



DIARIT^{Sup}: a framework to supervise live measurements, Digital Twins models computations and predictions for structures monitoring.

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DIARIT^{Sup} is a chain of various softwares following the concept of "system of systems". It interconnects hardware and software layers dedicated to in-situ monitoring of structures or critical components. It embeds data assimilation capabilities combined with specific Physical or Statistical models like inverse thermal and/or mechanical ones up to the predictive ones. It aims at extracting and providing key parameters of interest for decision making tools. Its framework natively integrates data collection from local sources but also from external systems [1, 2]. DIARIT^{Sup} is a milestone in our roadmap for SHM Digital Twins research framework. Furthermore, it intends providing some useful information for maintenance operations not only for surveyed targets but also for deployed sensors.

Thanks to its Model-view-controller (MVC) design pattern, DIARIT^{Sup} can be extended, customized and connected to existing applications. Its core component is made of a supervisor task that handles the gathering of data from local sensors and external sources like the open source meteorological data (observations and forecasts) from Météo-France Geoservice [4] for instance. Meanwhile, a recorder manage the recording of all data and metadata in the Hierarchical Data Format (HDF5) [6]. HDF5 is used to its full potential with its Single-Writer-Multiple-Readers feature that enables a graphical user interface to represent the saved data in real-time, or the live computation of SHM Digital Twins models [3] for example. Furthermore, the flexibility of HDF5 data storage allows the recording of various type of sensors such as punctual sensors or full field ones. Finally, DIARIT^{Sup} is able to handle massive deployment thanks to Ansible [5] automation tool and a Gitlab synchronization for automatic updates. An overview of the developed software with a real application case will be presented. Perspectives towards improvements on the software with more component integrations (Copernicus Climate Data Store, etc.) and a more generic way to configure the acquisition and model configuration will be finally discussed.

References

- [1] Nicolas Le Touz, Thibaud Toullier, and Jean Dumoulin. "Infrared thermography applied to the study of heated and solar pavement: from numerical modeling to small scale laboratory experiments". In: SPIE - Thermosense: Thermal Infrared Applications XXXIX. Anaheim, United States, Apr. 2017. url: <https://hal.inria.fr/hal-01563851>.
- [2] Thibaud Toullier, Jean Dumoulin, and Laurent Mevel. "Study of measurements bias due to

environmental and spatial discretization in long term thermal monitoring of structures by infrared thermography". In: QIRT 2018 - 14th Quantitative InfraRed Thermography Conference. Berlin, Germany, June 2018. url: <https://hal.inria.fr/hal-01890292>.

[3] Nicolas Le Touz, Thibaud Toullier, and Jean Dumoulin. "Study of an optimal heating command law for structures with non-negligible thermal inertia in varying outdoor conditions". In: *Smart Structures and Systems* 27.2 (2021), pp. 379–386. doi: 10.12989/sss.2021.27.2.379. url: <https://hal.inria.fr/hal-03145348>.

[4] Météo France. Données publiques Météo France. 2022. url: <https://donneespubliques.meteofrance.fr>.

[5] Red Hat & Ansible. Ansible is Simple IT Automation. 2022. url: <https://www.ansible.com/>.

[6] The HDF Group. Hierarchical Data Format, version 5. 1997-2022. url: <https://www.hdfgroup.org/HDF5/>.