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Sensors-64105-2023 Decision and Recommendations

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IEEE Sensors Journal <onbehalfof@manuscriptcentral.com>

Dec 7, 2023, 8:13 AM

to robmacl, nirupama.ism

07-Dec-2023

Paper:Sensors-64105-2023 Calibration and characterization of electromagnetic position and orientation trackers

Authors: MacLachlan, Robert; Pelle, Claudia; Hollis, Ralph; De Momi, Elena; Riviere, Cameron

Editor: Dr. Nirupama Mandal

Dear Mr. MacLachlan,

I am writing to you concerning the above referenced manuscript, which you submitted to the IEEE Sensors Journal.

Based on the enclosed set of reviews this manuscript is not acceptable for publication in its current form, but may be acceptable after being thoroughly reworked. If you choose to resubmit, please send the reworked manuscript no later than 05-Feb-2024, but preferably as soon as possible. The sooner we receive the resubmission, the better the likelihood that we can utilize the same editor and reviewers. If an extension is needed for any reason, please contact Shivani Chauhan at sensors-admin@ieee.org with an expected date for the resubmission.

Your resubmitted manuscript will require an additional full round of review, but as stated above, we will make every effort to utilize the previous reviewers if possible. Please be sure to mention the original paper number and include a point-by-point response to the reviewer comments in your cover letter and/or File Upload section.

Additionally, as you revise the manuscript, please use the Track Changes feature of MS Word, or a similar method, to show the changes you have made. The changes must be underlined or highlighted in the resubmitted manuscript. This will expedite the re-review process.

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or you can resubmit by accessing your Author Center, going to the "manuscripts with decisions" queue, and then choosing the "submit a resubmission" option. Your manuscript will receive a new ID, but using the resubmission option will automatically link your resubmission to the previous version; please do not create an entirely new submission.

If you have any questions regarding the reviews or this decision, please contact me directly. Any other support inquiries should be directed to Shivani Chauhan at sensors-admin@ieee.org.

Thank you for considering IEEE Sensors Journal for publication of your work.

Sincerely,

Dr. Nirupama Mandal

Associate Editor, IEEE Sensors Journal

nirupama.ism@gmail.com, nirupama.ism@gmail.com

https://mc.manuscriptcentral.com/sensors

Review Comments:

Reviewer: 1

Recommendation: Publish in Minor, Required Changes (as noted in the Comments section. This rating may not be assigned for Sensors Letters.)

Comments:

I believe that this paper should be of interest to researchers working on use of electromagnetics for tracking targets in visually impaired environments.

Following are questions and suggestions for modifications to your manuscript. These are in order of appearance in your manuscript.

On Page 1 of the review document, there is a diagram of the overall system. Is this diagram going to be included in the final manuscript?

* Yes, added

page 3, 2nd column, line 26, what is meant by the term "combinational explosion"? Does this mean a rapid expansion of the number of calculations required to reach a solution?

* Clarified, “This procedure is tedious, and rotation effects have often been ignored, perhaps in part because of the large number of poses that must be tested when rotation and translation are varied simultaneously.”

page 5, 1st column, eqn 3 - should there be a scaling factor?

* Yes, added k\_g and clarified “Where k\_g is a gain constant that in practice we absorb into the calibrated source and sensor moments, §VI.”

page 8, 1st column, line 21 - what is meant by the term "is in common"? Are you indicating that, as there are mirror images of some of the combinations of rotations, only 1/2 the combinations are unique? If this is the case, why can the uncertainty in the positioning of the rotation be ignored?

* Discussion of the rationale behind source and sensor fixturings has been expanded considerably.

The rationale and limitations of the stage and motion scheme need to be laid out more clearly. Maybe have a plot of the point clouds across source fixtures in the source coordinates. We do not access the full hemispherical workspace so that it can be calibrated and tested, and while we do exercise all of the source and sensor rotations (unlike common practice), we do not systematically explore the full 6DOF pose space. As well as not being something that can be done using this sort of positioning hardware, the size of the 6DOF space is daunting in the number of poses that need to be measured.

The limitation to 100mm cube is an unnecessary hardware constraint, there is no reason why a larger range stage could not be used. There would still be mechanical challenges in covering a full hemisphere workspace so far as supporting source and sensor without collisions. Being able to rotate the source is useful for getting all around access because you would not need to access a full hemisphere, but the angular accuracy required is quite high. While also desirable, getting arbitrary 3DOF angular motion at the sensor with magnetic compatibility would also be hard.

page 8, section E. You stated that, as the dimensions of the sensor are much less than those of the source, the source can be regarded as a dipole. This is only true if r >> 4 x diameter source as stated in Ref 25.

* Clarified: “While this is a fairly large 17x15x14 mm sensor (which improves the signal-to-noise ratio) it is still much smaller than the source, so the sensor response is much closer to a dipole than the source field is.”

page 8, section F, the acronym DLT is undefined.

* Fixed, this abbreviation is now defined as Direct Linear Transform in the cross-reference.

page 9, 2nd column, line 25, "model works has" do you mean "model has"

* fixed

page 9, 2nd column, line 35, " paffle.

* Fixed

page 10, Figure 10 comes before Figure 9. Looking at the captions for both figures, it appears as if the existing Figure 10 should be labelled Figure 9 and visa versa.

* Yes, fixed. The cross references had not been updated.

The last sentence of the caption for the exiting Figure 10 appears to be missing some words. At present this sentence reads: "See instead Fig.10 which summarizes this data by the vector magnitudes of direct and cross"

* fixed

If the Figures are relabelled, then the text will need to reflect these changes. For example, on page 10, 2nd column, line 12, Fig. 9 would become Fig 10.

