Eurographics Conference on Visualization (EuroVis) 2014
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(Guest Editors)

Volume 33 (2014), Number 3

Supplemental Material - User Study Description

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In the following, we provide more details on the user study that is performed in order to evaluate the effectiveness of the proposed method for the selection of sets of stream surfaces.

1. User Study

We perform a user study to assess the visualization quality of our automatically computed visualizations and compare the effectiveness of our method to classical stream surface seeding steered by the user. Effectiveness is measured both in terms of required interaction time and the satisfaction of the user with the resulting visualizations, which users also assess according to representativeness for a given data set. In addition, we evaluate the convenience of the selection of the number k of visualized stream surfaces, and measure the correlation between the users' choices. The study is carried out using a supervised setup in which participants interact with a 3D desktop application for stream surface-based flow visualization. All of the 22 participants (3 females, 19 males) are either CFD experts (5 participants) or have a strong visualization background, i.e., they are using, creating, or developing visualizations on a regular basis. For evaluation, both analytical and more complex simulated vector fields are used. In the study we compare the following two techniques, which are both used by the participants to create stream surface-based visualizations for each data set:

Technique 1: *Manual* Stream Surface Seeding
This technique allows users to perform classical user-driven stream surface seeding: a seed curve can be interactively manipulated, and starting from the seed curve stream surfaces can be integrated. For convenience we restrict the seed geometry to simple line segments that can be freely rotated, scaled, and positioned within the data domain. Users see a "preview" of the resulting stream surface in form of a sparse set of streamlines that are integrated from the seed curve and updated in real-time during seed curve manipulation. Surfaces can be marked and removed if the user is not satisfied with the result. Using these interaction techniques users are asked to create stream surface-based visualizations of unknown data sets such that the sets of stream surfaces yield representative visualizations and reveal the characteristics of the flows well.

Technique 2: Selection from *Pre-Selected* Surfaces
This technique corresponds to *our* proposed method. Using this technique participants are able to create visualizations using sets of steam surfaces that are automatically computed to optimize the global quality measures [MSRT13] in their restricted search spaces: the participants are able to vary the parameter k, i.e., the number of visualized stream surfaces, to select a set of stream surfaces. This corresponds to the process of interactively adding and removing surfaces given in fixed order. Again, users are asked to create visualizations using this technique such that the sets of stream surfaces are as representative as possible for the flow fields. Note that, in order to perform the task of k-selection, participants are not required to know details of the specific given pre-selections (computed by our automatic stream surface selection method), and these details are not communicated to them.

A **video** is attached to this submission showing typical user-sessions for both techniques.

1.1. Method

Every participant is shown a set of introductory slides on the definition and application of stream surfaces for flow visualization to ensure she is familiar with the concept of stream surfaces.

After this introduction the study application is started. As a tutorial the participant is asked to familiarize herself with the 3D application in a linear saddle vector field until she feels comfortable with the manual interface: camera manipulation (rotate, pan, zoom), seed line modifications (rotate, translate, scale), as well as creation, selection, and erasure of stream surfaces.

Using the above two techniques participants are asked to visualize **four** different increasingly complex data sets: TWOFOCI (analytic), TORNADO (analytic), BÉNARD (simulated), and TREFOIL (simulated, late time step). Every visualization task is carefully explained to the participants. The order of Technique 1 and Technique 2 is randomized for each data set and user to minimize the bias of knowing a data set after the visualization using the first technique. The data sets are chosen to have a low (TWOFOCI and TORNADO) and increasing number (BÉNARD and TREFOIL) of flow features, e.g., vortices or separated compartments. For comparability, integration parameters are fixed for each data set. For each technique the required *interaction time* is recorded, i.e., the time until the participant finishes the creation of a visualization using either the interactive manual seeding technique or the selection of the k value for pre-selected surfaces. Note that we distinguish between active interaction time, which is the amount of time required by the user to create the visualizations by interaction with the system, and unsupervised *pre-processing time* required by our method, which we do not measure in this study.

After having finished a visualization using both techniques (performed in random order) on a data set, participants are asked to answer a questionnaire with the following questions assessing the two visualizations independently in terms of satisfaction, representativeness, and ease of creation:

Question 1.a
I am *satisfied* with the resulting surfaces (**manual**).
Question 1.b
I am *satisfied* with the resulting surfaces (**pre-selected**).
Question 2.a
The surfaces are *representative* for the data set (**manual**).
Question 2.b
The surfaces are *representative* for the data set (**pre-selected**).
Question 3.a
It is uncomplicated to create *representative* results (**manual**).
Question 3.b
It is uncomplicated to create *representative* results (**pre-selected**).

