

Review of:

An Adaptable DTS-based Parametric Method to Probe Near-surface Vertical Temperature Profiles at Millimeter Resolution

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ter Horst and coauthors describe the design strategy, their own implementation, and experimental validation of a novel technique for distributed temperature sensing (DTS) at unprecedented resolution with a tightly wound fiber-optic cable. They take an open-source approach, with design instructions and laser file generation freely available, which I find especially admirable for a project like this which could feasibly be kept proprietary and marketed as a private instrument for sale. Overall, I think the instrument is useful and well designed, and in my review I hope to elevate the reach that it could have to the many communities that surely need finer resolution temperature measurements. After minor revisions I can support the publication of this work.

I will start my review by saying that I am not a regular reader of **Atmospheric Measurement Techniques** which I think is relevant based on some of the feedback that I have about writing style and target audience. Specifically, my two major points of feedback are:

- 1) The article is too fixated on a single use case for the instrument. I am aware that this use case for measuring near surface air temperature in a short canopy is particularly relevant for the readership of the journal, but I can imagine the instrument being useful in so many different ways, and you do mention a few of them (e.g., L82-84). To name a few that would be relevant in my work in the cryosphere:
 - a. soil temperature
 - b. snow temperature (gradients particularly important for avalanche forecasting)
 - c. sea-surface temperature gradient (set up this platform on a floating bouy)
 - d. sea-floor temperature gradient
 - e. ice-shelf front (temperature gradients and micro-currents are extremely important for understanding melt and currently poorly understood).

The point here is not that you need to fully describe every possible use case, but your introductory content should not limit the scope of possible uses. Lead with a paragraph that is generally about how there are often very strong temperature gradients at natural material boundaries but those are generally poorly measured (which is true), then describe DTS in the way you have and reserve and finally that you chose one relevant case as field validation which happened to be this grass canopy environment.

- 2) The manuscript *fee/s* like an instruction manual rather than a scientific article. That may not be a terrible thing, especially for this journal (as I said I am not a regular reader), but it may be a bit dry for a lot of readers. If you choose to limit the instruction manual feel, my suggestions would be to:
- a) Cut down the design section in favor of the reader's attention on subsequent sections which I do think feel more scientific and narrative driven.
 - b) Turn the lists for threshold and optimization criteria into a table or schematic.
 - c) Remove some of the overly specific details such as this sentence: "When the desired cutout path is achieved, the file is exported in an .SVG file." I don't think that the file type is particularly important in a narrative style article but would be important in the instruction manual. I give some other similar examples in the line items below.

I also think it would be neat if you had a fun name for this device, and could consider including that as a part of your title. You call it "the coil" or refer to "the design" and "the frame" throughout, but it would capture the attention of more readers if you had a strong name for the design/device. Something like:

Fine Resolution Adaptable Distributed Temperature Sensing (FRADTS)

Ha, I don't know, just an idea.

Line items

Title - "parametric" is sort of jargon-y in the sense that you are using it and pretty much means the same thing as adaptable.

L8 – "down to" instead of up to?

L8-9 – This sentence about the laser cutout path needs something to make it clear that it is for creating the instrument frame. Something like: "Our method uses a parametric script to specify the laser cutout path for the instrument frame components are assembled in a coil-like structure to hold the DTS fiber."

L10 – “different” and “identically reproducible” are close to each other in an awkward way. I would say that the parameters can be changed to “customize the design” and always in a reproducible way.

L16 – Successful based on what? Specifics here will be more convincing to a reader.

Overall, I would say the abstract should focus more on your FAIR approach and how that could make the product useful to many communities, and don't lead with thermal properties of the grass environment, save that for your description of the field test case.

L106-107 – The numbers 5 mm and 2 mm seem arbitrary here. Is there a physical reason you chose those (i.e., based on the environment to measure)? Or this is just a reasonable goal and you believe your design wouldn't be a sufficiently significant improvement from other methods if this prescribed resolution were not met.

