEASH in Action are contributing to the protection and privacy of data following Swedish and European Laws.

Thank you

Advanced Magnetic Resonance Elastography of the Brain

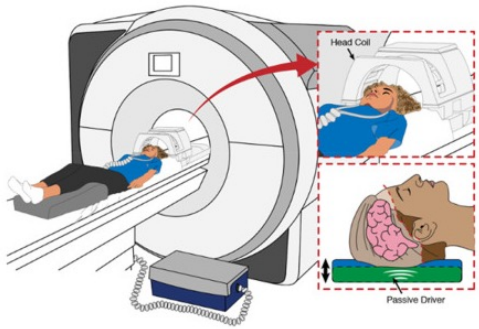
Prof. Rodrigo Moreno - CBH

Prof. Lisa Prahl Wittberg – SCI

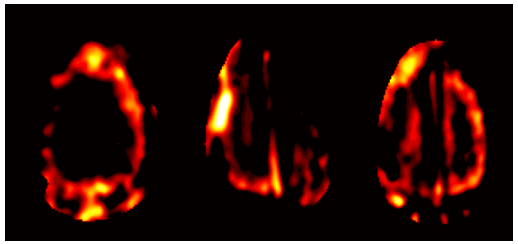
KTH Royal Institute of Technology

Magnetic Resonance Elastography (MRE)

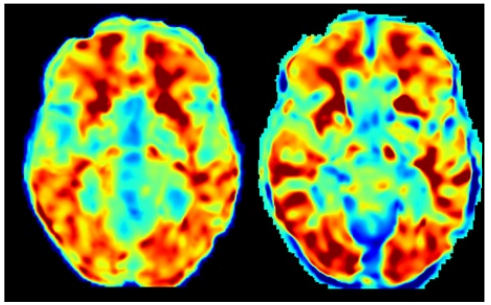
Aim: obtain mechanical properties of the brain



Acquisition



Inversion



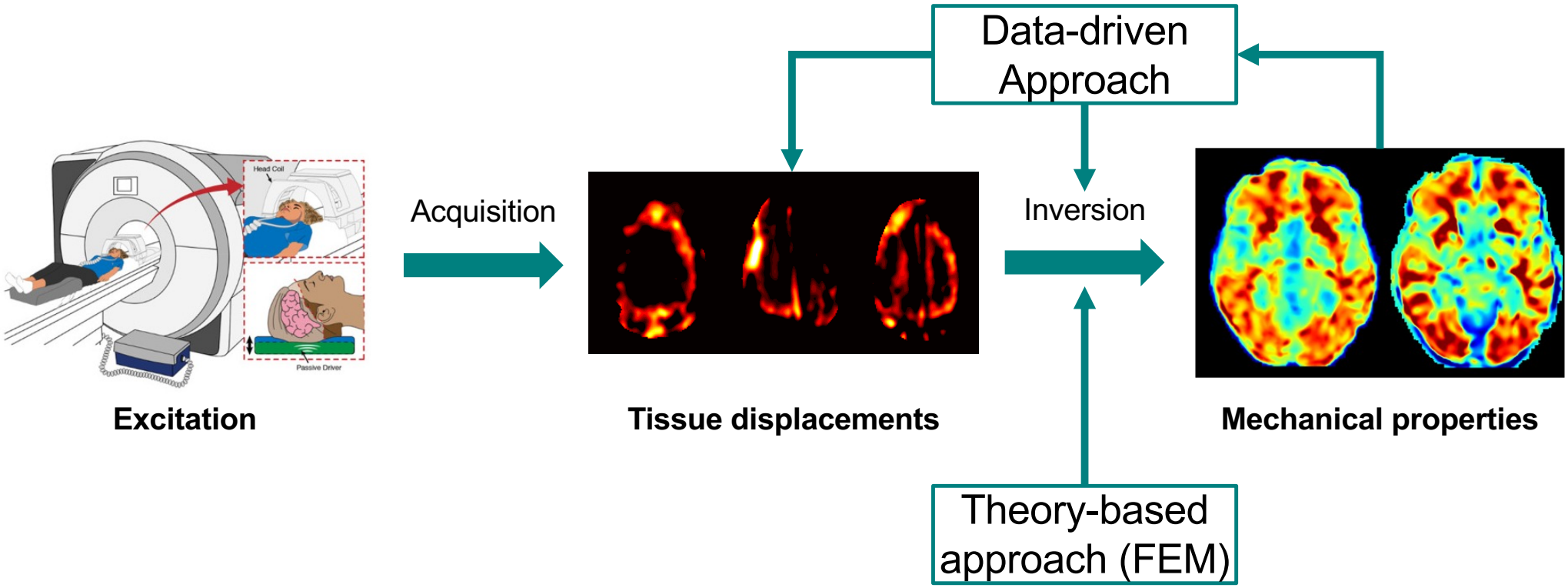
Excitation | **Tissue displacements** | **Mechanical properties**

KTH is the only site in Sweden with this technology

*Hiscox et al., 2021

Magnetic resonance elastography (MRE)

