

Master's Thesis / Diplomarbeit

AI-Based Differential Diagnosis of Rheumatoid and Psoriatic Arthritis from Musculoskeletal Ultrasound

Host Institute: Medical University of Vienna, Department of Rheumatology

Supervision: Jana Eder in collaboration with the AutoPiX consortium (Daniel Aletaha, Peter Mandl & Georg Langs)

Duration: 6 months

Start: Flexible

Background

Arthritis affects millions of patients worldwide. Early and accurate differentiation between rheumatoid arthritis (RA) and psoriatic arthritis (PsA) is essential for effective and personalized treatment.

Musculoskeletal ultrasound (US) is widely used in diagnosis and monitoring but requires expert interpretation, which is time-consuming and subject to inter-observer variability.

This thesis explores how artificial intelligence (AI) can assist in differentiating RA and PsA based on ultrasound images of hands and feet.

Research Questions

- Can AI-based models distinguish RA from PsA using musculoskeletal ultrasound?
- Which image regions or lesion types (e.g., synovitis, tenosynovitis, erosions) are most relevant for model predictions?
- Are explanation methods (e.g., attention maps, saliency/attribution methods) clinically interpretable and aligned with pathophysiological knowledge?

Methods and Approach

- Use anonymized ultrasound data from the Department of Rheumatology.
- Perform patient–image matching and data preprocessing.
- Train machine learning models for differential diagnosis.
- Apply and compare explainable AI (XAI) approaches for interpretability.

Required / Beneficial Skills

- Programming experience in Python (e.g., PyTorch, NumPy, pandas)
- Familiarity with image analysis and machine learning
- Interest in medical imaging and rheumatology

Timeline and Deliverables

Months 1–2: Literature review, data preparation, initial model development

Months 3–4: Implementation and comparison of XAI methods

Months 5–6: Validation, visualization, and thesis writing

Supervision and Environment

This project is part of the **IHI AutoPiX initiative**, a European collaboration between academic and industrial partners aiming to improve imaging for patient benefit in arthritis. You will work in an interdisciplinary environment with close interaction between clinical and technical experts.

Additional Thesis Opportunities

Beyond this specific topic, several other projects are available:

Further AutoPiX-related topics

AI-based image interpretation, image–text matching, data harmonization, quality control, and explainable AI.

Medical Imaging & Pediatric Oncology (St. Anna Children’s Hospital)

Projects involving pediatric oncology, data processing, medical imaging, and AI-driven analytics in cooperation with St. Anna Children’s Hospital.

AI & Knee Osteoarthritis (with academic and industry partners)

AI-based image analysis, segmentation, and biomarker development in knee osteoarthritis in collaboration with Paracelsus Medical University, Chondrometrics, and industry partners.

Student-initiated ideas

Students with their own project ideas are very welcome, **particularly those involving rheumatology data** or related imaging and AI topics.

If you are interested in any of these areas, please feel free to contact me:

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