Evaluation Form

This is the evaluation form for the techniques implemented for the master thesis of Arjan Broos: "Immediate Exploration of 4D PC-MRI Cardiac Flow". The goal of this project is to provide researchers of cardiac flow with a quick initial overview of a 4D PC-MRI cardiac flow dataset, without time-consuming manual labor or preprocessing. Keep in mind that the focus is on fast preprocessing, providing context for flow and different ways of easy seed point placement. Any techniques for improving the actual flow visualization are able to complement our work.

Note that these questions are focused on the techniques, not so much on the GUI that accompanies them. This is a prototype implementation, exposing an abundance of parameters. Please do not take the manner of interaction with these into account when answering the questions.

A short overview introducing all the concepts should have been given. But before answering the questions, a short recap and demo will be given for every section. Thank you for taking the time to help!

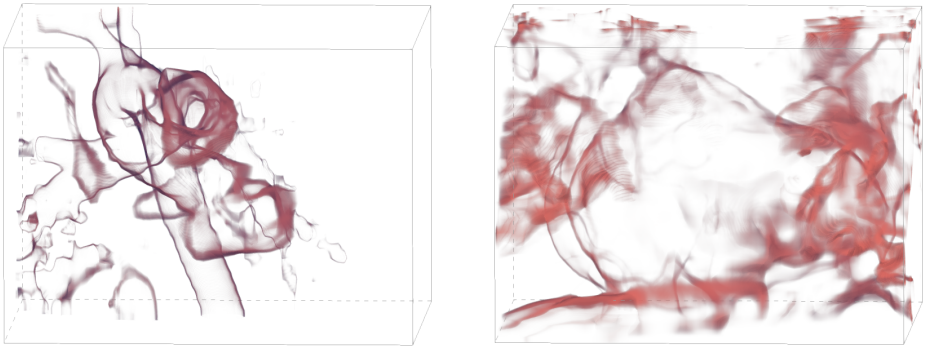
Name:

Research topic:

1 Context visualization

A flow visualization without any context loses its meaning. Without it, it becomes hard to determine where flow is coming from and where it is headed. The goal of the context visualization is to provide this insight, while not taking away the focus from the flow visualization.

1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree	1	2	3	4	5
Q1.1 The general structure of the heart can be perceived from the context.	☐	☐	☐	☐	☐
Q1.2 The context visualization helps with understanding the flow.	☐	☐	☐	☐	☐
Q1.3 The slices complement the volume rendering.	☐	☐	☐	☐	☐



(a) (b)

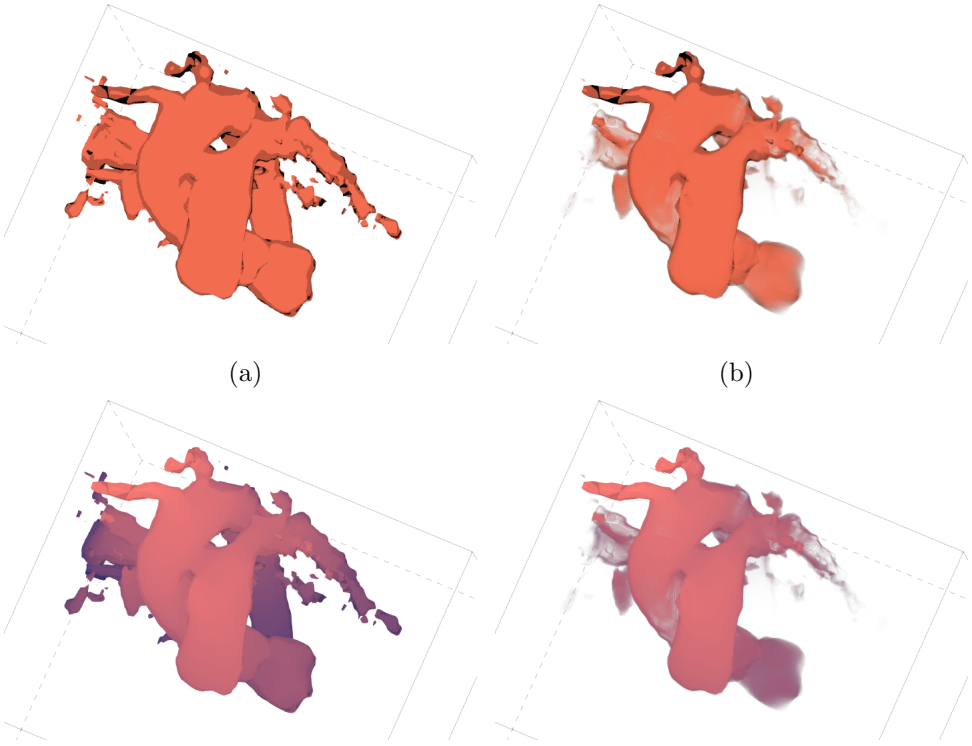
Figure 1: Context visualization based on (a) t-MIP and (b) PCA-M.