Aim: obtain mechanical properties of the brain

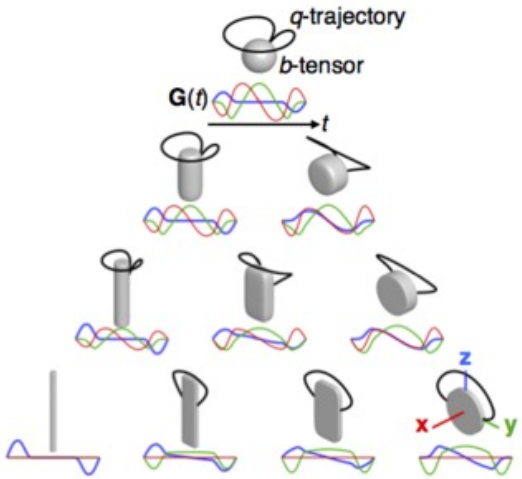


*Hiscox et al., 2021

Multidimensional diffusion MRI (MD-dMRI)

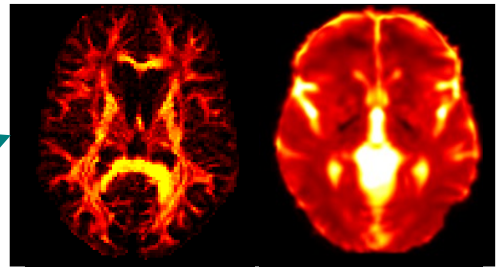
Aim: measure the brain's sub-voxel microstructure

Multidimensional diffusion MRI (MD-dMRI)