L120-121 – That the temperature measurements should be consistent with the temperature of the medium feels like it should be a threshold criteria to me, perhaps because of how it is phrased? If you dropped this sentence (or moved it to threshold) then the rest of this bullet makes it more clear that you are want to 1) minimize thermal mass to lower the equilibration time of the instrument and frame to the temperature of the medium, and 2) minimize the conductivity so that the frame is not moving heat across the temperature gradient you are trying to measure.

L131-132 – Can you give estimates for cost and fabrication time here? “minimized” is vague.

L135-139 – The description of laser cutting is wordy and not really needed here. Just a brief statement that you have open source laser cutting files and maybe a reference to the laser cutting technique if that exists, those would suffice.

L170 – Just call it the “threshold criteria” since you set that up above, no reason to change to new language for “discrete constraints”.

L181 – “we” not capitalized

L181 – “generation” and “generates” feel weird together, and what is a “new generation script” anyway, just say your approach is novel.

Equation 1 – I didn't fully appreciate until getting to here that you are treating this as a 1-dimensional measurement. That is, that the temperature variation within one coil wrap is effectively averaged over because the along-cable resolution is more like 25 cm, as you say in the abstract. It may be worth more plainly stating this and the assumptions that go with it (i.e., that you are looking for scenarios with a strong temperature gradient in only a single direction).

L192 – “[of] a given step”?

Table 1 caption – Restate “cable height” with the 1000 mm to make it clear that is what you are talking about (third sentence).

1.25 mm resolution along the cable? Is that true or am I misunderstanding what you are stating here? In the abstract you say 25 cm.

L196 – I don’t think that this sentence adds anything of substance. Describe the fabrication and installation and the user can decide for themselves whether it is simple or if they will need some patience.

L204 – How important is it that the winding is consistent or at a specific tension? Does the cable need to be precisely lined up with the wrap above and below it?

L208 – I would save this reference of Figure 5, and perhaps even the mention of the field test, for section 3.2. It feels weird that Figure 5 comes before Figure 6.

L249 – CESAR acronym never defined

L262 – Interrogator malfunction? Or?

L264 – the statement that “the data is still considered sufficient for validation” would be stronger if it was explicitly linked to the next statement: “sufficient for validation because...”

L272 – Is that described in Figure 5? Maybe include some annotation to make it more clear what you are talking about here.

L315 – Is this parenthetical exclamation intentional? I am not sure it is appropriate for this writing style.

L319 – is the bold intentional?

L327 – WMO acronym not defined.

L332-334 – The measurements are also significantly more variable than in the non-rain case. Do you have a simple explanation for that?

L339 – These can be removed, agree, but presumably you would agree that the vertical support structure has the same effect as the horizontal rings and that is much more difficult to remove (also possibly more problematic as it moves heat in the vertical as you mention).

L346 – I am confused about this discussion on horizontal variability since I see more variability in 9a than 9b and that was not mentioned.

L353 – but at 1.5 meters it is an extrapolation instead of a true measurement, correct? Need to say that if true.

Figures

Figure 2. You say that fiber position and spacing is accurately defined “as can be seen in the image”, but it is not entirely clear what you mean by that. You are saying that the spacing between fiber wraps is consistent? Maybe some annotations on the image here would be helpful.

Figure 6. It is not entirely clear how you are extracting the location of maximum gradient from the temperature data. You calculate a numerical gradient between points and select the maximum? And how are the uncertainty bars which you plot calculated? Adding a 1-d temperature plot that indicates the maximum gradient might be helpful here.

Figure 7. More notes and annotations added to the figure would be helpful. For instance, it is not immediately obvious to a reader what is night/day so adding annotations for those would help them see that instantly, also that the horizontal scale between (a) and (b) is very different. Add an arrow pointing out the very thin insulated layer in the grass at the bottom of (b).

Figure 8. Am I understanding correctly that the large blue dot at the top of the grass is a measurement but that at 1.5 m is the extrapolation? If so, I would suggest plotting them differently. Perhaps consider plotting the full line that you are extrapolating, from your measurements to 1.5 m continuously.

Figure 9a. Is the anomalous gradient at the top of your profile one of the “spike-like” artifacts caused by the rings? That one is particularly prominent and warrants more description.