Design and study of an instrumentation and software for permanent monitoring of a cable-stayed bridge

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ABSTRACT

These past years, a renewed interest in permanent monitoring of the structural behavior of civil infrastructures was observed, particularly for bridges. In this study, we present the dynamic monitoring of the Éric Tarbarly bridge in Nantes, France. It is a 210m long cable-stayed road bridge, crossing the Loire River which was inaugurated in 2011. Periodic or permanent dynamic monitoring (*e.g.* with relatively high sampling rate) enables the characterization of the response of the structure to dynamic loads such as traffic, wind or earthquakes. It also allows to follow the temporal evolution of the modal parameters of the structure. As a consequence, one of the main challenge is to distinguish the variations of the modal parameters of the structure due to damages from the ones due to environmental variations [3].

To achieve such purpose, we first present a real-time monitoring system that integrates an in-house manufactured hardware "Pegase". This generic acquisition platform was designed for the structural health monitoring field. In particular, the last version enables acquisition on multiple channels up to 30kHz, with the advantage of being time-stamped and more particularly in phase with the last version, a very important feature when merging multi-sensor data [2]. In our project, the Pegase system is implemented with 8 mono-axial accelerometers synchronized with a sampling rate of 100Hz. Then, data from those sensors are gathered by a framework developed in our laboratory [1] and recorded in a standardized Hierarchical Data Format (HDF5) file format ; able to handle a large number of data. Finally, adding weather stations, to characterize environmental influence parameters, may generate a raise of complexity in maintenance operations due to the required location of such sensors around a real structure. To skip such potential issue, we propose and compare the use of different meteorological data sources for modal analysis corrections. More precisely, a comparison of modal analysis using local weather data, online data from network weather stations such as Meteorological Airport Report (METAR) and meteorological data from Copernicus European program is proposed and discussed.

Finally, conclusions are proposed and perspectives toward the use of on-demand digital twin live computation for direct feedback of the cable-stayed bridge state are discussed.

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