Questions **1-3** are answered on a five-point Likert scale with the possible answers **[Strongly disagree, Disagree, Neutral, Agree, Strongly agree]**.

In addition, we ask three questions **4-6** in which the participants assess both visualizations relative to each other again in terms of satisfaction (question **4**), representativeness (question **5**), and ease of creation (question **6**). These questions are of the form

Question 4
Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

that are again answered on a five-point Likert scale of the form **[Manual are most *satisfying*, Manual are more *satisfying*, Both are equally *satisfying*, Pre-selected are more *satisfying*, Pre-selected are most *satisfying*]** (and similar for questions **5** and **6**).

Please, see attached the full questionnaire for more details.

1.2. Results

Participants complete the study on average in 35 minutes. The results of the study are divided into the following categories:

Interaction Time. The *mean* and *standard deviation* of interaction time is shown in Figure 1. For both the analytical and the more complex simulated data sets the average manual

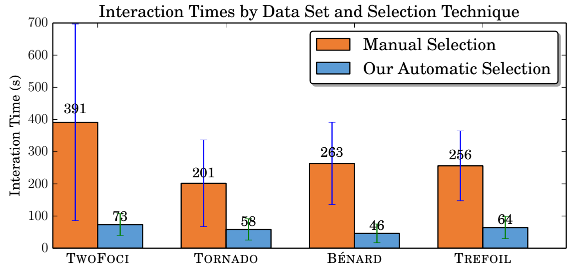

Figure 1: *Absolute Interaction Times. Grouped by data set, both the* mean *and* standard deviation *of the total required interaction time (in seconds) for each selection technique is shown.*

interaction time is consistently higher than the corresponding user interaction time required for our automatic selection technique. Also, the variance of the interaction times is consistently smaller for our automatic selection technique. Interestingly, interaction times for the automatic selection do not increase from the simple analytical data sets (e.g., for the single-feature TORNADO flow) to the more complex simulated vector fields BÉNARD and TREFOIL. In fact, interaction times are lowest for the BÉNARD flow for our automatic selection.

User k-Choice in Automatic Selection. The value of k chosen by every participant is shown in Figure 4 (right) for each data set. For the two simulated data sets BÉNARD and TREFOIL the majority of the participants agree on a favorite k value. Interestingly, this is not the case for the two analytical data sets TWOFOCI and TORNADO, for which the variance of k is higher. In fact, for the TORNADO data set the majority of participants agree on using only a single stream surface, such that it seems to suffice for this flow field and additional stream surfaces only provide contextual information.

User Assessment. For each tested data set the participants' assessments of their visualizations in terms of representativeness, satisfaction, and ease of use are shown in Figure 2 grouped by absolute quality (questions **1-3**) and relative quality (questions **4-6**).

For all four data sets the majority of participants are *satisfied* with their visualization results and assess their results to be *representative* using stream surfaces pre-selected using our approach, and not a single user disagreed with these properties (questions **1-2**). This is not the case for manual selection results: participants become even *less satisfied* with their visualizations of the more complex simulated data and rate them as *less representative*. An even stronger trend can be observed for the *simplicity* of the creation of visualizations using either technique (question **3**): while it is already *complicated* for the participants to create representative results for the two analytical data sets using the manual selection technique, it

