The Effect of Honeycomb Cavity: Acoustic Performance of a Double-leaf Micro Perforated Panel

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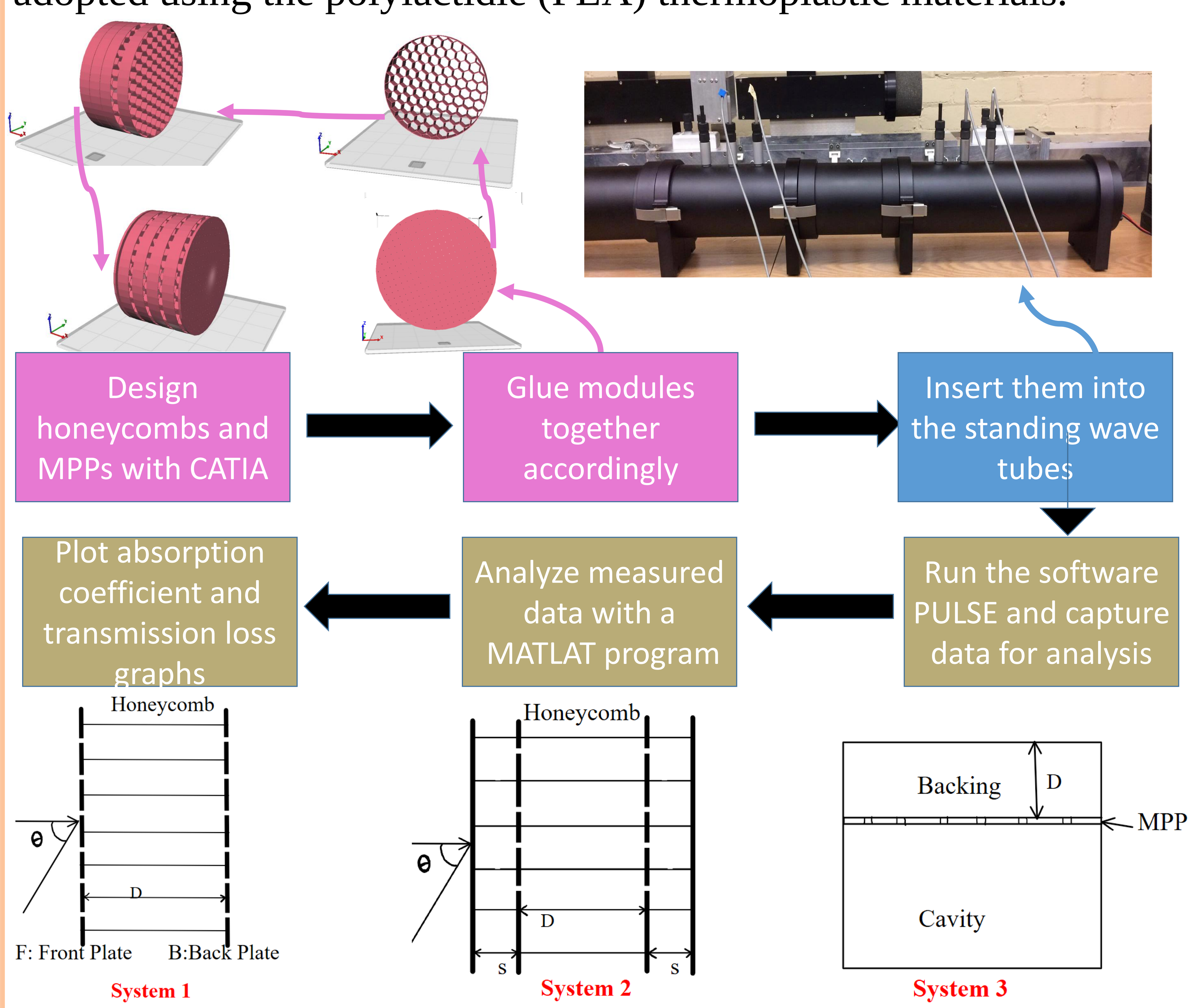
Introduction

