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# ”SYSID#5 - Estimation of the piezoelectric factor in nonlinear transducers”

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This study focuses on the characterisation of non-linear and piezoelectric systems. The behaviour of a structure displaying a geometric elastic nonlinearity and coupled to piezoelectric elements is explored. The elaboration of piezoelectric transducers is based on the maximization of their coupling factor to ensure optimal performances. The measurement of the coupling factor is thus a key step in the design of a non-linear piezoelectric transducer. In the case of linear transducers, several equivalent definitions based on mechanical parameters are used to estimate the coupling. The differences between the short-circuit (SC) and open-circuit (OC) behaviours are exploited to assess the electromechanical conversion taking place. The validity of the equations based on natural frequencies, stiffness and energies are questioned in the non-linear case. The definition based on energy transfer inside the resonator could be extended to evaluate its coupling. For a non-linear and piezoelectric ensemble, it is supposed that the coupling will vary with the amplitude of the device. The coupling would not only be function of the equivalent parameters but also of the usage range. An experimental study is performed an on a clamped-clamped beam covered with piezoelectric patches. A first methodology based on a mechanical quasi-static cycling in open and closed circuit is proposed to estimate the coupling for a given solicitation. A loading and unloading cycle is performed while switching the electric condition between the two steps. Cycles were performed for increasing solicitation levels to visualize their evolution. This study can be performed by prescribing either the displacement or the force. The equivalences between these two commands and the order of the OC and SC steps are further questioned. A numerical model is developed to better apprehend the portion of mechanical and electrical energies to considerate, in order to understand the impact of the geometric non-linearity on the piezoelectric elements. A second dynamical experiment is conducted to extend the equations based on the OC and SC frequencies of the system. The piezoelectric beam is mounted on a vibrating to assess the evolution of its backbone with the amplitude solicitation. The two results are then confronted.

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