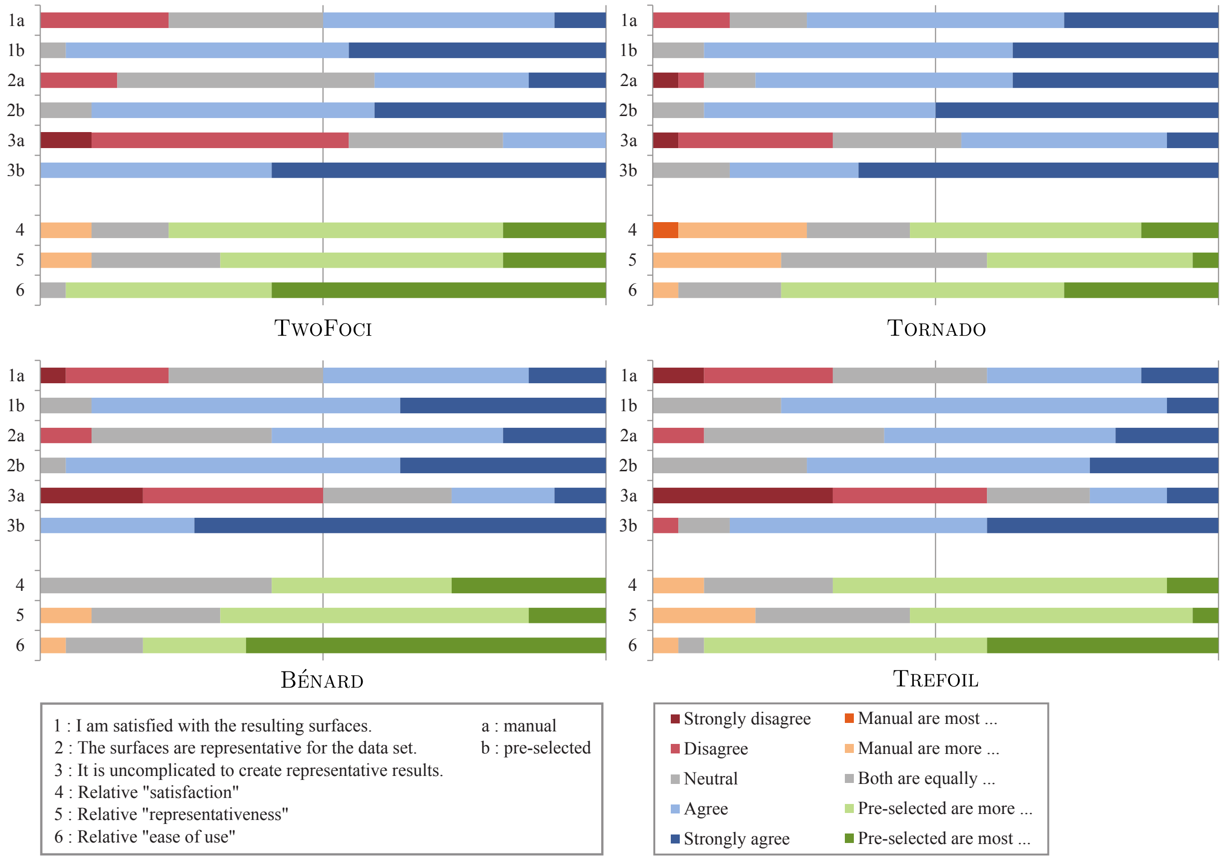

Figure 2: *Participant Assessment. For each data set we show the participants' assessments of their visualizations created using both techniques (manual and pre-selected) in terms of representativeness, satisfaction, and ease of use. Questions 1-3 evaluate the individual quality of both visualizations, questions 4-6 the relative quality of both visualizations.*

is even more difficult for them to create visualizations for the two more complex data sets with this technique. Contrary to this trend, it is *uncomplicated* for the vast majority of participants to create representative visualizations using the stream surfaces that are pre-selected by our method. Also, for all data sets the majority of participants rate their visualizations based on our automatically pre-selected surfaces to be more satisfying, more representative, and easier to create when directly compared to manual seeding (questions **4-6**).

We summarize these self-assessment trends in the two scatter plots of Figure 4 (left) in terms of representativeness and user satisfaction combined for all tested data sets and plotted relative to the required interaction time, which is normalized for each data set. The majority of participants agree that their visualizations using our automatically selected stream surfaces are representative for the tested data sets and they are satisfied with the results. Also, the visualization representativeness, user satisfaction, and ease of use (not shown by a scatter plot) using our approach is higher compared to manual selection. At the same time, the required active interaction time is significantly lower for our method.

User-Selection Results. We show an excerpt of sets of stream surfaces that are manually selected by the participants in Figure 3. The examples are rated by their creators to be either of high or low representativeness or satisfaction, respectively. Examples are labeled by the type of participant, i.e., whether the results are created by a CFD expert or a participant with a stronger background in visualization. Please, see Figure 7 of the submission for our automatically selected results in the same data sets.

This sample set indicates that certain user-selected results, which are rated to be either representative or satisfying, are very similar to our automatically selected results, e.g., the BÉNARD result selected by participant #16. Contrary to this, the results that are poorly rated in terms of representativeness and satisfaction indicate that for some participants it is a nontrivial task to create surface-based visualizations using manual selection. This property holds not only for the complex simu-