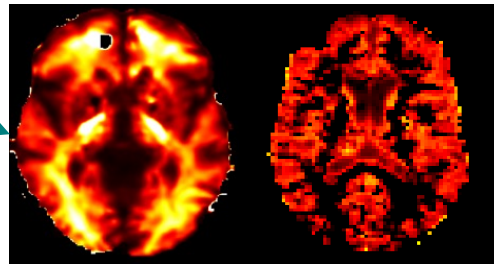
MD-dMRI parameters

Standard



FA, MD

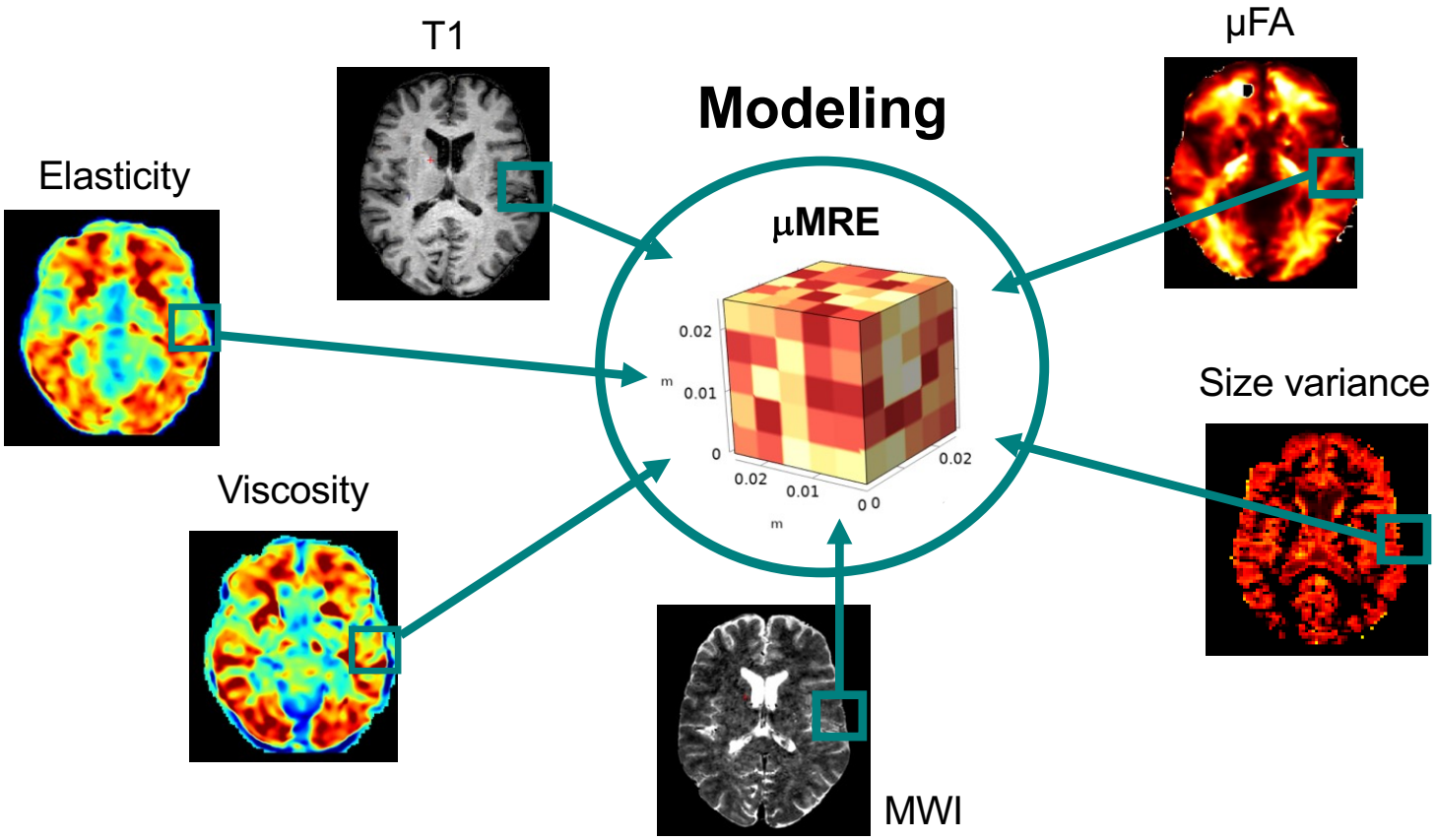
MD-dMRI only



μFA, Vmd

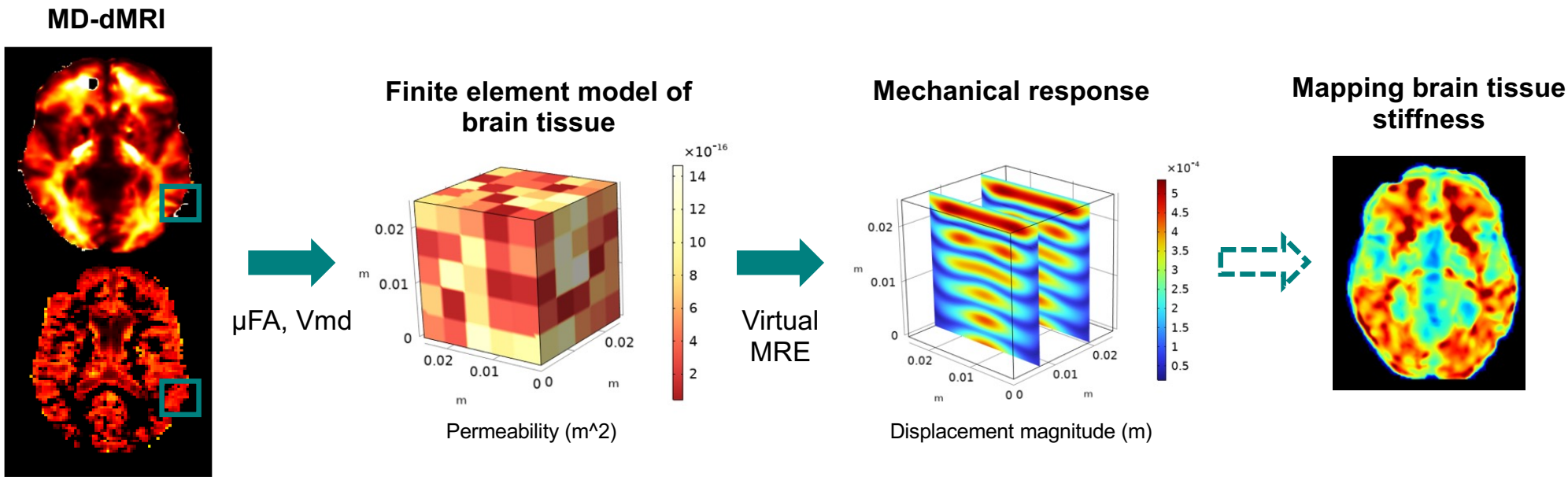
*Topgaard, 2017

Micro-MRE (μMRE)



Virtual MRE (vMRE)

Use MD-dMRI to estimate brain tissue stiffness



Project team

Rodrigo Moreno
Professor

Sarah Vandenbulcke
Postdoctoral researcher

Lisa Prahl Wittberg
Professor

Hampus Möller
PhD researcher

Christian Gasser
Professor

Henrik Palme
PhD researcher

Christoffer Olsson
Postdoctoral researcher

Thank you

Virtual Baby Platform

AI-based Positioning and Personalization Platform for Human Body Models HBMs (RP)

