Response to Reviewer 1 Comments

1. Summary

Thank you very much for taking the time to review this manuscript. Please find the detailed responses below and the corrections highlighted in the re-submitted files.

2. Questions for General Evaluation	**Reviewer's Evaluation**	**Response and Revisions**
Does the introduction provide sufficient background and include all relevant references?	Yes	The revisions have been made based on reviewer's comments.
Are all the cited references relevant to the research?	Yes	The revisions have been made based on reviewer's comments.
Is the research design appropriate?	Yes	The revisions have been made based on reviewer's comments.
Are the methods adequately described?	Must be improved	The revisions have been made based on reviewer's comments.
Are the results clearly presented?	Must be improved	The revisions have been made based on reviewer's comments.
Are the conclusions supported by the results?	Can be improved	The revisions have been made based on reviewer's comments.

3. Point-by-point response to Comments and Suggestions for Authors

Comments 1: Section 3.1 begins by rehashing the work of Jia et al. on coplanar line-point invariants (references 12 and 27) but omits so much material that the variables and equations that are included make no sense. This section only needs to explain how the proposed approach makes use of coplanar line-point invariants, not define it from first principles.

Response 1: Thank you very much for your correction; we wholeheartedly agree with your insights. Based on your suggestion, we have deleted the explanation of how coplanar line point invariants work and shifted the focus to how this article utilizes coplanar line point invariants and cited the literature. Indicate the problems solved in this section using point-line invariants. The use of point-line consistency in this article is described. According to the characteristics of the problem solved, this method selects a combination of the feature extraction algorithm sift, the straight line detection algorithm lsd and Muti-GS. Finally, the result diagram of feature extraction using the point-line consistency method is shown. You can find the corresponding revisions in the highlighted yellow portion of L216-L226 in the revised manuscript.

Comments 2: In sections 3.2 and 3.3, standard algorithms from image processing (such as

the Canny filter and morphological dilation) are needlessly described at length when they could be instead referenced by name and cited.

Response 2: Thank you very much for pointing out the inadequacies in our work. Based on your suggestion, we have deleted the detailed description of standard algorithms for image processing (including Canny algorithm and closed arithmetic operations). Describing its usage in this algorithm through the terminology and citation. You can find the respective corrections in the highlighted yellow portion of L231-L233 and L241-L244 in the revised manuscript.

Comments 3: The rest of the text in sections 3.2 and 3.3 (line 267-424), which describes the actual novel elements of the authors' edge contour feature generation and alignment algorithms, is too unclear to follow and needs to be rewritten entirely. This is the most concerning weakness in the manuscript by far.

Response 3: Thank you for pointing this out. Regarding the construction of edge contour features and the implementation process of matching proposed in this article, we have again organized it in detail as a whole. In Sections 3.2 and 3.3, we elaborate on the key steps of the edge contour feature construction and matching algorithm proposed in this paper and emphasize the close connection between these steps. Since many formulas are derived, we explain the meaning of each formula in detail. Description of key steps: The feature construction process is mainly processed on the basis of Canny detection results, because the results generated by Canny detection are composed of multiple local edge objects. The edge contour features are extracted for each local edge object, and the edge tracking method is used to separate the largest possible edge contour. Then peak detection is performed on the contour, and the contour is decomposed to obtain a standard straight line or curve structure. Finally, the edge contours that meet the fitting conditions are merged into a large contour. In the feature matching process, the global homography is calculated to achieve rough alignment of the spliced images, and then the positional relationship of the contour features is judged through the circumscribed rectangle of the edge contour. Finally, multiple factors are considered comprehensively, their matching similarity is calculated, and the matching process is completed. You can find the revised content in Section 3.2 and 3.3 in Materials and Methods. The revision content is in L228-L421. Since there are too many revisions, it is inconvenient to highlight the revisions. Thank you for your understanding.

Comments 4: Section 3.4 rehashes the whole Multi-GS algorithm (reference 26) and should be replaced by more minimal text stating how Multi-GS was used.

Response 4: Thank you very much for pointing out the inadequacies in our work. Based on your suggestion, we remove the restatement of the Multi-GS filtering algorithm. Cite Multi-GS and describe its use in the algorithm of this article. You can find the respective corrections in the highlighted yellow portion of L425-L426 in the revised manuscript.

Comments 5: The grid warping approach in Section 3.5 appears very similar to Section 4 of Jia 2021 (reference 12); please reference this paper again here and explain the similarities and differences to that work.

Response 5: Thank you for pointing this out. Section 3.3 draws on the grid optimization method in the LCP literature. According to your suggestion, our literature has quoted it. Different parts: The constraints of local point features and line features are constraints

included in most current algorithms to ensure the alignment of overlapping areas; But in the local line feature constraints, we not only use the shortest distance from the two endpoints of the matching straight line feature to another straight line as a constraint, In addition, since the short straight line generated by the straight line being cut by different grids has an intersection with the grid, the shortest distance from the intersection to another straight line is used as a constraint. You can find the respective corrections in the highlighted yellow portion of L445-L447,L462-L465 and L475-L477 in the revised manuscript.

Comments 6: Section 4 provides an adequate evaluation of the proposed method against other published algorithms. The authors thoughtfully explain the various parameter values chosen for the experiments. The photographic images are too low-resolution to be able to see anything of interest, but I assume this is just an issue with the review draft.

Response 6: Thank you very much for pointing out the inadequacies in our work. Based on your suggestions, we reran the experiment and formatted the digital information on the image, resulting in a more visually satisfying result. Subsequently, we rearranged these results figures to better and clearly present the experimental results.

Comments 7: The points in Figure 10 don’t seem to bear any relationship to the numbers in Tables 2 and 3; was the wrong figure inserted?

Response 7: Thank you for pointing this out. We insert the calculated fitted values of the contour pairs in the splicing results with contour constraints into the chart as the true values, i.e. the red data. The fitted values calculated for the contour pairs in the splicing result without contour constraints are not the true values, i.e. the blue data. In order to view the distribution gap between them, the difference between the corresponding red and blue values was calculated, and the difference was expanded five times and added to the blue data. In order to facilitate readers' understanding of the results, we have made modifications and inserted all real values into the table. Please note that Figure 10 in the revised manuscript is now Figure 9 due to the deletion of a figure from the original manuscript. You can find the revised results in Figure 9 in the revised manuscript.

Comments 8: It would be helpful to provide plots for the results in Tables 4 and 5 as well.

Response 8: Thank you for your valuable advice. We have carefully considered your opinions and provided corresponding result graphs in Table 4 and Table 5, as well as data analysis through icons to further enhance readers' understanding of our experimental results. You can find the added Figure 12 in the revised manuscript.

Comments 9: The authors must describe the weaknesses and limitations of their algorithm.

Response 9: Thank you for your suggestions on our paper. Based on your comments, we have added a detailed description of the weaknesses and limitations of the algorithm at the end of the conclusion section, as well as an outlook for future research. According to the experimental results of the algorithm running time, it is found that the running time of the splicing algorithm is significantly affected by the complexity of the scene. Especially when processing scenes with a large amount of details or textures and large changes, more computing time is required to match feature points or perform splicing operations, thus affecting real-time performance. According to the different distribution and importance of different types of features in the scene, in splicing scenes dominated by point or straight line features, the registration effect of the edge contour constraint proposed in this article is

slightly insufficient compared to the point-line combination. In view of the above limitations, we propose that future research can optimize the real-time performance of the splicing algorithm, adjust feature matching and constraint strategies in different scenarios, and improve the flexibility of the algorithm. You can find the added content in the highlighted yellow section of L712-L724 in the revised manuscript.