Dear Prof. Ümit Çatalyürek,

We would like to thank all reviewers for their thoughtful reviews on our paper. We have fixed all raised issues based on the reviews. Please see a more detailed response to each reviewer comment below.

Common Responses to Editor-in-Chief and all reviewers

Comment: *In particular, the reviewers noted that not much new insight is gained from the paper in its current form, and they offer suggestions for discussion and analysis that would add insights and improve the paper. We ask that the authors strongly consider the reviewer comments and address them as possible in the new version.*

Response: This paper is a survey paper based on a traditional questionnaire. The method used in this paper is quite common. The scale of the questionnaire targeting MPI is unprecedented and very important in terms of the number of participants who are geographically wide-spread. As you know, the MPI standard is keep evolving. We believe that it is about the time to know how MPI is used and what is the problem when using MPI. Without having clear and right views of these, how can MPI widely be accepted? Connotations without having any backup data may lead to wrong directions.

The large number of answers (851) enabled us to conduct cross-tab analysis. The geographical nature of our survey enabled us to find different aspects by locations. Both of them cannot be found in the precedent survey papers.

We analyzed all simple question results and all cross-tab results. Our developed program did the cross-tab analysis on all possible combinations of two questions. The number of the combinations is more than 400! We found that only some of them showed apparent correlations and are presented in the paper. We think we did our best.

Given that, one of the findings of this paper is that many MPI users are sticking to the very basic functions, not knowing somewhat newly introduced functions. Again, MPI is keep evolving and getting more complex than ever. Will the newly introduced MPI functions be accepted by those who are still using old MPI functions?

Most of the authors have been involved in MPI related projects of their

own and have the experiences of attending MPI Forum meetings. Like the all of the other MPI Forum members, all of us know MPI implementation is not easy at all but each of us knows only small number of MPI users near by. The sense of danger drove us to write this paper.

Reviewers claimed that the findings of this paper is thin. This is because there is almost no contradictions to connotations. The most crucial part of this paper is that these connotations are supported by the large-scale data.

Comment: *As for the future survey*
Response: Unlike technical papers, we cannot conduct another complementary survey to the same community in near future. If I were a participant of this survey and would get the second one, I would say "I already spared my precious time for answering the survey. Why shall I do this again?" Thus we intentionally did not talk about the future survey. However, it is very interesting for conducting the similar survey to the same community, 5 year later for example. This would reveal the changes over time.

Responses to Review 1

Comment: *Overall, the paper needs a proofreading pass, and addressing the following comments could improve their readability:*
Response: We greatly appreciate your detailed comments and we fixed all proofreading issues.

1. *Please upfront define what (multiple) and (single) mean at the end of each option (e.g., MPI Experience (single)). I had to guess the meaning based on the context a lot later in the paper. It would be better to add a sentence describing how to read these options.*
   Response: We added the description at the very first appearance of it.

2. *Similarly, describing AD and ST in Section 3 on page 2 (last sentence of the "Design" subsection) will not take up too much space but are necessary for improving readability. These are defined in Appendix as well, but if readers skip the Appendix, they will run the risk of not understand the messages.*
   Response: The text is updated.

3. *The text in the related work section can be converted into a table and significantly improve that section's readability. E.g., it is hard to re-*

member what S, R, Q, etc., mean, and why does it matter what their goals are? Explaining in terms of questions that S and R survey categories cannot answer and where the strength of the Q category lies will better explain the motivation of this paper. I am missing the point of why there are so many categories and what their unique contributions are.
Response: The entire section has been reorganized to address this comment.

4. *It is not clear what the authors mean when they say, "There is a trade-off between the number of participants from each major contributor and the number of the major contributorsin the cross-tab arinalysis." Is "contributorsin" a typo? What is the trade-off? Which cross-tab comparisons are being referred to?*
Response: Fixed.

5. *Define cross-tab analysis before using it. I do not know if it is a standard term, and I assume most readers will not.*
Response: Fixed.

6. *"... may suggests ..." → "... may suggest ..." on page 8, the paragraph right below Figure 18.*
Response: Fixed.

7. *Page 8: "In same time, UK participants overwhelmingly learned MPI from online sources, which usually translate by via practical examples." → "At the same time,..... translated via .."*
Response: Fixed.

8. *Page 11: Section 5.7 – ".... contributorshave ....." → "contributors have".*
Response: Fixed.

Responses to Review 2

Comment: *The paper is well structured and largely follows the structure of the questionnaire, yet the language could be improved in several places (see comments below). The chart visualizations are well done, yet often they focus on a single question and and provide only a single view on a specific question.*

Response: We have addressed most of the suggested grammatically issues, and have arranged for a native english speaker to go over the paper before the publication. The charts are focused on a single question in order to avoid speculation on the correlations between answers.