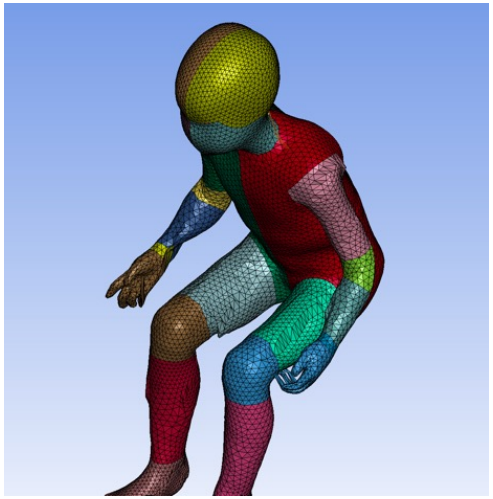
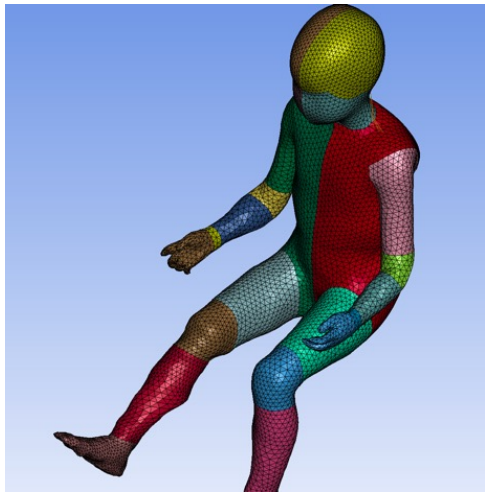
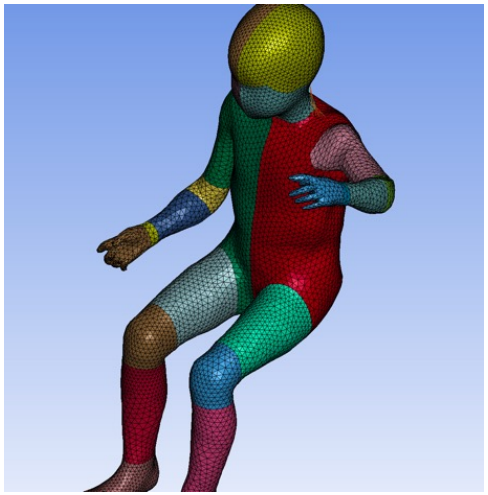
Research Pairs Project: KTH & RISE

Xiaogai Li (co-PI, KTH)
Giorgio Diena
Siyuan Chen
Natalia Lindgren

Henrik Abrahamsson (co-PI, RISE)
Yuju Son

- Biomechanics/HBM
- AI & Digitalization

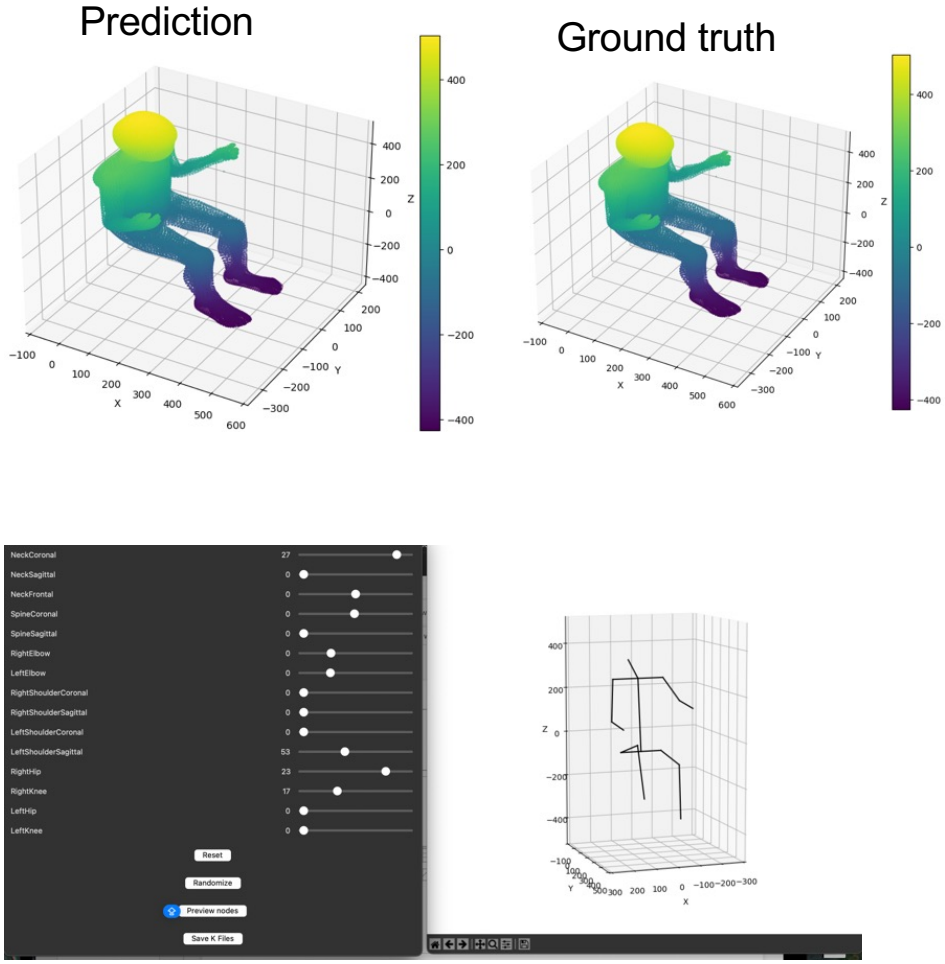
Finite element Human Body Models (HBMs)

