

## Expose:

The main **purpose** of medical professionals is to treat patients but over the years the documentation burden of medical professionals has dramatically increased. [1,2] Documentation of **treatment** history is important for future **treatments** and to establish a history of responsibility for every diagnosis and **treatment**. **None the less** reducing the time of medical professionals spend on administrative tasks would increase the time spend with patients and the number of treated patients.

The analyses of 4D PC-MRI blood flow in the aorta could become an essential diagnostic tool in the near future and could partially increase diagnostic capability compared to the current 2D PC-MRI analysis. It can be used to identify mitral valve abnormalities, aorta wall calcification, thrombus formation, aorta wall thinning and a host of other critically important conditions. However 4D PC-MRI it is currently not widely utilized in clinical practice. **One of the reasons is that the analysis and documentation of time depended 3D data is time consuming and has to be done by specialized personal e.g. Radiologist and Cardiologists.** This work is aiming to reduce the documentation workload for those professions.

~~To introduce 4D PC-MRI blood flow analyses~~ in clinical practice we have to find a way to accurately document the diagnostic findings. Current 2D analyses are documented via a simple snapshot of the relevant slice. Finding a representative snapshot in a 4D dataset can be time consuming and ~~has often~~ a low degree of reproducibility. To solve this problem this work aims to develop an automatically generated image or short animation of clinically relevant sections of the dataset for documentation purpose. This automated approach will produce a reproducible form of documentation that enables comparison of different patients and pathologies.

~~Automating the process of finding a medically interesting time point and choosing an appropriate camera position is subject of this work.~~ The first step is to visualize the dataset and to explore it with a free moving camera as well as implementing an efficient way to step through the different time points. Furthermore the visualisation should be able support different parameter mappings, such as pressure, wall shear stress or flow velocity.

The second step is to identify interesting time points for each imaging modality. The naive approach of choosing the time point in each parameter mapping which displays the highest value of the current metric is probably a good starting point to finding diagnostically relevant points in time. However this method alone could result in time points being chosen that only show salt and pepper noise. Therefore, some kind of global parameter has to be established to measure if the single high value is just an outlier. Combining both local and global parameters will make it more likely to find clinically interesting time points in the 4D dataset.

The third step is to find a suitable camera position at a given time point to capture the region of interest as well as a suitable amount of context information and to display important blood flow behaviour. In a first processing step, a rough camera position will be determined

via analytical analysis of the 3D object. This could be done by utilizing a PCA to identify the first two principal components, and placing the camera along the third component to cover the entire object. A first approximation of the distance above this plane for the camera could be done by calculating coordinates above the mentioned plane that would still make it possible to view all vertices with a given field of view. From this rough position imaged based analysis will then fine tune the camera position to its final point.

After combining the camera position algorithm with the time point algorithm we will be able to create snapshots of medically relevant parts of the 4D dataset. To prove the usefulness of our method, we will conduct an evaluation.

Our evaluation will be composed of two parts. In the first part a group of visualization experts will be presented with the visualisation of the 4D data and they will be tasked to a find interesting time point and camera position using a free floating camera. The performance of the automatic determined camera position will be evaluated by a distance measure to the position found by the experts.

In the second part, the test group will be presented automatically determined snapshots and snapshots at random time points and at random camera position of the same dataset. The test group then has to decide which snapshot would better capture the relevant information.

The work on this project will start in September and according to examination regulations of the Faculty of Electrical Engineering and Information Technology the work has to be completed within of 20 weeks. This means the latest this work will finish is in February of 2020.

[1] Lu Chen et al., Racing Against the Clock: Internal Medicine Residents' Time Spent On Electronic Health Records

<https://www.igme.org/doi/pdf/10.4300/JGME-D-15-00240.1>

[2]E. Ammenwerth et al., The Time Needed for Clinical Documentation versus Direct Patient Care

<https://pdfs.semanticscholar.org/205c/9dca7faba47307d6aba44e5b0d11018bcced.pdf>