A planar Bézier horn with high displacement amplification and low stress concentration

![Bézier horn diagram](image)

**Design**

**Profiles of horns**

- Catenary
- Stepped
- Linear

Design of the Bézier horn is based on an optimization procedure where the profile of the horn is optimized via the parameters of a cubic Bézier curve to meet the requirement of displacement amplification.

**Simulation results**

- Displacement amplification
- Stress distribution

**Experiments**

- Fabricated horns
- Experimental setup

**Experimental results**

- Horn: Bézier
- Specimen material: potato
- Penetration speed: 0.2 mm/s.
- Penetration force with the ultrasonic excitation is approximately 30% of that without ultrasound.

- Penetration force required to enter the workpiece using the Bézier horn is 75% of that of the traditional catenary horn.
- The decrease in the penetration force is due to the high displacement amplification of the Bézier horn.