- Finite element HBMs are **digitalized representations of the human body** and have emerged as significant tools for driving industrial innovation and clinical applications.
- These models are often a baseline and in a specified position. **Personalization and positioning of HBMs are needed, but challenging and time consuming** (requires today manual work and expertise)
- **Our goal is to build an AI-based platform for automated, and robust personalization and positioning of HBMs, focusing on baby HBMs**

Project progress

- We are investigating if and how neural networks and random forest models can be trained to automatically produce correct body element positions for a given set of joint angles.
  - Challenging problem with promising initial results
- Development of platform and interface
  - Sliders to control the positioning
  - Stickman for the positioning's preview



Visit us in the break-out session

- Welcome to our display in the break-out session for more information and a demo

Thank you

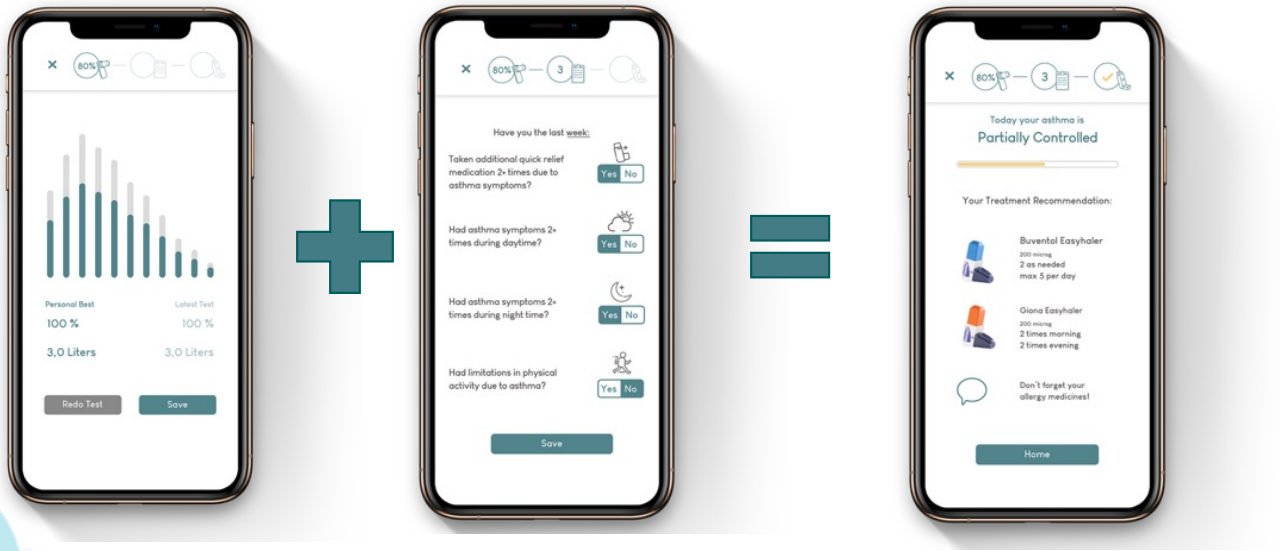
A3S: AI-based Asthma App using Spirometer

Zhendong Wang
Postdoc at at KTH EECS / KI

Asthma diagnosis

- Background: Asthma is affecting about 10% of the European population, is a significant healthcare issue and is increasing by environmental deterioration
- Misdiagnosis: One-third of adults with asthma diagnosis in the 5 last years did not have asthma
- Goal: Objectively verify asthma diagnosis based on lung function measurements

[GINA guidelines, 2023]
[S. D. Aaron et al., JAMA 2017]