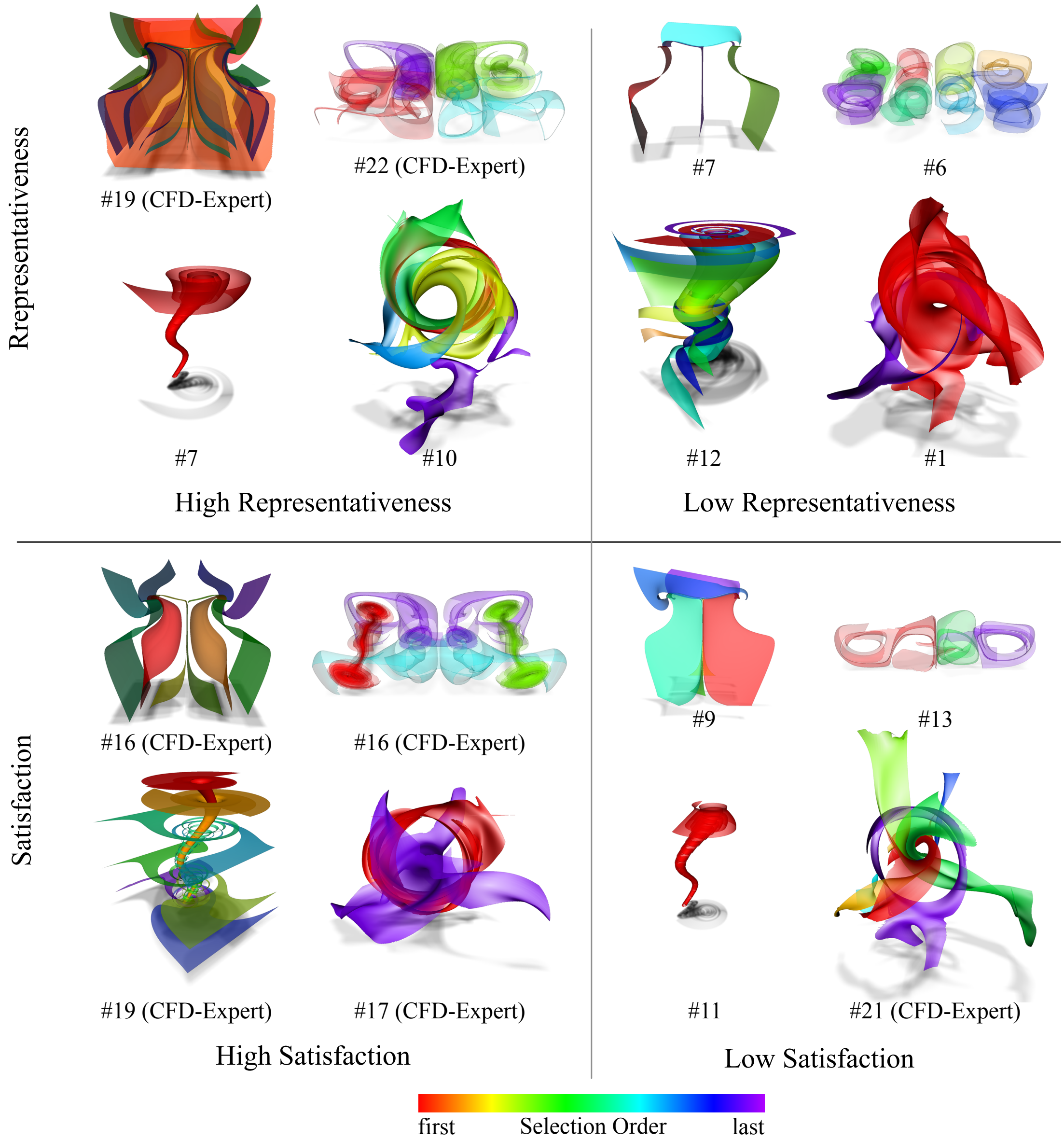

Figure 3: *Participant Results. We show exemplary user-selected results for which participants self-assess their selection to be of high/low representativeness or of high/low satisfaction. The data sets are arranged as* TWOFOCI *(top left),* TORNADO *(bottom left),* BÉNARD *(top right),* TREFOIL *(bottom right). Each example is labeled with the anonymous participant number and participant expertise and the surface selection order is color-coded.*

lated data sets, but even for the more simpler analytical flows. For all shown examples, the interaction times for creation are higher compared to the users' times required for choosing from our automatically selected surfaces.

Selection of Separation Structure. The simple TWOFOCI flow

$$\mathbf{v}(x,y,z) = \begin{pmatrix} x\,(x^2\,(y^2-1)-y^2+y+1) \\ x^2\,(x^2y^2-y^2-x^2)-y \\ -y/4 \end{pmatrix}$$

is used as a test data set because it has a dominant planar separating structure orthogonal to the x-axis between two

