Dear Reviewers,

Thank you for your conscientious reviews and helpful feedback for how to improve the manuscript. This report contains a summary of the changes we have made in response.

The coordinator summary indicated we should address the following issues:

1. **Improve the general exposition**

What we did: We accepted and actioned the suggestions put forward by reviewers to improve our document. This includes notation, descriptions, clarifications, and ordering of text. Our modifications are mainly in the introduction, method and results sections. We include additional references in the related work section.

1. **Clarify the contribution with respect to [JH20]**

What we did: We include sentences in the introduction that distinguish between feature level-sets and feature confidence level-sets. Interestingly, we view our method as an extension of the [ZWK10] uncertainty visualization approach, with feature level-sets acting as the vehicle to visualize multivariate data. That said, the outcomes for the techniques can be the same if there is no uncertainty in the domain. Thus, feature confidence level-sets are associated with the amount of variation at each grid point as well as the distribution of the mean function across the spatial domain.

1. **Improve the figure descriptions. To make space, authors can reduce the number of figures used in the paper or provide additional material.**

What we did: We improve our descriptions of the figures in the results section. We do move results from our Mantel data set experiments to additional material to accommodate improved discussions for the other data sets.

The remainder of the document contains review comments that we viewed as action items (in blue), followed by our response (in red). Additionally, we added suggested references as well as another new reference of recent work. Finally, we also did a full grammar review of the manuscript and we have not listed minor changes.

Once again, thank you for your careful reviews that helped improve the manuscript.

Best regards,

Authors of Visualization of Uncertain Multivariate Data via Feature Confidence Level-Sets

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**coordinator review**  
  
    When describing the proposed approach, the overall clarity could be improved. In  
    particular, when describing the Feature Confidence Level-sets. The notation used  
    in equations 8 to 10 could be simplified. For example, authors may consider  
    adopting classical symbols used for indicating mean and standard deviation.  
  
    They may also reduce equations 8, 9, and 10 into a single equation.

Thank you for your very thoughtful feedback. We improve our exposition by improving the descriptions of the approach as well as extending the discussion in the results section (Sections 1, 3, 4).

We also adopt standard notation for mean and standard deviation as well as reduce previously equations 8, 9, and 10 into a single equation.   
  
    Most importantly, I think Figure 1 should be used to guide the reader while  
    describing the method rather than only being mentioned at the end of the section.

Thank you for this suggestion. We reference Figure 1 earlier in the Section, as well as tag the related terms with the corresponding subfigures of the notional example.

    The experimental section could also benefit from some improvement. In general, the  
    description of the results obtained is limited to the figure captions. I would  
    suggest providing a more detailed explanation for at least one among Figures 4, 5,  
    and 6.

    Here it would be important to guide the reader through your figures and help them  
    understand how to read them. How should we interpret the surfaces depicted in your  
    figures? What information are they conveying regarding the specific underlying  
    dataset?

Thank you for the suggestions. We improve the level of detail for our description of results for the red sea eddy ensemble data set. Additionally, we improve our discussion of the results for the Tornado and Ethanediol data set.

    For example, a few questions specific for Figure 4:  
    - in (c) FCLS\_{TB} mainly encloses the non-covalent bond identified by ZLS\_T.  
    Similarly, FCLS\_{TC} encloses oxygen. However, this is not the case for FCLS\_{TA}  
    which encloses most of the structures in ZLS\_T. Is this information relevant for  
    the user? Should we understand something regarding the dataset uncertainty?  
  
    - Differently from the others, FCLS\_{TD} creates concentric isosurfaces. Is this  
    difference semantically relevant or useful for interpreting the dataset  
    uncertainty?

Thank you for your guiding questions. We provide an interpretation of the feature confidence level-sets obtained in our results for the ethanediol data set by considering the trait definitions in relation to the distribution in the scatterplot, and the synthetic nature of the uncertainty introduced.   
  