Cloud-based data storage

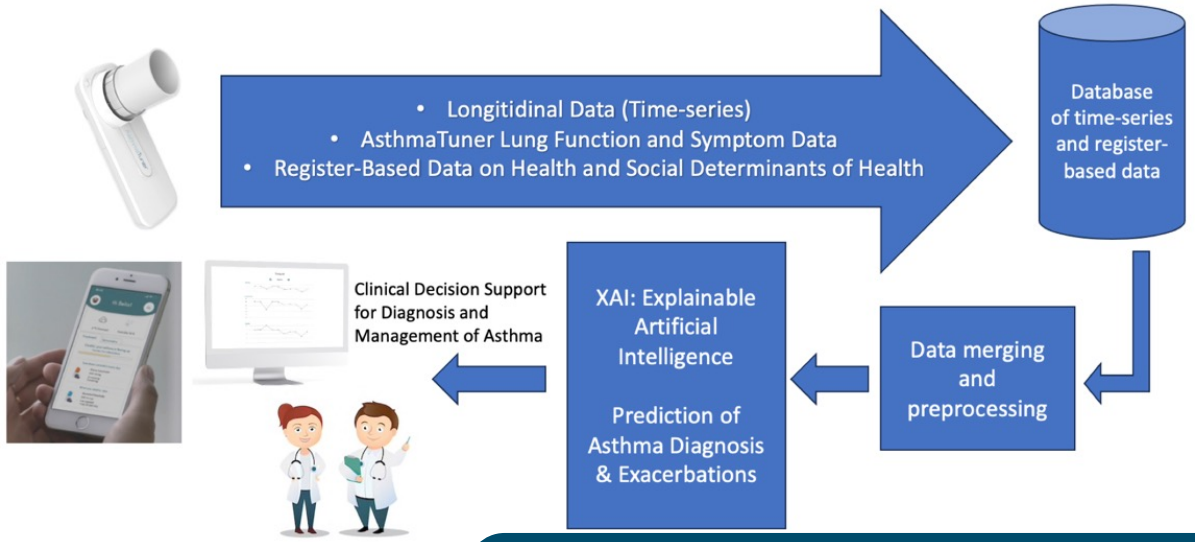
Healthcare provider

- AsthmaTuner supports both clinicians and patients in visualizing patient data **in real-time**, with **automated analysis** on lung function variability
- Research showed digital spirometer app **shortened clinical decision time by 6-7 weeks** compared to traditional care

EFA BEST ASTHMA DIGITAL TECHNOLOGY 2023
WWW.EFANET.ORG

[A. Bjerg et al., 2020]

Aim: Developing XAI algorithms of a seamlessly integrated clinical decision support system (CDSS) for the prediction of asthma diagnosis



- Can support **reduce unnecessary healthcare visits** by predicting costly asthma exacerbations; provide patients with **asthma self-management plans**

1. GINA Report (Global Initiative for Asthma). 2023. https://ginasthma.org/wp-content/uploads/2023/05/GINA-2023-Full-Report-2023-WMS.pdf .

2. S. D. Aaron *et al.*, “Reevaluation of Diagnosis in Adults With Physician-Diagnosed Asthma,” *JAMA*, vol. 317, no. 3, p. 269, Jan. 2017, doi: 10.1001/jama.2016.19627.

3. A. Bjerg *et al.*, “Shorter time to clinical decision in work-related asthma using a digital tool,” *ERJ Open Research*, vol. 6, no. 3, Sep. 2020, doi: 10.1183/23120541.00259-2020.

