

Study about the influence of the shape of a horn in the mechanical behavior of an airborne power ultrasonic transducer with rectangular radiator.

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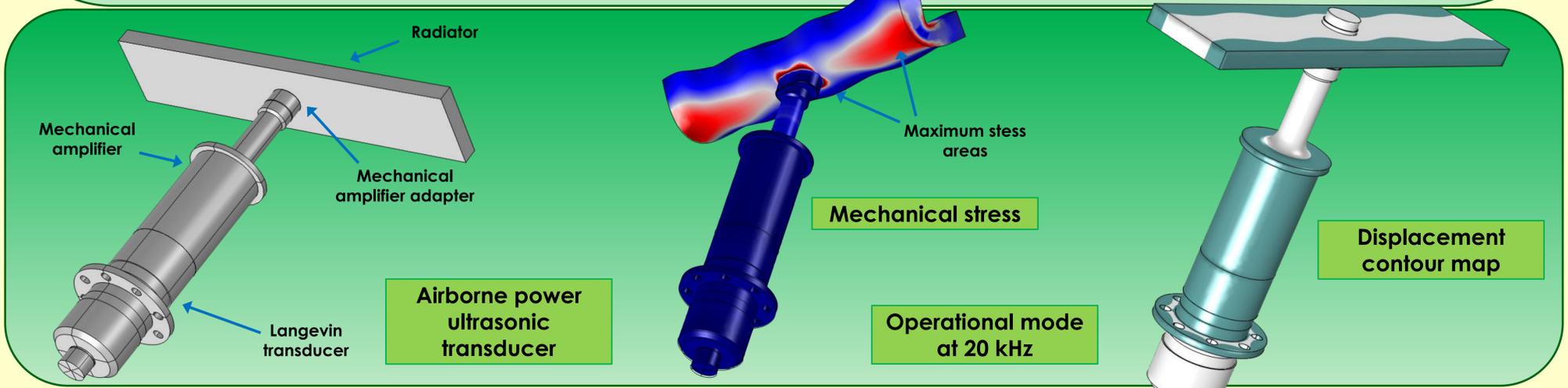
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Introduction: Industrial processes assisted by airborne power ultrasound have become an attractive field for industries because of its sustainability (low energy consumption, non-pollutant or green processes). In order to obtain the desired effects, the airborne power ultrasonic transducers (APUT) have to work properly, vibrating at the desired frequency and achieving high values of displacement with a minimum mechanical stress in its different constitutive parts.

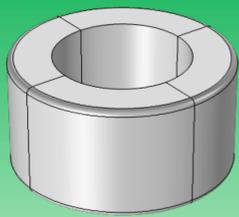
The mechanical amplifier, composed by a metallic element with two different sections, is the part of the transducer where the highest displacement amplification takes part, and also a part where high mechanical stresses occur, mainly in the connection point with the plate radiator.

In order to assess the influence of the shape of the mechanical amplifier (more specifically the shape of the contacting area between the mechanical amplifier and the radiator) in the behavior of the APUT, a series of numerical simulations have been carried out.

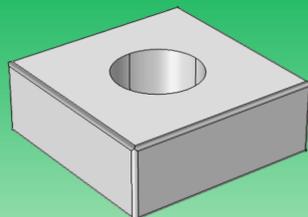
The goal of this work is to show the results regarding displacement amplification and mechanical stress, obtained by numerical methods, of an airborne ultrasonic transducer with rectangular radiator and five different shapes of mechanical amplifier adapters.



