Centerline Reformation Evaluation

Name:

The aim of this questionnaire should be the evaluation of our visualization technique, called Centerline Reformation. This method offers the possibility to inspect the lumen of arbitrarily spatially oriented vessels, due to a new way of creating the lumen. We will compare this method with Curved Planar Reformation (CPR) and Multipath Curved Planar Reformation (mpCPR). Furthermore, we will present different context visualization in combination with CR. The questionnaire will assess the following points:

- Visualization of one vessel lumen
- Visualization of the lumen of many vessels
- Halos augmenting the vessel lumen
- Visualization of different context rendering methods

1 Single Vessel Visualization

The following two images show the lumen of one vessel visualized with two different methods.



1	Which image depicts the vessel best?	a□		Х□		b□
2	Which image visualizes the flow-channel qualitatively better?	a□		Х□		b□
3	Which image depicts the calcifications best?	a□		xП		b□
4	Which image visualizes the additional organs besides the vessel qualitatively better?	a□		Х□		b□
	1 - highly undesired / 2 - undesired / 3 - neutral / 4 - desired / 5 - highly desired	1	2	3	4	5
5	How desired is the visualization of the additional organs besides the vessel?					

The user can increase the vessel radius if it is not sufficient enough. This offers the possibility to view pathologies which have initially been hidden or are not visible.



6	Which image depicts the calcifications best?	a□		Х□		b□
	1 - highly undesired / 2 - undesired / 3 - neutral / 4 - desired / 5 - highly desired	1	2	3	4	5
7	Is it desired to increase the vessel radius manually?					

2 Multiple Vessel Visualization

Multipath CPR (mpCPR) was initially designed to visualize the vessel lumen of lower human extremities. It splits the image into parts according to the branches of the vessel tree. Then for each part the CPR is visualized and finally all parts are combined to the final image. The following images show the peripheral vessel which split into femoral arteries left and right (a,b), cervical vessels (c,d), a peripheral pulmonary vessel tree (e,f) and an aneurysm (g,h).



(d)









(f)

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8	Which image depicts the vessels best?	a□		Х□		b□
9	Which image depicts the vessels best?	$c\square$		Х□		d□
10	Which image depicts the vessels best?	e□		XП		$\mathbf{f}\square$
11	Which image depicts the vessels best?	g□		Х□		h□
12	Which image depicts the depth perception best? (Anterior vessels vs. posterior)	a□		Х□		b□
13	Which image depicts the depth perception best? (Anterior vessels vs. posterior)	$c\square$		XП		d□
14	Which image depicts the depth perception best? (Anterior vessels vs. posterior)	e□		Х□		$\mathbf{f}\square$
15	Which image depicts the depth perception best? (Anterior vessels vs. posterior)	g□		Х□		h□
	1 - highly undesired / 2 - undesired / 3 - neutral / 4 - desired / 5 - highly desired	1	2	3	4	5
16	Do you consider the surrounding parts as visualized in (a, c, e, g) as desired?					
	1 - totally not helpful / 2 - not helpful / 3 - neutral / 4 - helpful / 5 - very helpful	1	2	3	4	5
17	How clinically helpful is the visualization of vessels of any orientation?					
18	Is this helpful when detecting pathologies?					
19	Is this helpful to detect pathologies faster?					

3 Halos

To enhance spatial relations and depth perception, a gap, called halo, can be optionally added around the lumen visualization. The user is able to specify the width of the halo. The images shown below are from an artificial data-set, which contains several different sized helices with various color gradients.



20 21	Which image depicts the vessels best? Which image depicts the depth perception best? (Anterior vessels versus posterior vessels)	a□ a□		b□ b□		c□ c□
22 23	Which image depicts the vessels best? Which image depicts the depth perception best? (Anterior vessels versus posterior vessels)	d□ d□		X□ X□		e□ e□
	1 - totally not helpful / 2 - not helpful / 3 - neutral / 4 - helpful / 5 - very helpful	1	2	3	4	5
24	Is it helpful to adjust the width of the halo?					

4 Context Rendering

Since the vessel lumen shows no further information concerning the spatial orientation and position of the vessels, context/surrounding information can be created around the lumen. Since rendering a context may reduce the focus and/or perception of the vessel lumen, halos can be added. The following images show two different types of surrounding parts together with the vessel lumen as overlay.



(a)



(b)

(c)

25	Which image depicts the surrounding parts qualitatively best?	a□		b□		c□
26	Which image depicts the vessels best?	a□		b□		c□
27	Which image depicts the lumen best?	a□		b□		c□
28	Which image depicts the surrounding parts qualitatively best?	b□		Х□		c□
29	Which image depicts the vessels best?	$b\square$		XП		c□
30	Which image depicts the depth perception best?	b□		XП		c□
	(Anterior vessels versus posterior vessels)					
	1 - totally not helpful / 2 - not helpful / 3 - neutral / 4 - helpful / 5 - very helpful	1	2	3	4	5
31	Are halos helpful when investigating dense vascular structures?					

The following images show specific vessels of interest. In order to delineate the lumen from the context, halos in yellow are added.



(a) Vessels of a carotis data set

(b) Peripheral pulmonary vessels

	1 - totally not helpful / 2 - not helpful / 3 - neutral / 4 - helpful / 5 - very helpful	1	2	3	4	5
32	How clinically helpful is the visualization of specific vessels of interest?					
33	Is this helpful when detecting pathologies?					
34	Is this helpful to detect pathologies faster?					