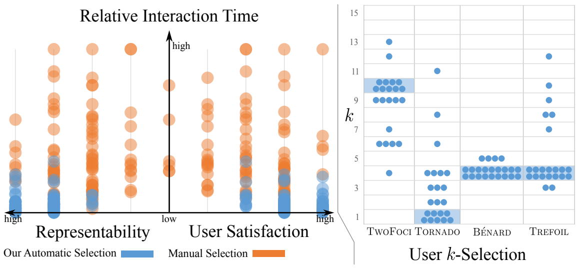

Figure 4: *User Study Results. For both selection techniques and combined for all data sets the two scatter plots (left) show self-assessment in terms of representativeness of and satisfaction with the visualizations created by the users relative to the required relative interaction time. The frequency plot (right) shows the variation of the selection of parameter k of all 22 participants (●) for each data set. Highlighted cells show the favored k values.*

focus points. Our automatic stream surface selection method *does not* select this separating structure (see Figure 7 of the submission) because it does not minimize the global quality measures given by [MSRT13]. Still, it may be an interesting feature to visualize the data set. Hence, one goal of the study is to determine how users choose to visualize the separating structure. It turns out that participants select near-symmetrical surfaces on both sides of the dominant planar separation and they do not attempt to get as close as possible to this structure by tweaking the seed curve position. The manually created visualizations are in accordance with our automatically selected result (see Figure 3 for some user-selected examples).

Please, see attached raw user study data at the end of this document for more details.

1.3. Interpretation

The main findings of the user study are summarized in the following results:

- Participants consistently assess that they are *satisfied* with the automatically selected stream surfaces and they rate them to be *representative* for the tested data sets. Also, it is more convenient for the participants to create visualizations using the automatically selected stream surfaces compared to manually selected surfaces.
- The total interaction time required by the user with classical manual selection is higher compared to the required interaction time using our proposed automatically selected stream surfaces (excluding the unsupervised preprocessing time required by our method).
- For each tested data set the majority of participants agree on an optimal k value for the number of our automatically selected stream surfaces that yield a subjectively representative visualization of the data set.

These results can be interpreted as follow: even for users with a strong background in visualization it seems to be difficult to manually select seed curves of stream surfaces that yield representative data set visualizations. On the other hand, the low required interaction time and the major consensus on the number k of automatically selected stream surfaces indicates that it is easy for users to rate a given visualization for its representativeness. Hence, our proposed method can be considered to assist users by taking advantage of both properties: our method automatically selects seed positions of representative stream surfaces (which is difficult for the user) and the user can conveniently select the number of stream surfaces for the final visualization (which is easy for the user).

References

[MSRT13] Martinez Esturo J., Schulze M., Rössl C., Theisel H.: Global selection of stream surfaces. *CGF (Proc. EG) 32*, 2 (2013), 113–122.

Stream Surface-based Flow Visualization User Feedback - Questionnaire

Participant #: _______ Start Time: _______

Data Set 1

Please mark only one box per question!

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.a	I am satisfied with the resulting surfaces (**manual**).	☐	☐	☐	☐	☐
1.b	I am satisfied with the resulting surfaces (**pre-selected**).	☐	☐	☐	☐	☐
2.a	The surfaces are representative for the data set (**manual**).	☐	☐	☐	☐	☐
2.b	The surfaces are representative for the data set (**pre-selected**).	☐	☐	☐	☐	☐
3.a	It is uncomplicated to create representative results (**manual**).	☐	☐	☐	☐	☐
3.b	It is uncomplicated to create representative results (**pre-selected**).	☐	☐	☐	☐	☐

4. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most satisfying	Manual are more satisfying	Both are equally satisfying	Pre-selected are more satisfying	Pre-selected are most satisfying
☐	☐	☐	☐	☐

5. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most representative	Manual are more representative	Both are equally representative	Pre-selected are more representative	Pre-selected are most representative
☐	☐	☐	☐	☐

6. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most uncomplicated	Manual are more uncomplicated	Both are equally uncomplicated	Pre-selected are more uncomplicated	Pre-selected are most uncomplicated
☐	☐	☐	☐	☐

Data Set 2

Please mark only one box per question!

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.a	I am satisfied with the resulting surfaces (**manual**).	☐	☐	☐	☐	☐
1.b	I am satisfied with the resulting surfaces (**pre-selected**).	☐	☐	☐	☐	☐
2.a	The surfaces are representative for the data set (**manual**).	☐	☐	☐	☐	☐
2.b	The surfaces are representative for the data set (**pre-selected**).	☐	☐	☐	☐	☐
3.a	It is uncomplicated to create representative results (**manual**).	☐	☐	☐	☐	☐
3.b	It is uncomplicated to create representative results (**pre-selected**).	☐	☐	☐	☐	☐

4. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most satisfying	Manual are more satisfying	Both are equally satisfying	Pre-selected are more satisfying	Pre-selected are most satisfying
☐	☐	☐	☐	☐

5. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most representative	Manual are more representative	Both are equally representative	Pre-selected are more representative	Pre-selected are most representative
☐	☐	☐	☐	☐

6. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most uncomplicated	Manual are more uncomplicated	Both are equally uncomplicated	Pre-selected are more uncomplicated	Pre-selected are most uncomplicated
☐	☐	☐	☐	☐

Data Set 3

Please mark only one box per question!

