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Synchronicity phenomenon of circular cylindrical shell under random excitation

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Abstract: In the present paper is deeply described an experimental campaign focused on the random vibrations of circular cylindrical shells under thermal gradients across the shell thickness and broadband random loading. Many engineering fields are involved in this subject and in real environments, the excitations are likely non-deterministic, moreover, extreme thermal conditions can cause differences of the temperature inside and outside the shell, as in thermal ex-changers. Due to the importance of the subject the literature on shell vibration is extremely wide, it is not analyzed here for the sake of brevity; however, it is to note that the number of papers containing experimental results is not large. Under a random forcing, a system generally expects a random response, however, in some particular conditions (e.g. internal resonances, parametric resonances, ...) the presence of nonlinearity in the systems can give rise to a surprising phenomenon: the synchronization of non-linear oscillators subjected to random forcing that has been partially studied in the literature for its remarkable characteristic of conveying the spectral energy of a random forcing over specific frequencies. This work takes advantage of previous setup and experimental techniques developed by the present research team. The phenomenon of synchronicity is clearly observed for some particular thermal conditions: a strong transfer of energy from a broadband excitation signal to an almost harmonic response is experimentally observed.

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