Upgraded Emissometer at the University of the Basque Country

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The HAIRL emissometer (High Accuracy Infrared Radiometer, Leioa) is a mid-infrared emissometer that was designed and built at the University of the Basque Country (UPV/EHU) [1]. The instrument can measure spectral directional emissivity in the range between 0.83 and 25 µm, and it is equipped with an electric heater that can increase the surface temperature of the samples up to 1273 K. During 20 years of service, the instrument has undergone instrumental and methodological updates, such as the development of specific uncertainty budgets and the implementation of a Monte Carlo method to propagate uncertainties when integrating spectral and directional data [2].

However, the emissometer required an update to replace some of its core components, such as the FTIR spectrophotometer, which led to an integral upgrade that went beyond the mere substitution of the instruments. We present the total renovation performed to the HAIRL, which consists of three blocks: hardware, software and methodology. The hardware renewal is based on the use of control-design paradigms that allow the construction of scalable and maintainable instruments. Based on this philosophy, we have upgraded or replaced most of the devices that constitute the instrument. Among other modifications, we replaced the previous FTIR by a Bruker Vertex 80v, improved the sample heating system, redesigned the temperature measurement system and installed a new low-temperature blackbody. Regarding the software, we have not only rebuilt all the communication protocols between the different devices and the control-computer using an expandable software-design, but we have also implemented a monitoring system based on new technologies such as InfluxDB and Grafana. The system can be completely controlled and monitored remotely, and it will be able to measure autonomously. Finally, all these technical improvements permitted us to adopt a new uncertainty budget, which treats statistically magnitudes such as the spectra measured by the FTIR or surface temperatures, and allows discarding anomalous data.

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