Integration of Ultra-NeRF with ImFusion for 3D Ultrasound Slicing and Training

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

In this project, the aim is to integrate Ultra-NeRF with ImFusion software. By doing this, we aim to streamline the process of learning INRs on ultrasound acquisitions, and also introduce a new way of slicing an acquired 3D US volume within a commercially used software, ImFusion. This would be the first step of what can be later developed, as a guided research project or a master thesis.

Background and Motivation

In ultrasound (US) imaging, certain regions of interest (ROIs) are often not fully visible from specific views. This issue typically arises when the US signal has to pass through highly reflective or attenuative tissues before reaching the target, causing shadows in the scanned image.

In 3D US scanning, combining images from multiple views can result in unrealistic representations, as signal attenuation from different views is often neglected. Ultra-NeRF offers a solution by enabling more accurate 3D ultrasound reconstructions, helping to better understand the scanned scene.

So far, Ultra-NeRF has been developed for use exclusively through Python, without a GUI. ImFusion, as one of the most advanced softwares for medical image processing, offers powerful processing and visualization capabilities. The goal of this project is to integrate the training and inference of Ultra-NeRF with the processing and visualization tools provided by ImFusion.

Student's Tasks Description

- **Familiarization**: The student should begin by thoroughly understanding the codebase of Ultra-NeRF and gaining knowledge of the ImFusion SDK.
- **Implementation**:
    - **Phase 1**: Use a pre-trained NeRF model to perform slicing of the ultrasound (US) scene within ImFusion.
    - **Phase 2**: Acquire US sweeps using ImFusion and then utilize these sweeps to train the NeRF model directly within the ImFusion environment.

Technical Prerequisites

- C++
- Python
- Pytorch

References

- Ultra-NeRF: Neural Radiance Fields for Ultrasound Imaging

  https://openreview.net/pdf?id=x4McMBwVyi

- https://github.com/magdalena-wysocki/ultra-nerf

Please send the completed proposal to tianyu.song@tum.de, shervin.dehghani@tum.de and felix.tristram@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.