- A micro-perforated panel (MPP) is a device consisting of a thin plate with submillimeter perforations and a backing cavity for reducing low frequency noise.
- Advantages compared to traditional sound absorption materials: recyclable, cleanable, durable, aesthetically pleasing, lightweight, can withstand high temperatures or severe environments.
- Applications: Acoustic window systems, duct silencing systems, noise barriers, passenger and crew compartments of aircrafts, noise reduction in combustion engines, etc.
- Honeycomb cavity partitioning in MPPs: improves acoustical performance and structural integrity.

Materials and Methods

The perforations would be made using laser cutting technology but it is costly. In the current project, the 3-D printing technology is adopted using the polylactidie (PLA) thermoplastic materials.



Results and Discussion

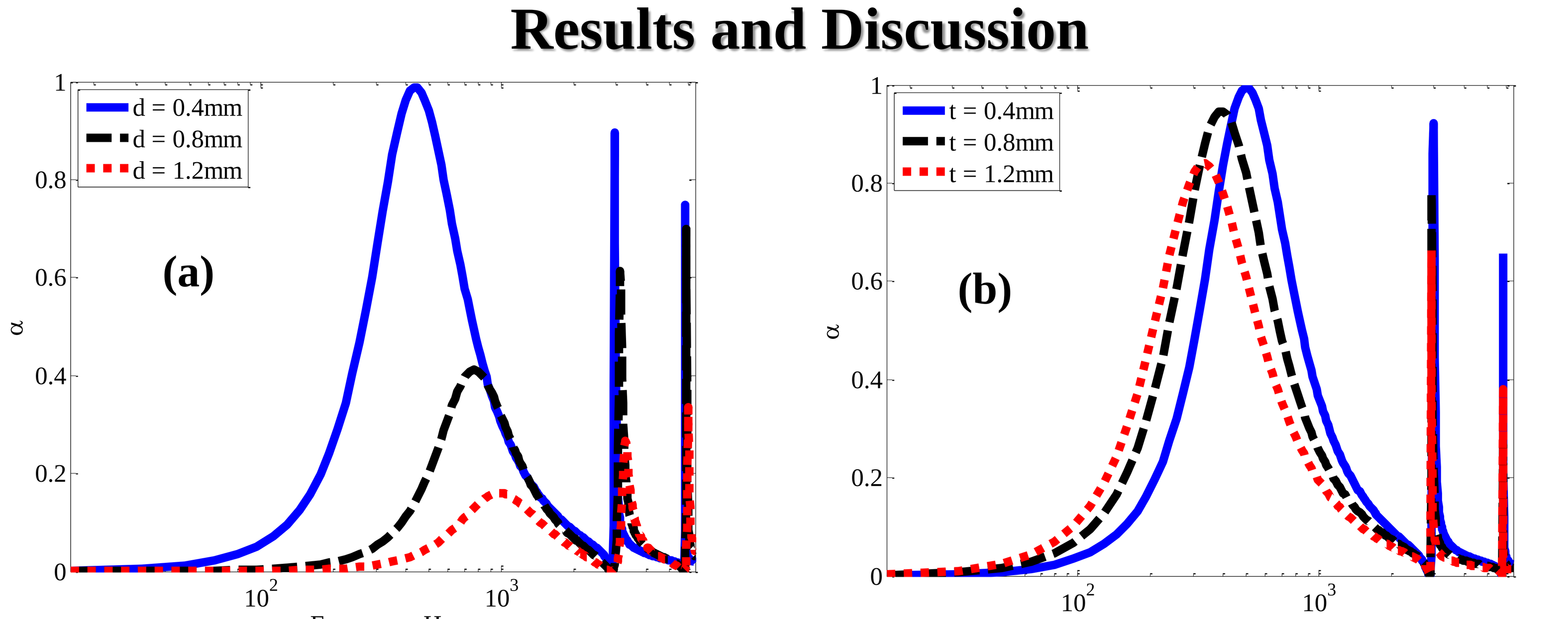


Figure 1: *System 3 Absorption Coefficient : (a) Effect of the Thickness, t = 0.6mm, D = 60mm; (b) Effect of the Diameter of the Perforations, d = 0.4mm, D = 60mm*