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.a	I am satisfied with the resulting surfaces (**manual**).	☐	☐	☐	☐	☐
1.b	I am satisfied with the resulting surfaces (**pre-selected**).	☐	☐	☐	☐	☐
2.a	The surfaces are representative for the data set (**manual**).	☐	☐	☐	☐	☐
2.b	The surfaces are representative for the data set (**pre-selected**).	☐	☐	☐	☐	☐
3.a	It is uncomplicated to create representative results (**manual**).	☐	☐	☐	☐	☐
3.b	It is uncomplicated to create representative results (**pre-selected**).	☐	☐	☐	☐	☐

4. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most satisfying	Manual are more satisfying	Both are equally satisfying	Pre-selected are more satisfying	Pre-selected are most satisfying
☐	☐	☐	☐	☐

5. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most representative	Manual are more representative	Both are equally representative	Pre-selected are more representative	Pre-selected are most representative
☐	☐	☐	☐	☐

6. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most uncomplicated	Manual are more uncomplicated	Both are equally uncomplicated	Pre-selected are more uncomplicated	Pre-selected are most uncomplicated
☐	☐	☐	☐	☐

Data Set 4

Please mark only one box per question!

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.a	I am satisfied with the resulting surfaces (**manual**).	☐	☐	☐	☐	☐
1.b	I am satisfied with the resulting surfaces (**pre-selected**).	☐	☐	☐	☐	☐
2.a	The surfaces are representative for the data set (**manual**).	☐	☐	☐	☐	☐
2.b	The surfaces are representative for the data set (**pre-selected**).	☐	☐	☐	☐	☐
3.a	It is uncomplicated to create representative results (**manual**).	☐	☐	☐	☐	☐
3.b	It is uncomplicated to create representative results (**pre-selected**).	☐	☐	☐	☐	☐

4. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most satisfying	Manual are more satisfying	Both are equally satisfying	Pre-selected are more satisfying	Pre-selected are most satisfying
☐	☐	☐	☐	☐

5. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most representative	Manual are more representative	Both are equally representative	Pre-selected are more representative	Pre-selected are most representative
☐	☐	☐	☐	☐

6. Compare the **manually** selected surfaces **to** the **pre-selected** surfaces.

Manual are most uncomplicated	Manual are more uncomplicated	Both are equally uncomplicated	Pre-selected are more uncomplicated	Pre-selected are most uncomplicated
☐	☐	☐	☐	☐

Supplemental Material - User Study Raw Results

Data Set TwoFoci

	Participant	Manual Duration	Manual Num Surfaces	Pre-Selected Duration	Pre-Selected Num Surfaces	Q 1.a	1.b	2.a	2.b	3.a	3.b	4	5	6
	1	238.184	6	96.2535	7	2	4	3	3	1	4	4	4	4
	2	231.224	6	39.257	6	4	5	3	4	1	5	4	4	5
	3	218.065	5	82.0247	9	4	4	4	4	2	4	4	3	4
	4	299.463	5	110.789	10	2	4	3	4	3	5	4	4	5
	5	566.684	13	39.4943	9	3	5	4	5	2	5	4	4	5
	6	377.507	8	44.6796	6	3	4	2	4	2	5	4	4	4
	7	228.857	4	55.1532	6	3	5	2	5	2	5	5	5	5
	8	164.275	4	29.2017	4	4	4	3	3	4	4	4	3	3
	9	248.043	6	39.039	13	2	4	2	4	3	4	4	3	5
	10	223.301	4	65.3287	10	5	5	4	5	3	5	4	4	5
	11	472.839	4	137.397	12	2	4	3	5	2	5	5	5	4
	12	167.229	9	43.1135	10	3	5	3	5	2	5	5	5	4
	13	245.302	10	72.0811	9	3	4	3	4	3	5	3	3	5
	14	585.925	7	49.399	10	3	5	4	4	2	4	5	5	5
	15	298.028	12	89.2129	9	2	3	3	4	2	4	4	4	5
	16 (CFD exp.)	448.046	10	105.982	10	5	4	5	4	2	5	2	2	5
	17 (CFD exp.)	238.129	2	50.0079	6	4	4	3	5	3	5	3	4	4
	18	510.901	8	91.1121	10	4	5	5	5	4	4	4	4	5
	19 (CFD exp.)	1622.79	19	134.597	10	4	5	5	5	4	5	3	3	4
	20	348.081	6	43.8035	9	4	5	3	4	4	5	4	4	5
	21 (CFD exp.)	550.216	5	70.8031	10	4	5	4	4	2	4	2	2	4
	22 (CFD exp.)	327.201	4	128.092	10	4	4	4	5	3	4	4	4	5
Mean		391.38	7.14	73.49	8.86									
Median		298.75	6.00	68.07	9.50									
Std. Dev.		305.40	3.87	33.84	2.17									
Min		164.28	2.00	29.20	4.00									
Max		1,622.79	19.00	137.40	13.00									
Frequency	1					0	0	0	0	2	0	0	0	0
	2					5	0	3	0	10	0	2	2	0
	3					6	1	10	2	6	0	3	5	1
	4					9	11	6	11	4	9	13	11	8
	5					2	10	3	9	0	13	4	4	13
	none					0	0	0	0	0	0	0	0	0