Comment: *Especially the use of color in the bar charts does not feed a specific purpose, and more advanced info-vis chart types (e.g., heatmaps) could improve the ink to information ratio. Also it's often not clear why a specific chart type was chosen for a specific question. Furthermore, information sometimes presented in tables could have been combined and presented with charts in a visual way.*
Response: Table 6, 7 and 8 were converted into graphs.

Comment: *The questionnaires used for the survey were specifically designed to attract many participants and the survey seems to be the largest of its kind in the near past. The methodology behind the questionnaire (which topics, how many questions per topic, how to best formulate questions, etc.) should be discussed in a more structured way, explaining which underlying information was the target for a specific batch of questions.*
Response:

We did not created a new methodology for this work and We just followed the instructions which can be found everywhere.

Comment: *Overall, the work presented provides a view on how MPI is used across the globe, yet many questions remain open. It presents a valuable source of information for the MPI community, yet should address the open questions and comments before publishing to unfold its full potential. Furthermore, it would be good if the authors also included an outlook sections on "lessons learned" from this survey and what should be done differently in future surveys of this kind.*
Response: Thanks. We added the "Lessons Learned" section.

1. *The authors used input on how to engineer the questionnaires from two social scientists. Next to the limitation of overall questions, which other factors shaped the design of the questionaires?*
   Response: Among many other critical aspects, one of the important things when designing survey is to make questions clear and as easy-to-answer as possible, so that participants can concentrate on the survey and would not struggle to understand the questions and give up.

2. *If there is a limitation of questions, how could one achieve a good coverage across all topics.*
   Response: The survey is only as good as the questions asked were. Which is why the involvement of people in the polling field was deemed critical to this survey

3. *Why was I/O excluded, it seems that an opportunity was missed to check whether developers are aware of MPI's ability to parallelized their I/O (which at scale can easily become a bottleneck for the whole application).*
   Response: Yes, we agree I/O can be a severe bottleneck in some applications. We argued on this at the questionnaire design phase of this survey, and decided against including these question for mostly two reasons: we wanted to have a reasonable number of questions in the survey (up to 30), and that many of the I/O issue often comes from the underlying file system or server setup and not specifically from limitations of the MPI-IO API. While making the distinction between MPI-IO API and underlying setup issues might be possible for domain experts, the survey being targeted toward a larger and more diverse (in terms of MPI skills level) audience the answers would have been skewed by the lack of expertise. e thought it is very difficult for some MPI users to distinguish whether the I/O issue comes from the underlying file system or MPI-IO itself. This can be true when MPI users are domain experts but they lack system knowledge. Hence, we decided not to have MPI-IO related questions.

4. *Was the elimination of counting lines of code a suggestion by the consulting professors? If so this might be an interesintg take away for future designs of similar surveys.*
   Response: The decision to remove the counting of lines of code came from the computer scientists (authors), not from the social scientists. Many numerical applications are large, but the code to call MPI routines can be very small. Thus, the size of a program may or may not correlate with the code size where calling MPI routine. We could have asked participants to count the lines only calling MPI routines, but we wanted to make the questionnaire easy-to-answer by eliminating such effort.

5. *The end date of the survey is given with "until recently", however, the publication data will be well in the future and the data when this is read even further. A similar end like "Month Year" should be given.*

Response: This will be fixed in the final version.

6. *The colors in the charts don't seem to be well suited for color-blind or color-impaired readers.*
   Response: The color set has been changed.

7. *Try to avoid meta language, explaining your thought process. For example: "One of the first questions we had to ask was how to reach a largely international ..." → "To reach a largely international community, we ..." (more occasions of similar meta language throughout the document)]*
   Response: Fixed.

8. *Why is some data given in Table form and other in chart form. Try to convert as many tables into charts that actually contain numbers, or tables that contain charts (e.g., inline horizontal bar chart in the columns '#Ans' and '%'. A survey evaluation is all about information discovery and visualization, so it would be good to try to employ well seasoned chart types of the info-vis community.*
   Response: Table 6, 7 and 8 have been converted to graphs.

9. *What is the trade off between number of participants and the number of contributors in the cross-tab analysis? This is unclear and should be made more explicit. What was limited? Why was the threshold of 50 chosen?*
   Response: We agree, this statement was not clear and we changed the wording. The threshold was chosen to include USA which plays very important role in the HPC field, therefore we thought USA must be included in the major contributors. The sampling number of 50 is a little bit larger than that of the case satisfying 80% confident level and 20% error margin.

10. *Regarding the correlation of Figure 3, how could this ambiguity be avoided in a future survey?*
    Response: We had expected to have more number of the AI choice, since AI is becoming a significant target for distributed aspects nowadays. You may think that the numerical app/lib dominates because this is a multi-answer question. However, we could not find any obvious correlation between them.