Project team

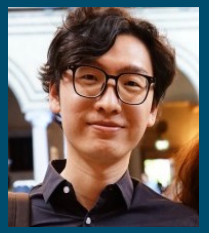
Magnus Jansson
Professor
KTH

Björn Nordlund
Docent
KI/KS

Saikat Chatterjee
Associate Professor
KTH

Lynnea H. Myers
Postdoc
KI

Ioanna Milliou
Assistant Professor
SU



Zhendong Wang
Postdoc
KTH/KI

Thank you

AI-based Detection of Colorectal Cancer In Primary care

Jayanth Raghothama

KTH CBH

KTH + RCC Stockholm Gotland + RCC Väst

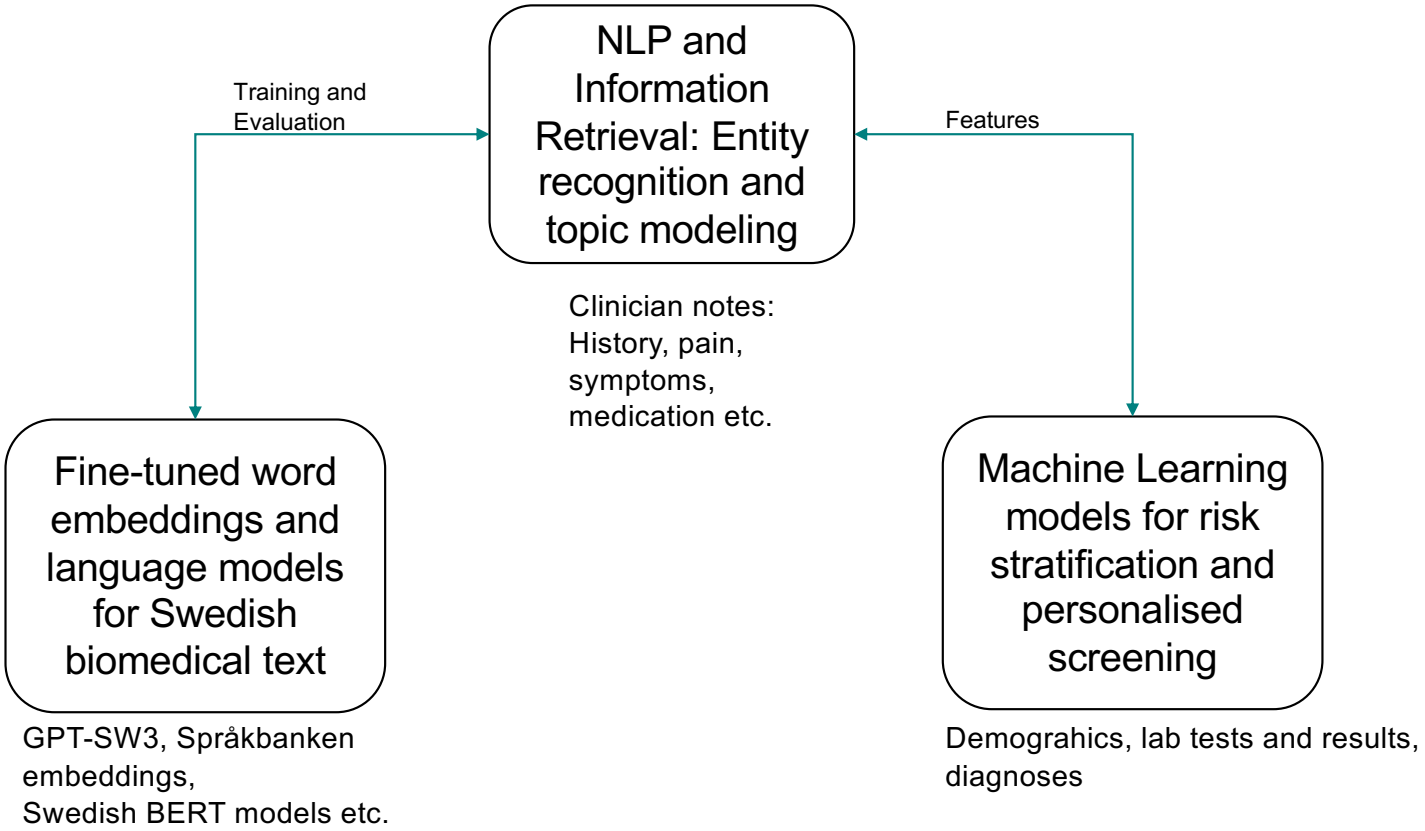
Problem

- Cancer patients present with early symptoms in primary care, which are often missed
- ColoRectal Cancer (CRC) is third most common type of cancer in Sweden
- Survival is excellent in Stages I and II, intermediate in Stage III, and poor in Stage IV
- CRC is the **most-missed** cancer in primary care, leading to increased burden in screening, subsequent care and reduced quality of life
- Screening is currently based on age (60-74)

