

## Review of „*Modular Hardware and Software System for Multi-Sensor Environment Perception (MOSEP)*“

### **General comments**

In their study, the authors present MOSEP, a novel, portable remote sensing system designed to facilitate multivariate in situ measurements of environmental change processes. This is achieved by combining a wide range of remote sensing sensors on a single data acquisition and storage platform, eliminating the need to install different instruments or align data streams acquired independently. Another significant difference from traditional measurement instruments used in the geosciences is the use of less expensive sensors that were originally built for non-scientific applications; for example, lidar sensors used by the automotive industry. In terms of software, the authors rely on open-source software, which is highly regarded for its usability and reproducibility.

The primary objective of the study is to outline the technical properties of MOSEP. To this end, the text is accompanied by a number of well-designed schematic illustrations and photographs of the hardware and software components used. The second half of the manuscript shows two in-situ measurements (precipitation detection and iceberg monitoring) to demonstrate the potential measurement applications of MOSEP using different sensor configurations. The manuscript is well written and structured. It starts with a general overview of the motivation behind the research and the shortcomings of current in-situ sensors, such as high costs and a lack of interoperability. This is then followed by a detailed description of the platform components and a discussion of their applications. Given its clear focus on in-situ remote sensing techniques, the manuscript's scientific objectives fall within the scope of Earth observation.

Most of my comments are minor and relatively easy to implement. However, I think the manuscript could be substantially strengthened if the authors could elaborate on two more general issues:

- 1) Measurement accuracy of automotive-grade sensors: Using industry perception sensors is an interesting approach to making scientific in-situ measurements more cost-efficient. However, it raises questions about their accuracy compared to traditional geoscience instruments. Throughout your manuscript, you repeatedly state that there are certain shortcomings (e.g. reduced range). It would be interesting to elaborate on these in more depth. Ideally, you would provide a direct comparison between MOSEP and a sensor system typically used in geoscience. Judging by your manuscript, I assume that no reference measurements were taken alongside MOSEP in your case studies. Nevertheless, you could at least expand on the comparison between MOSEP sensors and other 'professional' instruments typically used. This would make it easier for readers to decide whether a degradation in measurement quality (in terms of resolution, range, frequency, etc.) is acceptable for certain use cases.
- 2) Power consumption and weight: Although the authors present a wealth of technical information, I feel that a few important details are missing. Most notably, there is no description of power consumption and supply. While it is clear that power consumption depends on the configuration of the sensors, it would still be interesting to give the reader an idea of what to expect. For example, the power consumption during the two case studies could be presented. Similarly, I missed information on potential power sources (e.g. batteries) and the weight of the field-ready sensor system.

### **Specific comments:**

- Line: 25-26: Add short explanations or example references about what you mean by „advanced use cases“ versus „traditional monitoring“
- Line 27: „ ... the high temporal resolution of automotive sensors ...“ => depending on the sensor high temporal resolution can mean everything from days to milliseconds. I would add a short explanation to what temporal resolution you refer.
- Line 32: „... about 10Hz ...“ In the rest of your paper you state 20Hz
- Line 76-77: I think you could strengthen your argument by precisely stating the gaps that cannot be solved by current techniques. For example, you could add case studies where current measurements are insufficient or where a number of assumptions have to be applied.
- Line 94-104: These two paragraphs are partially redundant because you state multiple times that certain devices are built to be waterproof or resistant to bad weather. I would also remove the sentence in L.96-98 as you stated this already before.
- Line 121: „compare 3“ I guess you mean: compare Figure 3?
- Line 123-124: „SLAM algorithm LIO-SAM“ a reference could be added here
- Line 185: I would simply state that radar can penetrate adverse weather conditions (to a certain degree) which is not possible for optical sensors
- Table 2: It is for sure interesting to see the actual costs of each component. The most expensive category is „Other small parts“. This is stunning because the parts mentioned in brackets should not be very expensive (except maybe the waterproof housing). In fact, this category is responsible for 60% of the total budget. Can you please elaborate on this?
- Figure 2 & 3: a scalebar would be nice
- Line 261-262: „...ROS decouples application logic from the communication layer and provides configurable Quality-of-Service options...“ => Not sure what you mean here, maybe add a more detailed explanation
- Line 317: „...software like Lichtblick ...“ Please add a reference here, e.g. github link
- Line 332-333: „For us, MOSEP, and application specific derivatives of it, evolved to a universal measurement platform and we believe it to be a generally useful tool in geosciences.“ => This sounds like a conclusion which you draw before demonstrating your casestudies to the reader. I would remove this sentence (also the next one on financial risks) and rather focus on the potential applications. This would build a nice bridge to the specific usecases you show in the subsections. Besides, there is a small spelling mistake in „usefull“.
- Line 353-355: Was the main objective to detect and measure the distance to the approaching car? Could be stated more clearly.
- Line 381ff. You state that penetration below water level is possible but depends on incidence angle and distance? Could be stated more clearly.
- Line 454: „MOSEP requires a certain level of technical expertise ...“ Here and in the next sentence you mention a technical documentation (user guide?). Is this online available? If so, please include a link (e.g. in data availability statement). Another option could be to add the documentation as supplementary materials.