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”SYSID#1 - Comparative study of the first bending modes of a cantilever beam from a video measurement”

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Today, there is a real interest in using video cameras for operational modal analysis or preventive maintenance applications rather than using traditional sensors. Indeed, the video camera allows a non-intrusive diagnosis and allows a synchronous measurement of displacement and deformation, all with few cables and equipment. The potential of video-based vibration monitoring is all the more interesting because it could potentially be achieved in the future by using any smartphone. The objective of this work is to provide a new methodology of operational modal analysis adapted to the bending vibrations of the beams from video measurements. The major advantage of video measurements is the spatial resolution of the observations: a pixel can be seen as a sensor in its own right as long as its spatial position can be estimated throughout the acquisition. Comparative measurements with a scanning laser Doppler vibrometer will be performed on a more limited number of points. This work presents in detail the steps prior to the comparison, which are particularly influential on the conclusions concerning the estimation of the Modal Assurance Criterion (MAC). Indeed, it is necessary to compare what is comparable: the video camera gives information for each pixel while the scanning laser Doppler vibrometer gives information on a pre-defined mesh. It is therefore important to be able to match pixels to points on the mesh by performing spatial synchronization operations. A comparative study is implemented on a test bench presenting a cantilever beam and observed with a high-speed camera (more than 2000 frames per second). In order to study a maximum of modes and to know if the camera is able to observe the first bending modes despite their low amplitude, a random excitation (white noise) excites the beam. The parameters of the first bending modes estimated by the video camera are compared to those obtained by the scanning laser Doppler vibrometer.

Presenter(s) : TOUZET JIMMY

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