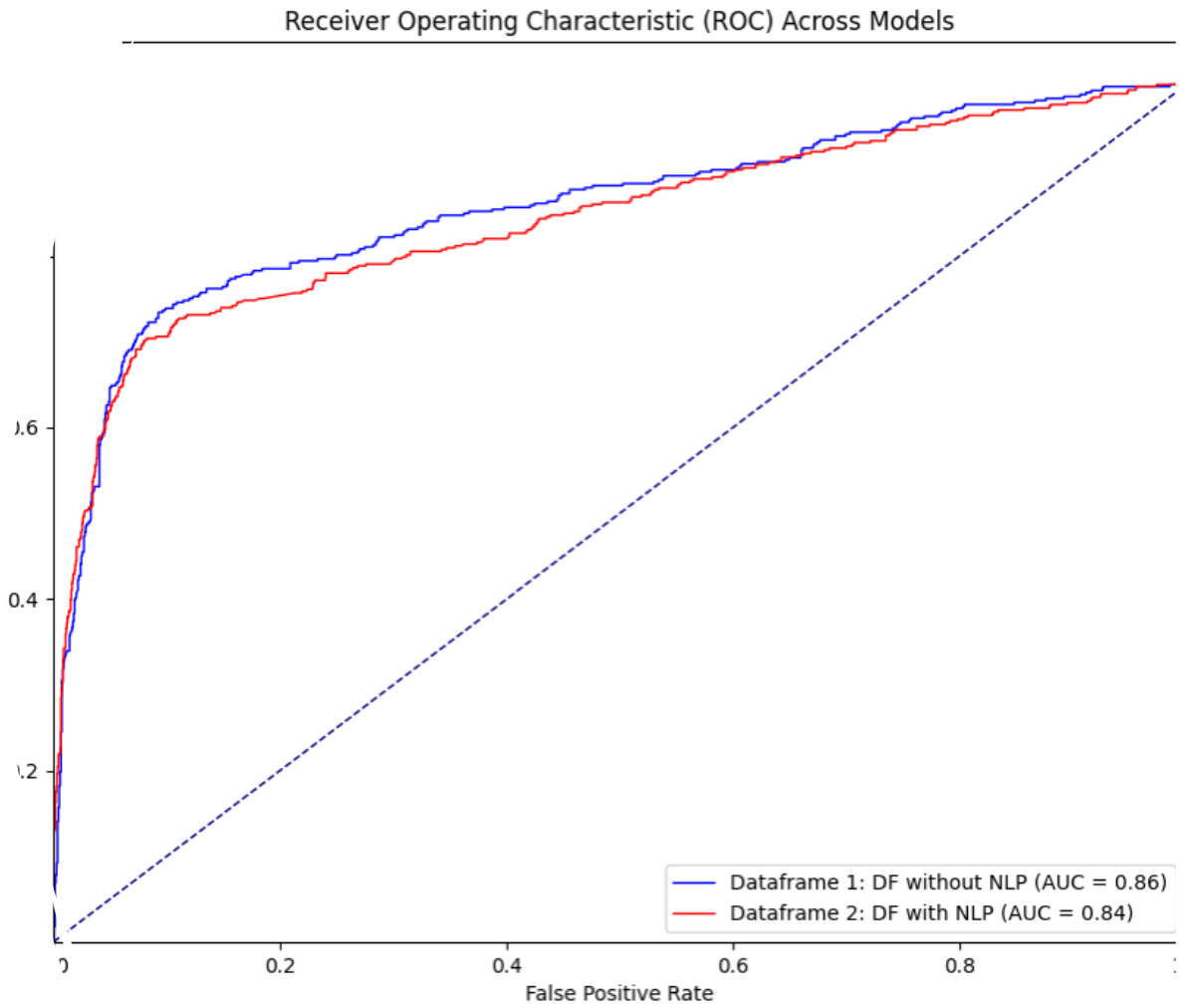
Goal

- AI solution for Early Warning in primary care, using primary care data
- Feed into national guidelines and clinical care pathways
- Use Natural Language Processing on clinician notes for information retrieval
- Machine Learning to develop prognostic models to:
  - Improve risk stratification
  - Personalised screening

Methodology



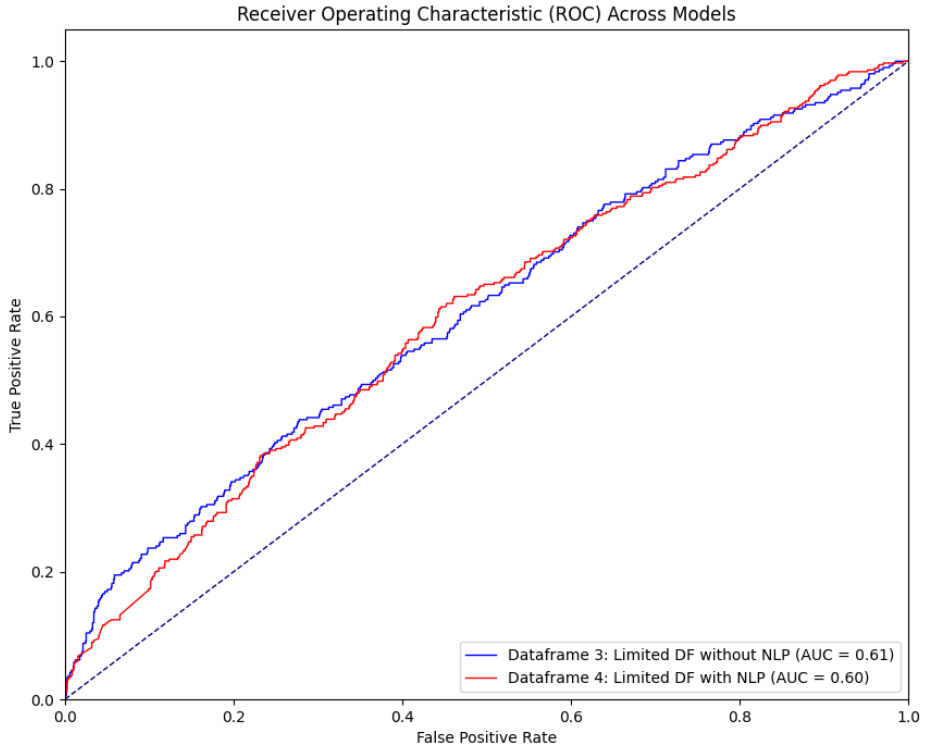
Preliminary Results



2025-04-15

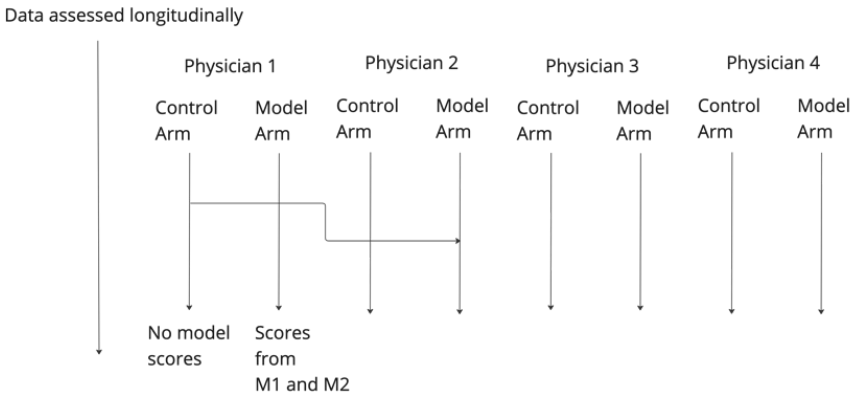
Time Bias

- Models pick up on what doctors already know



Evaluation

- Crossover design with 10 physicians to assess:
  - Impact of models on their decision making
  - Biases
  - Interpretability



Thank you

digital futures

PARTNERS