Don’t bury the lede.

* If you want to implement an EMT, then here is a way to do the calibration and accuracy testing. Here is the code.
* If you want to understand how an EMT works, then we do this in a clearer way
* We describe a more rigorous approach to characterizing EMT accuracy. (Consider motion error and overfitting.)
* We’ve established some generality of the approach and the code by considering two source designs and two pose solutions/calibration models. Specific comparisons also enable non-arbitrary design choices.

Respect the form:

* Assuming the paper is the only product, how have we added to the body of knowledge?

Polemic:

* How should EMT research be done better? Open science, open design, don’t reinvent. Don’t just tell us that you did XYZ and it worked, prove to us we should do X, Y and Z. Compare things, in as realistic a context as possible. *[This is done most constructively by showing rather than ranting.]*

Use of a clearer matrix/vector formulation of the magnetic tracking problem

Low-order direct linear transform position correction

Comparison of different source designs and pose solution methods, all with all other things held constant.

Open source reusable implementation (open design itself is not unprecedented, what is novel is the implementation itself, including practical qualities such as comprehensibility and generality).

Open science

Use of multiple manual source and sensor fixturings together with fixture transforms in order to evaluate accuracy across large source/sensor rotations and all faces of the source. What happens when the calibration data does not cover the workspace?

Detailed examination of how error is quantified, especially considering that the same motion system is used for calibration and testing.

Method of evaluating the local nonlinearity (derivative of the error), which is a more relevant quantity for most magnetic tracker relative positioning uses than is the error across the entire workspace.

If the goal is to develop an EMT for some particular immediate use, rather than to do research on EMT methods, then the presence of open code and hardware designs are of particular interest. Even in a purely academic context, having existing code to work from allows effort to concentrate on things that actually are novel. The open data and analysis scripts also enable investigations into areas such as pose solution and error correction, without having to first implement a every part of an EMT.

We hope that these codes and techniques will enable future academic and commercial EMT efforts to concentrate on developing new methods and delivering new devices, rather than rediscovery and reimplementation.

Aside from just staking a claim, the novelty discussion should add value. What is there in this paper, and in this project, that I should care about?

Can consider somewhat separately the questions of “*Why should I read this paper?”* and *“What is the significance of the work described?”* There is an elephant on the iceberg, things that we traditionally do not talk about in academic papers, and significance to the body of work which is not delivered in the paper itself. Open science is a new way of doing research. Open source and hardware is a new way of making things.

To me the open aspect seems particularly important, though it is perhaps not so much in the purely academic context, where the goal is for students to have an interesting project to work on for a while, rather than to create a usable system. Where it would really seem useful is in a commercial tracker implementation embedded in some product.

In the paper itself, and the supporting code, there is also useful discussion of how to do the calibration and testing, something that is not well represented in the literature. So this is tutorial content.

Open design enables direct comparison of particular design details such as pose solution and source/sensor design, rather than comparing the performance of entire systems, and not answering what qualities of the system contribute to that performance.

From the viewpoint of improving EMT design, one limitation of comparing the performance of entire EMT systems is that we cannot determine what aspects of a system contribute to that performance (even if the details are known, which they often are not in proprietary systems).

Can I make citations or quantitative arguments about the degree of reinvention that has been prior practice?

Three main threads of literature:

* Incomplete descriptions of commercial trackers, with emphasis on impressive testing procedures. A kind of extended marketing literature. So far as tracker design itself goes, this mainly establishes that particular high-level EMT operating principles have been shown to work: number of coils, type of sensor, etc.
* Efforts by users of EMTs to characterize the performance and improve the accuracy and reliability of various commercial EMTs. This is valuable to EMT users, and helps to convey context dependence of EMT performance, but does little to advance the EMT state of the art because it is unclear what proprietary techniques are used and how they contribute to the overall performance.
* Academic work on improving EMT technology by proposing new methods. Sometimes results are demonstrated by simulation, which does have the advantage of isolating the component under simulation from other systemic effects, but magnetic components such as the source and sensor are often highly non-ideal, and so are difficult to simulate. If actual hardware is developed, then this requires considerable reinvention, but it is impractical to implement all parts of the system to a high standard, and many seemingly arbitrary decisions need to be made. Then, much as with proprietary commercial EMTs, it is unclear how the parts of the system contribute to the overall performance. Either with simulation or experiment, there is frequently no comparison to the results of any other approach.

So, I can criticize the literature, and the current practice, but what is the point? It really only makes sense when I can show that there is a better way, or at least that a different approach answers important needs.

Also bear in mind that the current paper only describes a part of what has been done, and an even smaller part of the (incompletely realized) vision. This wasn’t supposed to be the main thing.

Do open science upload

Push to project github