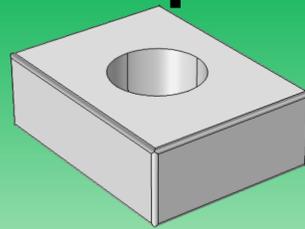
Mechanical amplifier adapters



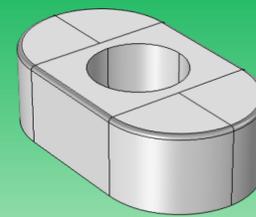
A – Circular shape
d=10.5 mm



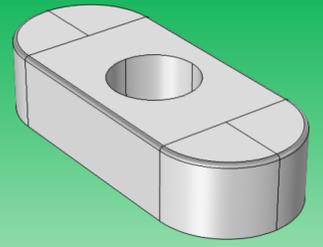
B – Square shape
l=25 mm



C – Rectangular shape
21 x 27 mm

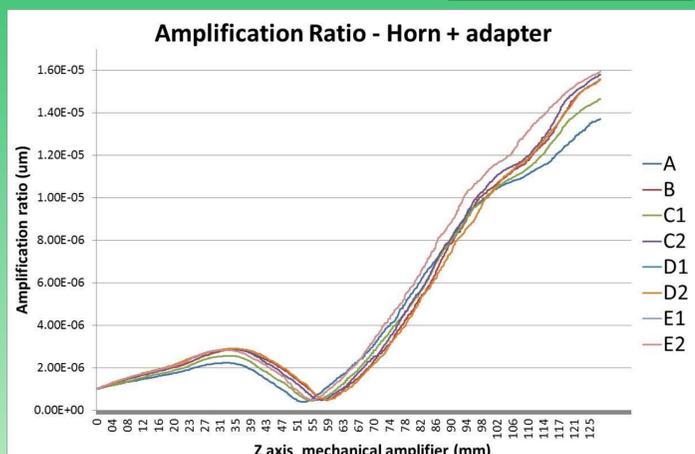
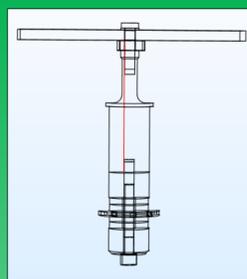


D – Long shape 1
18 x 32 mm

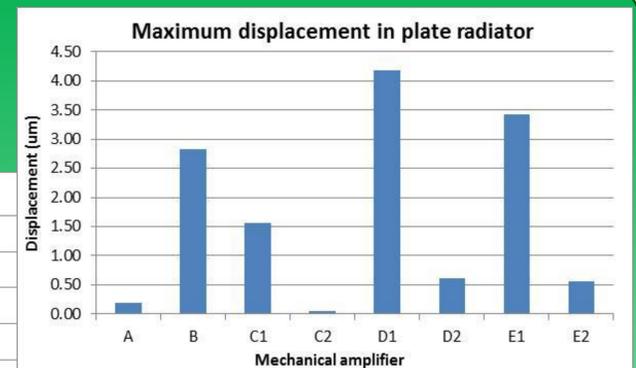
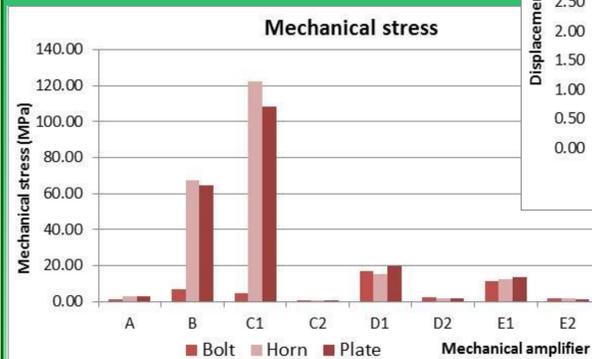


E – Long shape 2
18 x 44 mm

Effect of the adapters in horn's amplification



Simulation under operational conditions



Direction 1 – Paralell to the nodal lines
Direction 2 – Perpendicular to the nodal lines

Shape D, long side parallel to the nodal lines– Highest displacement.

Shape C, long side parallel to the nodal lines– Highest mechanical stress in the bolt and the plate

Conclusion: This work has dealt with the effect of the mechanical amplifier in the whole behavior of an APUT. The numerical analysis of the shape of the mechanical amplifier adapter indicates that long shapes (D and E) parallel to the nodal lines of the operational mode provide higher displacements of the plate radiator with smaller values of mechanical stress in the plate, bolt and horn.

Acknowledgments: This work has been supported by the project DPI2012-37466-C03-01 funded by the Spanish Ministry of Economy and Competitiveness.