Data Set Tornado

	Participant	Manual Duration	Manual Num Surfaces	Pre-Selected Duration	Pre-Selected Num Surfaces	Q 1.a	1.b	2.a	2.b	3.a	3.b	4	5	6
	1	159.131	1	26.9055	1	4	4	4	4	1	4	4	3	4
	2	115.923	1	49.737	3	4	5	3	4	3	5	4	4	4
	3	95.5465	1	39.6483	1	4	4	4	4	4	4	3	3	3
	4	351.256	3	76.909	4	3	4	4	4	2	4	4	4	4
	5	196.72	4	48.1248	2	4	4	5	4	4	5	2	2	4
	6	191.043	4	58.3843	3	3	4	4	4	4	5	4	3	4
	7	59.4344	1	31.0128	1	4	4	5	5	5	5	4	4	3
	8	56.8102	1	26.4735	1	4	4	4	3	3	3	3	3	3
	9	174.549	7	56.595	12	5	3	5	4	3	3	2	2	2
	10	38.5092	2	30.7408	2	4	5	5	5	3	5	5	3	5
	11	225.767	1	55.716	4	2	4	1	4	2	5	5	4	5
	12	231.905	9	94.9874	6	2	5	2	5	2	5	5	5	5
	13	146.26	1	23.8704	1	5	5	5	5	2	5	3	3	5
	14	162.393	1	56.032	1	4	3	4	3	4	5	1	2	4
	15	96.0996	3	41.0641	1	3	5	3	5	4	5	4	3	5
	16 (CFD exp.)	284.487	1	56.463	1	5	5	5	5	2	5	3	4	4
	17 (CFD exp.)	177.165	1	68.6709	1	5	5	4	5	4	4	4	4	4
	18	271.53	8	77.3477	4	5	4	4	4	4	5	2	2	4
	19 (CFD exp.)	666.56	8	52.978	3	5	4	5	5	5	5	2	2	3
	20	213.701	1	42.1964	2	2	4	4	5	2	5	4	4	5
	21 (CFD exp.)	173.417	3	98.64	4	4	5	4	5	3	4	4	4	4
	22 (CFD exp.)	351.537	6	173.692	8	4	4	5	5	4	3	2	3	4
Mean		201.81	3.09	58.46	3.00									
Median		175.86	1.50	54.35	2.00									
Std. Dev.		134.63	2.74	33.04	2.74									
Min		38.51	1.00	23.87	1.00									
Max		666.56	9.00	173.69	12.00									
Frequency	1					0	0	1	0	1	0	1	0	0
	2					3	0	1	0	6	0	5	5	1
	3					3	2	2	2	5	3	4	8	4
	4					10	12	10	9	8	5	9	8	11
	5					6	8	8	11	2	14	3	1	6
	none					0	0	0	0	0	0	0	0	0