11. *With citing other books, tutorials and other online resources, maybe a correlation of "what is used" with "what is taught" can be found?*

This should be investigated. The claim: "The MPI standard maybe too complex and leads to limited understanding" (p.5) may not be the only conclusion that could be drawn from the survey data.
Response: We checked the heatmaps of Q14-Q16 and Q14-Q17. The situation is very similar to the above Q3-Q17. Those heatmap graphs reflects the biased distribution of the answers and no significant correlations can be found. When we firstly checked the generated heatmap graphs, we were very disappointed because only some of them have significant correlations which are shown in the paper.

12. *The authors claim that by having a fixed boundaries and conditions (p.6) leads to static MPI applications. However, the boundaries are not what makes a program dynamic. A dynamic need for computing resources (and proper re-balancing of such) can be present in such static scientific domains. What is not investigated here is that the operation of HPC systems (batch scheduling) often prohibits the dynamic allocation of new resources for a running job. However, with the survey data this can probably not be investigated. (Potential question for a future survey?)*
Response: We agree with you about the usage of dynamic process creation and the operation policy does not allow users to create processes dynamically. However, the current text does not deny the usage you pointed out.

13. *Also for future surveys: Maybe users are not aware that SINGLE is the thread level that MPI_Init uses. Does this correlate with answers of "MPI-only" applications?*
Response: We checked the cross-tab graph between Q17 asking thread model and MPI+X. As the number of answering MPI only users ('No' in our survey) is not large and we could not see any strong correlation between them.

14. *The percentage numbers in Table 8 don't add up to 100%. What do they refer to?*
Response: This is because there are many other multiple-answer combinations and only the top 7 combinations are listed in this table. We converted the table to a graph.

15. *Page 8: "Portability, which translates into maintaining backward compatibility across versions, ..." ... Portability is much more than that and would in my mind first and foremost be a portability across differ-*

ent MPI libraries and Hardware using the same MPI version.
Response: It was our fault for using the word 'portability' in Q28, where we should have talked about (backward) compatibility here. We changed the wording here.

16. *Why is is interesting that the same number of people have checked "read the full standard" and "never read the standard"? Also, Figure 20 does not support this claim.*
Response: UK is very interesting because it has both extremes, no other countries exhibits the similar situation. Yes, the wording was wrong and has beed changed.

17. *The authors remark that many users did not know about Endpoints (a proposal never officially released with MPI and currently abandoned?), yet maybe the questions should have been rephrased not to ask about a specific solution but more on what Endpoints was trying to address: "Do you wish MPI to be thread-aware?" or "Do you wish an interface that helps with performant multi-threaded interaction with the MPI library?"*
Response: The endpoint topic was very actively discussed at the MPI Forum meetings at that time. Hence, we wanted to know how many users are interested in or have ever heard of that term regardless how much users understand it correctly. We are a bit surprised because the percentage of endpoints are larger than that we thought.

18. *The authors identify a focus on MPI+CUDA as "interesting". Why is this interesting? Which hypothesis could one derive that would/should be tested by a future survey? (The authors should extend the discussion here)*
Response: We are sorry we cannot go into more details here because this is the only information available. Yes, we agree with you to have another survey on this topic.

Comment: *Syntax/Grammar/Wording:*
Response: We fixed everything pointed out.

Responses to Review 3

Comment: *But, it is not clear how the MPI Forum can address this issue,*

since the goal of any standardization body should be define the standard. The MPI Forum already supports several activities such as BoFs and there are a large number of books, free tutorials, and other material available at most HPC centers, in addition to workshops and tutorials dedicated to the use of MPI.

Response: Most of the authors are or were active participants in the MPI Forum meetings. MPI Forum is having BOF meetings at SC, and many MPI Forum members have the experiences of teaching MPI, lecturing MPI, and/or writing MPI books. However, our survey reveals that many MPI users are willing to have another form of MPI information, despite those efforts. The quote at Sec. 6.2 "most of such web pages are out-dated and not kept in sych with todays web standards." get to the point. Most notably one of the authors of the quoted web page is the most active MPI Forum member. Many MPI users are longing to have consistent, up-to-dated, well-structured teaching materials and good examples. It is important to note that from the standpoint of the targeted community, the MPI standard diverges from many other standardization efforts, addressing a community of non MPI-experts computational scientists. Such a large and diverse community need special care, from a clear definition of the terms and conventions to a well-defined behavior of the API. As a broader impact activity and in order to ease the adoption of MPI by a larger community, the MPI Forum itself can take care of the making available a large set of coherent examples and documentation.

Comment: *Data in Brief (optional): We invite you to convert your supplementary data (or a part of it) into an additional journal publication in Data in Brief, a multi-disciplinary open access journal. Data in Brief articles are a fantastic way to describe supplementary data and associated metadata, or full raw datasets deposited in an external repository, which are otherwise unnoticed. A Data in Brief article (which will be reviewed, formatted, indexed, and given a DOI) will make your data easier to find, reproduce, and cite.*

Response: We are happy to do this.