A Method Comparison Study Between Open-Source and Industrial Environmental Loggers - Abstract

Evmorfia P. Bataka[1], Christos T. Nakas[2]

[1]Laboratory of Biometry, Dept of Agriculture, Crop Production and Rural Environment, University of Thessaly, Volos, Greece; e-mail: bataka@uth.gr
[2]Laboratory of Biometry, Dept of Agriculture, Crop Production and Rural Environment, University of Thessaly, Volos, Greece

Summary

Open-source software and hardware can be implemented almost in every field that includes technology and automations. We will address the issues of Agreement, Reliability, Precision and Sustainability of open-source devices against industrial equipment during an agricultural experiment at the experimental greenhouses of the University of Thessaly, Velestino, Greece. Open-source alternatives are low cost, user-friendly that can be applied to the equipment according to the needs of the scientist and a huge community that supports the users. On the other hand, industrial choices are, most of the time, rigid when it comes to modifications and the cost forbids conducting experiments that require specialized equipment. However, industrial equipment is fully tested and reliable. Agreement and Similarity analysis will be performed between an open-source Arduino compatible environmental data logger and an industrial weather station.

Agreement and Similarity evaluation is the most efficient and trustworthy method comparison analysis when it comes to comparing two or more devices, methods or treatments. Many publications that compare devices, methods or treatments use the correlation coefficient, MSE or other metrics that have been proven to be misleading. Furthermore, the usual metrics do not reveal the source of disagreement, while combining plots like Bland-Altman, Trellis, Agreement, Total Bias, Percentage Agreement and MSE, enriches an agreement study and provides a complete review about both sources of agreement and disagreement. The most appropriate agreement and similarity measures to be used are TDI (total deviation index) and CCC (concordance correlation coefficient) but others will also be investigated.

We create a guide that provides all measures, plots and methods of Agreement and Similarity with their corresponding advantages and disadvantages, that will help researchers analyze and further improve the quality and robustness of relevant research. Our work also addresses methods of implementing this research to STEM learning in order to make environmental monitoring processes easy and understandable to a wide range of audiences and allow them to get involved in the process of construction/evaluation of open-source devices and make cross curricular integration possible. After a pilot experiment for the comparison of the two devices measuring air

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temperature, the evidence revealed heteroscedastic data. Solutions include longitudinal, mixed-effects and measurement error models. This is a work in progress.

Keywords: Statistical Agreement and Similarity; Open-Source loggers; STEM learning; Environmental Monitoring.

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