HAAG Weekly Report (Simplified) – Omar Moursy – 3D Modeling

Time-Log

What did you do this week?

- Uploaded the Weekly reports and meeting recordings for Week 7.
- Had a progress update meeting with Nikita and Steve where we went through next steps for testing and validating PCA based registration.
- Fixed a bug in the PCA constrained registration method to make it run much faster

What are you going to do next week

- Meet with researchers and Dr. Arthur Porto to discuss the pca registration tests and starting the publication.
- Add more relevant performance metrics based on the ground truth data from Dr. Porto

Blockers, things you want to flag, problems, etc.

- None for this week

Abstracts

Gatti, et al. (2024). ShapeMed-Knee: A Dataset and Neural Shape Model Benchmark for Modeling 3D Femurs.

Analyzing anatomic shapes of tissues and organs is pivotal for accurate disease diagnostics and clinical decision-making. One prominent disease that de- pends on anatomic shape analysis is osteoarthritis, which affects 30 million Americans. To advance osteoarthritis di- agnostics and prognostics, we introduce ShapeMed-Knee, a 3D shape dataset with 9,376 high-resolution, medical- imaging-based 3D shapes of both femur bone and cartilage. Besides data, ShapeMed-Knee includes two benchmarks for assessing reconstruction accuracy and five clinical prediction tasks that assess the utility of learned shape representations. Leveraging ShapeMed-Knee, we develop and evaluate a novel hybrid explicit-implicit neural shape model which achieves up to 40% better reconstruction accuracy than a statistical shape model and implicit neu- ral shape model. Our hybrid models achieve state-of- the-art performance for preserving cartilage biomarkers; they're also the first models to successfully predict lo- calized structural features of osteoarthritis, outperforming shape models and convolutional neural networks applied to rawmagnetic resonance images and segmentations. The ShapeMed-Knee dataset provides medical

evaluations to reconstruct multiple anatomic surfaces and embed mean- ingful disease-specific information. ShapeMed-Knee re- duces barriers to applying 3D modeling in medicine, and our benchmarks highlight that advancements in 3D mod- eling can enhance the diagnosis and risk stratification for complex diseases. The dataset, code, and benchmarks will be made freely accessible

What did you do and prove it

Uploaded the missing weekly reports and meeting recordings.

We had a team meeting to discuss next steps for testing PCA based kernel.

Vectorized a time consuming nested loop in the pca kernel that needs to be optimized.