Peer review of Intermediary reports

Adrian Cozma, Louise Dompnier, Nicolas Sozzi

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This document reviews the *Intermediary Report: Empirical modeling of the dynamic behavior of a non-homogeneous cylinder* by Tiphany Thaiduc and Louis Maillard. The most important comments are marked with **[*]**.

1 Clarity and organisation

- The report's **structure** is clear, with labelled sections and a logical order. Maybe the **goal** of the project, "to experimentally determine the optimal weight distribution along the rods that minimizes the cylinder's travel time" could be mentioned earlier on in the introduction, or even before, so that the reader can clearly identify it.
- The **schemes** are useful and well realized.
- The **mind map** is perfect and very clear.
- The **"feasibility" subsection** adds credibility by testing measurement precision. However only 5 measurements were made for the "close weighs" case, and two for the "far weighs" one. This difference is not explained, and more repetitions would strengthen the statistical confidence. Nevertheless, the standard deviation of 142 ms seems to be of the right order of magnitude.
- In the explanation of strategies and in conclusion it is written that the experimental space has been reduced from 256 to 64 relevant configurations, but in paragraph 3.2, it is stated that the number of possibilities is reduced to 55 points.

2 Methodology

- The **factors** are well defined at the beginning of the report in the mind map, as well as the **output variable** t, which ensures reproducibility.
- **[*]** Different **designs** were suggested, which is great, but the **chosen points** are not really justified. It does make sense to focus on a particular set of measurements for a given design but from our opinion it would also be justified to check if your design can be improved. Maybe you have another set of 4-measurements that are more precise i.e the det. of the dispersion matrix is smaller. Since you didn't mention how you chose your square design, one can only assume that it is random.
- It is a great option to settle on a design for future tests but unfortunately we don't think that **Hadamard** is adapted since the points will never be orthogonally dispatched. You could for instance mention that you think it's interesting to study a **Hadamard "like"** model but can not quite reach it.
- The mention of **Anova** in the "Next Steps" section reflects strong awareness of the need for rigorous statistical validation in future stages.
- We think it is really nice the way you explained the models and how you develop them. You started really easy with the **linear model** without interactions. Then you tried to show that this model is not suitable for this experiment. Progressively, you went to the **linear with interactions** and **quadratic** which was really pleasant to go through.

- One of the last thing we noticed is in your **theoretical assumptions**. In a very nice way you tried to explain simply how the system could behave, ideally, but unfortunately your assumptions are not quite correct. In this case the acceleration is not constant because the centre of mass is not translated parallel to the inclined plane. $\ddot{\theta}$ is actually a function of time i.e. $\ddot{\theta}(t)$.

3 Data and assumptions

- The **materials** and their densities are well-documented, which is helpful for reproducibility. To improve completeness, details such as the cylinder's width, total mass, and measurement **uncertainties** should also be included.

- Maybe the **design matrices** could be included as it is essential data to analyse the quality of the models explored.

- **[**]** The plots (Figures 3-5) indicate that the data were **normalized**, which is appropriate for computing the VIF or the variance function. However, the normalization was performed **between** 0 **and** 1, implying a mean value of 0.5. This approach does not ensure orthogonality between the main effects and interaction terms, which may explain why the **variance function** (incorrectly referred to as VIF) exceeds 6. The authors appear to have confused the variance function with the VIF; unlike the VIF, the variance function can legitimately exceed this threshold. A normalization **between** -1 **and** $+1$ would likely produce significantly better orthogonality and improve the overall model quality.

- Although **variational analysis** is used, no quantitative results (e.g., specific **VIF** values) are reported in detail. Including those in a table for instance would strengthen the methodological transparency.

Conclusion

The report is well-structured, and explores interesting possibilities. We think you chose a great direction for your DOE and modulo some corrections to your results and interpretation you should stay on the same track. Don't forget to reconsider the theory, the variance function, VIF, the normalization of your plots and which model is suitable. From our point of view these are the main points you should focus on in the future. Besides that, the report was clear and really pleasant to read showing that you know how to structure a clear report.