	a	b
Q1.4 Which of the context visualizations in Figure 1 do you prefer?	☐	☐

	a	b	c	d
Q1.5 For which of the context visualizations in Figure 2 do you best perceive depth?	☐	☐	☐	☐

	a	b	c	d
Q1.6 Which of the context visualizations in Figure 3 do you prefer?	☐	☐	☐	☐

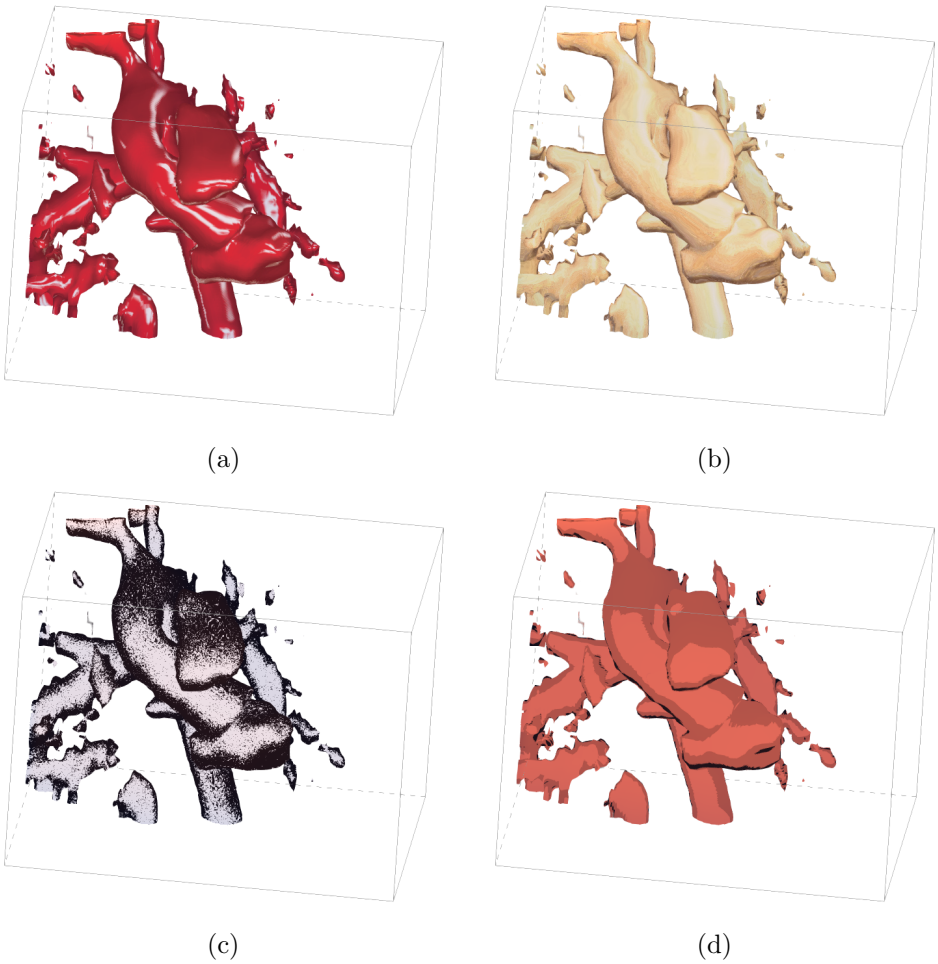
Q1.7 Would you use this anatomical context visualization? If so, how does it fit into your current workflow?