    - The traits selected from A are always shown at the end. Shouldn't they be at the  
    beginning (being the first step performed before extracting the FCLS?)

Thank you for this suggestion. We rearranged our subfigures to show the trait definition first.   
  
    I understand that the proposed changes may force the authors to eliminate some of  
    the paper's figures. However, these can still be included as additional results.

We include the results from the Mantel data set in additional material .

    The authors are also encouraged to include recent work done on uncertainty  
    visualization. In particular,  
  
    Athawale, Tushar, et al. "Uncertainty visualization of 2d morse complex ensembles  
    using statistical summary maps." IEEE Transactions on Visualization and Computer  
    Graphics (2020).

Thank you for suggesting this reference. In addition to the above reference, we add another recent reference on bivariate fiber surfaces uncertainty visualization.

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**committee member review**  
  
    The paper addresses a relevant problem and provides an appropriate solution. The  
    exposition is clear, the presentation is alright (only minor issues, e.g., could  
    be more self-contained; not everyone may be familiar with the acronym EDT,...).

Thank you for your review. We aim to improve exposition via better descriptions in the introduction, method, and results section. Additionally, we include sentences in the distance metric section (3.3) to better understand EDT.

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**reviewer 3 review**

    1) There is absolutely no reason to enumerate domains, D\_i. Functions living on  
    different domains should only considered a multivariate function over the  
    intersection of all D\_i. This also makes the next line, D\_i = D obsolete.  
    2) To clarify matters, consider the use of \subseteq to disambiguate from proper  
    subsets.

    3) "For uncertainty in each dimension i of attribute space" - i has been  
    previously used to mean the index of the data field. "

Thank you for this feedback. We update and simplify our definition of multivariate data. This change also addresses 2) and 3).

    4) mean\_i, SD\_i could be replaced by the more commonly recognized \mu, \sigma.  
    Otherwise, SD should be defined first.

Thank you for this suggestion. We have adopted the standard notations for mean and standard deviation.

    5) the choice of the Euclidean metric should be motivated better. At least a  
    weighted version should be considered to allow for data with components of  
    different dynamic range. Example: Computational Fluid Dynamics data: velocity in  
    the range -1,1 m/s, pressure 0..1100mbar, temperature 20C..30C. The ranges  
    involved ensure that Euclidean distance is quite meaningless (also a potential  
    problem in [JH20]).

Thank you for your thoughtful comment. Our choice of Euclidean metric is computed in the spatial domain and thus allowed us to explore the use of a distance field that has the potential to be more intuitive and can be reasoned based on domain information rather than navigate a distance field derived from dynamic ranges across multiple attributes. We add sentences in the manuscript that better motivate our choice. That said, our choice of distance metric has limitations as well. We believe feature level-sets do have the shortcoming of poor discernability currently, and the exploration of various distance metrics could provide paths forward.

    6) Due to the page constraints of this track, the construction of the level set is  
    not entirely obvious from the description in 3.4 and 3.5. The pullback of the  
    distance transform is clear from [JH20], but the authors of this paper fail to  
    mention explain what the 0-level is (clear from Fig. 1b,c) and it would make this  
    section easier to understand if the authors could state that the distance is with  
    respect to the set (mean\_i intersect T) != empty set.

Thank you for this suggestion as we believe it will certainly help readability. We include a statement in each of Sections 3.4 and 3.5 that state what the distance is with respect to.

    7) Reference and / or definition of the analytical tangle function is missing in  
    Fig.2, and this function is, to my knowledge, not too well known and ambiguous  
    (e.g., compare R's tangle with tanglegrams and their use as hash functions).  
    8) Reference to EF-5 tornado data set is missing in Fig.3, as is an explanation of  
    the "prespert" attribute.

Thank you for your suggestions. We include the reference of the data sets in the figures. Additionally, we include a sentence to provide some context regarding the prespert attribute in the results section text.   
  
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