Data Set Benard

	Participant	Manual Duration	Manual Num Surfaces	Pre-Selected Duration	Pre-Selected Num Surfaces	Q 1.a	1.b	2.a	2.b	3.a	3.b	4	5	6
	1	360.427	9	29.1197	4	2	4	4	5	1	5	5	5	5
	2	208.747	4	116.385	4	2	3	3	4	1	4	4	4	5
	3	261.564	6	46.4797	4	3	4	3	4	2	4	4	4	4
	4	469.785	5	43.744	4	4	4	4	3	2	5	3	3	5
	5	308.665	10	36.4301	5	4	4	4	5	2	5	5	4	5
	6	241.15	8	14.2388	4	2	4	2	4	3	5	4	4	5
	7	153.184	4	40.5613	4	4	5	4	5	3	5	5	5	5
	8	114.566	4	19.5771	4	4	4	4	4	4	4	4	3	4
	9	72.843	2	33.456	5	4	4	4	4	4	4	3	3	3
	10	104.781	4	31.9348	4	4	5	3	5	2	5	4	4	5
	11	348.989	4	47.878	4	3	4	4	4	2	4	4	4	5
	12	167.562	6	28.6426	5	4	4	4	4	4	5	3	4	5
	13	153.433	3	27.8656	4	1	5	2	5	1	5	5	5	5
	14	326.036	3	59.211	4	3	4	3	4	3	5	5	4	5
	15	334.424	8	60.485	4	3	3	3	4	1	5	3	4	5
	16 (CFD exp.)	325.373	4	60.92	4	5	5	5	4	2	5	3	2	5
	17 (CFD exp.)	178.42	2	52.286	4	4	5	5	5	5	5	3	4	3
	18	560.997	14	38.308	4	3	5	4	4	3	5	4	3	4
	19 (CFD exp.)	175.024	3	14.665	4	5	5	5	5	5	5	3	3	3
	20	195.667	4	28.5046	4	3	4	3	4	3	5	3	4	5
	21 (CFD exp.)	465.547	8	52.37	4	2	4	3	4	2	5	4	4	4
	22 (CFD exp.)	270.746	4	133.716	5	5	5	5	5	4	4	3	2	2
Mean		263.54	5.41	46.22	4.18									
Median		251.36	4.00	39.43	4.00									
Std. Dev.		127.96	2.97	29.10	0.39									
Min		72.84	2.00	14.24	4.00									
Max		561.00	14.00	133.72	5.00									
Frequency	1					1	0	0	0	4	0	0	0	0
	2					4	0	2	0	7	0	0	2	1
	3					6	2	7	1	5	0	9	5	3
	4					8	12	9	13	4	6	7	12	4
	5					3	8	4	8	2	16	6	3	14
	none					0	0	0	0	0	0	0	0	0

Data Set TreFoil

	Participant	Manual Duration	Manual Num Surfaces	Pre-Selected Duration	Pre-Selected Num Surfaces	Q 1.a	1.b	2.a	2.b	3.a	3.b	4	5	6
	1	270.035	2	72.3851	4	2	3	2	4	1	4	4	4	5
	2	332.885	4	74.143	3	2	4	3	3	1	3	4	3	4
	3	145.316	2	67.3979	4	3	3	4	4	3	4	3	3	4
	4	349.276	4	73.461	8	5	4	4	3	2	5	3	3	5
	5	194.814	5	24.5124	4	4	4	5	4	4	5	2	2	4
	6	311.072	5	25.2484	4	4	4	4	5	3	5	4	4	5
	7	165.691	6	113.467	7	2	4	3	5	2	5	5	4	5
	8	159.1164	6	24.0124	4	2	4	3	4	4	4	4	4	4
	9	138.026	7	54.216	4	3	4	4	4	3	4	4	4	4
	10	153.194	5	43.4505	4	4	5	5	5	1	5	4	2	5
	11	159.226	5	47.19	4	1	4	2	4	1	5	5	4	5
	12	200.204	14	54.8491	12	3	4	4	5	5	2	4	4	4
	13	145.478	7	54.5237	8	4	4	4	4	1	5	3	3	5
	14	387.282	3	55.904	4	4	4	3	3	2	4	4	3	4
	15	212.71	4	34.9115	4	3	4	3	4	1	4	4	4	5
	16 (CFD exp.)	489.791	4	92.7863	3	5	5	5	5	3	5	3	4	4
	17 (CFD exp.)	119.218	2	117.185	4	5	4	5	3	4	3	2	2	2
	18	426.56	11	42.503	10	3	3	4	3	2	4	4	4	4
	19 (CFD exp.)	253.504	10	50.681	4	4	4	4	4	5	5	4	3	3
	20	299.354	3	75.0403	4	2	3	3	4	1	4	4	4	5
	21 (CFD exp.)	386.696	7	169.524	9	1	3	3	4	2	4	4	5	4
	22 (CFD exp.)	332.598	6	47.905	4	3	4	4	3	2	4	3	2	4
Mean		256.00	5.55	64.33	5.27									
Median		233.11	5.00	54.69	4.00									
Std. Dev.		108.44	3.00	34.56	2.51									
Min		119.22	2.00	24.01	3.00									
Max		489.79	14.00	169.52	12.00									
Frequency	1					2	0	0	0	7	0	0	0	0
	2					5	0	2	0	6	1	2	4	1
	3					6	5	7	6	4	2	5	6	1
	4					6	15	9	11	3	10	13	11	11
	5					3	2	4	5	2	9	2	1	9
	none					0	0	0	0	0	0	0	0	0