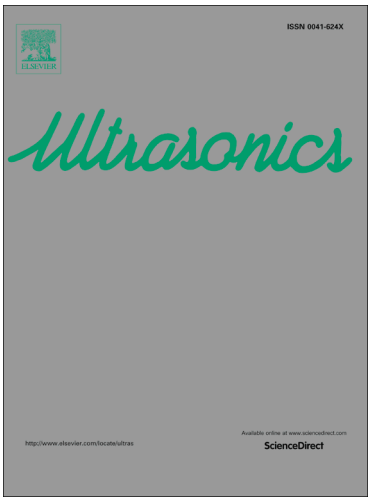

Modal analysis and nonlinear characterization of an airborne power ultrasonic transducer with rectangular plate radiator

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Modal analysis and nonlinear characterization of an airborne power ultrasonic transducer with rectangular plate radiator

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Abstract.-

Some industrial processes like particle agglomeration or food dehydration among others can be enhanced by the use of power ultrasonic technologies. These technologies are based on an airborne power ultrasonic transducer (APUT) constituted by a pre-stressed Langevin-type transducer, a mechanical amplifier and an extensive plate radiator. In order to produce the desired effects in industrial processing, the transducer has to vibrate in an extensional mode driving an extensive radiator in the desired flexural mode with high amplitude displacements. Due to the generation of these high amplitude displacements in the radiator surfaces, non-linear effects like frequency shifts, hysteresis or modal interactions, among others, may be produced in the transducer behavior. When any nonlinear effect appears, when applying power, the stability and efficiency of this ultrasonic technology decreases, and the transducer may be damaged depending on the excitation power level and the nature of the nonlinearity. In this paper, an APUT with flat rectangular radiator is presented, as the active part of an innovative system with stepped reflectors. The nonlinear behavior of the APUT has been characterized numerically and experimentally in case of the modal analysis and experimentally in the case of dynamic analysis. According to the results obtained after the experiments, no modal interactions are expected, nor do other nonlinear effects.

Keywords: Airborne power ultrasound, ultrasonic transducers, modal analysis, non-linear effects, finite element analysis