* fixed

In the existing Fig 9, there are plots of errors and non-linearities for the X, Y and Z axes. Reference is made to a plot of "The data in Fig. 9 is here reduced to two curves (see arrows)". These two plots appear to be missing.

* Clarified that we referring to the other figure not this figure. This was extra confusing because of the mixed-up numbers. “In this figure the data in Fig. 9 has been reduced to two curves (see arrows):”

In your discussion section you report that your implementation will be freely available. Can you provide details of how to access your implementation?

* Added “These are available under Apache License 2.0 on osf.io[3].”

Page 12, 2nd column, line 55, there is a missing link to a reference.

Page 13, 1st column, line 13. You state that: "Fortunately, any metallic interference drops as 𝑟^6". Can you provide a reference that explains the mechanism for this level of fall off?

Additional Questions:

1. Is the topic appropriate for publication in these transactions?: Yes

2. Is the topic important to colleagues working in the field?: Yes

1. Is the paper technically sound? If no, why not?: Yes

2. Is the coverage of the topic sufficiently comprehensive and balanced?: Yes

3. How would you describe the technical depth of the paper?: Appropriate for the generally knowledgeable individual Working in the Field or a Related Field

4. How would you rate the technical novelty of the paper?: Somewhat novel

1. How would you rate the overall organization of the paper?: Satisfactory

2. Are the title and abstract satisfactory?: Yes

title and abstract explanation:

3. Is the length of the paper appropriate? If not, recommend how the length of the paper should be amended, including a possible target length for the final manuscript.: Yes

length of the paper recommendation:

4. Are symbols, terms, and concepts adequately defined?: Yes

5. How do you rate the English usage?: Satisfactory

6. Rate the Bibliography?: Satisfactory

1. How would you rate the technical contents of the paper?: excellent

2. How would you rate the novelty of the paper?: sufficiently novel

3. How would you rate the "literary" presentation of the paper?: mostly accessible

4. How would you rate the appropriateness of this paper for publication in this IEEE Transactions?: good match

If you are suggesting additional references they must be entered in the text box provided. All suggestions must include full bibliographic information plus a DOI.

: N/A

Would you recommend this paper for a Best Paper Award?: No

Reviewer: 2

Recommendation: Review Again After Resubmission (Paper is not acceptable in its current form, but has merit. A major rewrite is required. Author should be encouraged to resubmit a rewritten version after the changes suggested in the Comments section have been completed.)

Comments:

The Authors propose a suitable method for EMTS calibrating by investigating the effect of positioning error on calibration accuracy.

The paper is interesting and well structured. Some remarks should be addressed to improve the manuscript.

Please explain the meaning of ρ in first formula

Please enumerate all used formulas

In the section IV the authors introduce matrix multiplication T1 and T2 but these matrices are not used in the formulas

In sub-section VIII.C the authors assert that “The stage position uncertainty is 107 μm,” , please explain how this value was calculated.

* Clarified that this is discussed in the supplement

Please justify the assertion “Non-repeatable variation in the coupling is dominated by drift.

* Drift measurements added to supplement show that the drift is large enough to dominate other error sources.

the authors assert that “To minimize this drift, we powered up the tracker at least 2 hours prior to data collection”. Please explain how the authors have evaluated this time period. It should be useful to show the drift after both 2 hours and 8 hours.

* Clarified that drift is only relevant to the scope of this paper insofar as it affects the calibration process. Added drift plot and further discussion in supplement section IV.

Please justify the selected frequencies values (7.5 kHz, 10.5 kHz and 13.5 kHz) used for sinusoidal signals of three different coils.

* Clarified that hardware design decisions of the ILEMT tracker are outside the scope of this paper, which concerns EMT calibration in general.

Does the proposed algorithm take the non-orthogonality between source and sensor into account?

* Clarified that both default and concentric methods include axis non-orthogonality

The proposed algorithm was tested for small distance between source and sensor (200 mm). Normally the maximum distance for EMTS used in surgical environmental is 500 mm. Do the authors think their technique can be applied for distance close to 500 mm?

* Expanded on the discussion of r/d workspace scaling

Additional Questions:

1. Is the topic appropriate for publication in these transactions?: Yes

2. Is the topic important to colleagues working in the field?: Yes

1. Is the paper technically sound? If no, why not?: Yes

2. Is the coverage of the topic sufficiently comprehensive and balanced?: Yes

3. How would you describe the technical depth of the paper?: Appropriate for the generally knowledgeable individual Working in the Field or a Related Field

4. How would you rate the technical novelty of the paper?: Somewhat novel

1. How would you rate the overall organization of the paper?: Satisfactory

2. Are the title and abstract satisfactory?: Yes

title and abstract explanation:

3. Is the length of the paper appropriate? If not, recommend how the length of the paper should be amended, including a possible target length for the final manuscript.: Yes

length of the paper recommendation:

4. Are symbols, terms, and concepts adequately defined?: Not always

5. How do you rate the English usage?: Satisfactory

6. Rate the Bibliography?: Satisfactory

1. How would you rate the technical contents of the paper?: good

2. How would you rate the novelty of the paper?: sufficiently novel

3. How would you rate the "literary" presentation of the paper?: mostly accessible

4. How would you rate the appropriateness of this paper for publication in this IEEE Transactions?: good match

If you are suggesting additional references they must be entered in the text box provided. All suggestions must include full bibliographic information plus a DOI.

: I don't suggest additional references

Would you recommend this paper for a Best Paper Award?: No

decision and recommendations