(a) (b)

(c) (d)

Figure 2: Context visualization with different methods of enhancing depth perception.



(a) (b) (c) (d)

Figure 3: Context visualization with different lit sphere maps.

2 Clipped ellipsoids

Since time-consuming manual labor is ruled out, a heart segmentation is assumed to not be available. However, the left ventricle (LV) can be approximated with half an ellipsoid. This can be seen in Figure 4 Since the right ventricle (RV) is wrapped around the LV, it can be modeled by a set difference: RVE \ LVE. Flow inside the ventricles can be inspected by placing seed points in these approximation volumes.
Another use for the ellipsoid is to clip out any data or part of the visualization outside of the ellipsoid, as to mark an area of interest. This sort of clipping usually happens with planes, while the heart has more of an ellipsoidal shape.

1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree	1	2	3	4	5
Q2.1 The left ventricle can be approximated by LVE.	☐	☐	☐	☐	☐
Q2.2 The right ventricle can be approximated by RVE \ LVE.	☐	☐	☐	☐	☐
Q2.3 The placement and interaction with the ventricle ellipsoids is intuitive.	☐	☐	☐	☐	☐
Q2.4 Using an ellipsoid for clipping (compared to clipping planes) is suitable for heart data.	☐	☐	☐	☐	☐

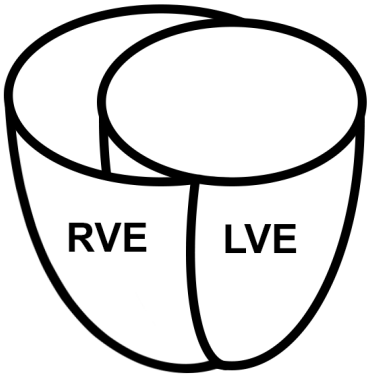


Figure 4: Ventricles approximated by two half ellipsoids: LVE is the ellipsoid for the left ventricle, and RVE is the ellipsoid for the right ventricle.

Q2.5 Would you use the clipped ellipsoids as a quick approximation of the ventricles, when a time-consuming segmentation is not an option?

3 Feature-based seeding

When inspecting cardiac blood flow, one is often interested in particular areas: high velocity, high vorticity, lower signal in the magnitude image, or perhaps a combination of multiple features. Feature-based seeding allows a researcher to automatically place seed points in such areas. A transfer function determines which values of a given feature will be assigned seed points. For any voxel, the value for that feature is looked up in the transfer function, which returns the probability of spawning a seed point. Multiple features can be combined by specifying multiple transfer functions. An ellipsoid can be used to further refine the area of interest.

1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree	1	2	3	4	5
Q3.1 Automatic seeding in areas of interest can be done based on flow features.	☐	☐	☐	☐	☐
Q3.2 Transfer functions are an intuitive way of specifying the properties of areas of interest.	☐	☐	☐	☐	☐

Q3.3 Would you use feature-based seeding? If so, how does it fit into to your current workflow?

Q3.4 Would you see a need for combining more than two features and why?

Q3.5 Which other flow features would you like to see implemented?

4 General

Below we have some questions about the project as a whole.

1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree	1	2	3	4	5
Q4.1 This project enables exploration, providing an overview of cardiac flow before using other methods for closer inspection.	☐	☐	☐	☐	☐

Q4.2 Do you see a need for quick initial exploration of cardiac flow? Is getting an overview of the flow, before looking more into specifics using other methods, helpful?

Q4.3 Do you have any other suggestions for this project?

Thank you for your help!