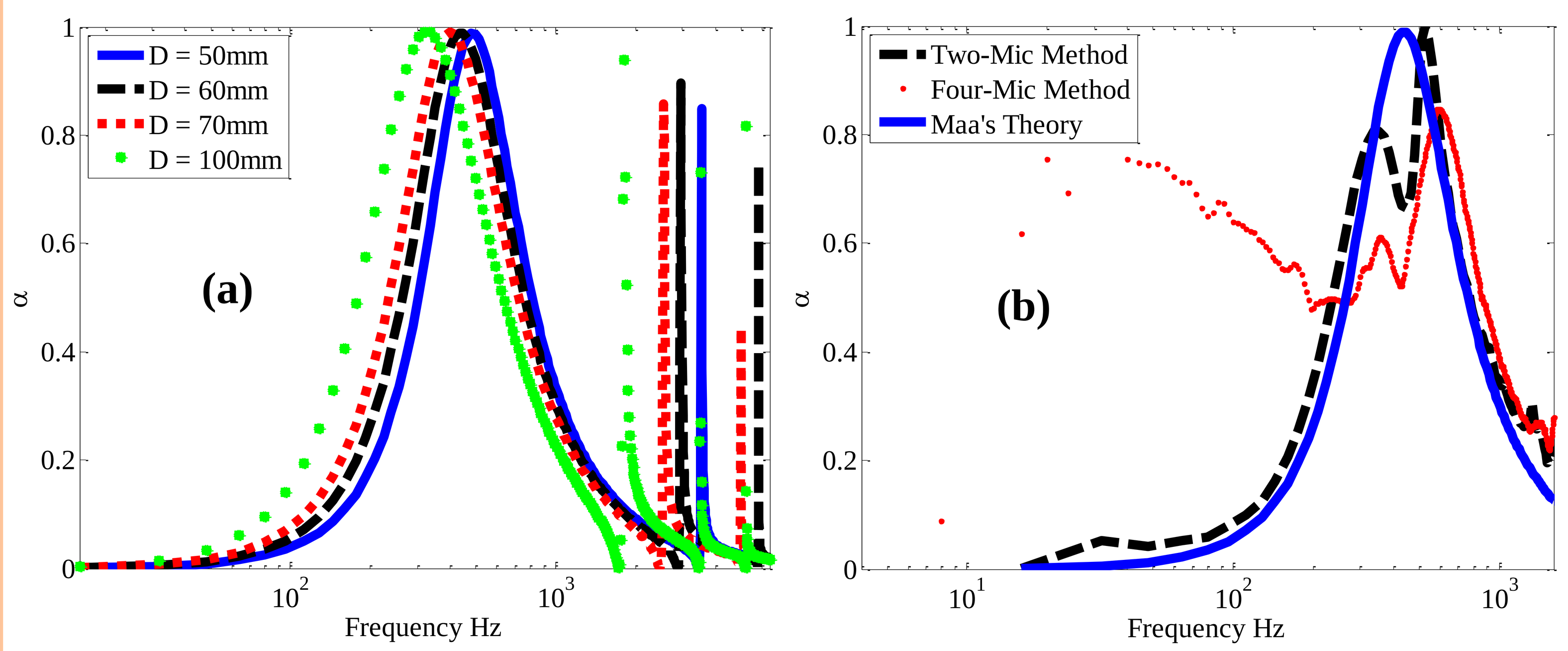


Figure 2: *System 3 Absorption Coefficient : (a) Effect of the Backing Length of the MPP, t = 0.6mm, d = 0.4mm; (b) Comparing Theoretical and Experimental Results Using Different Methods (10cm Tube)*

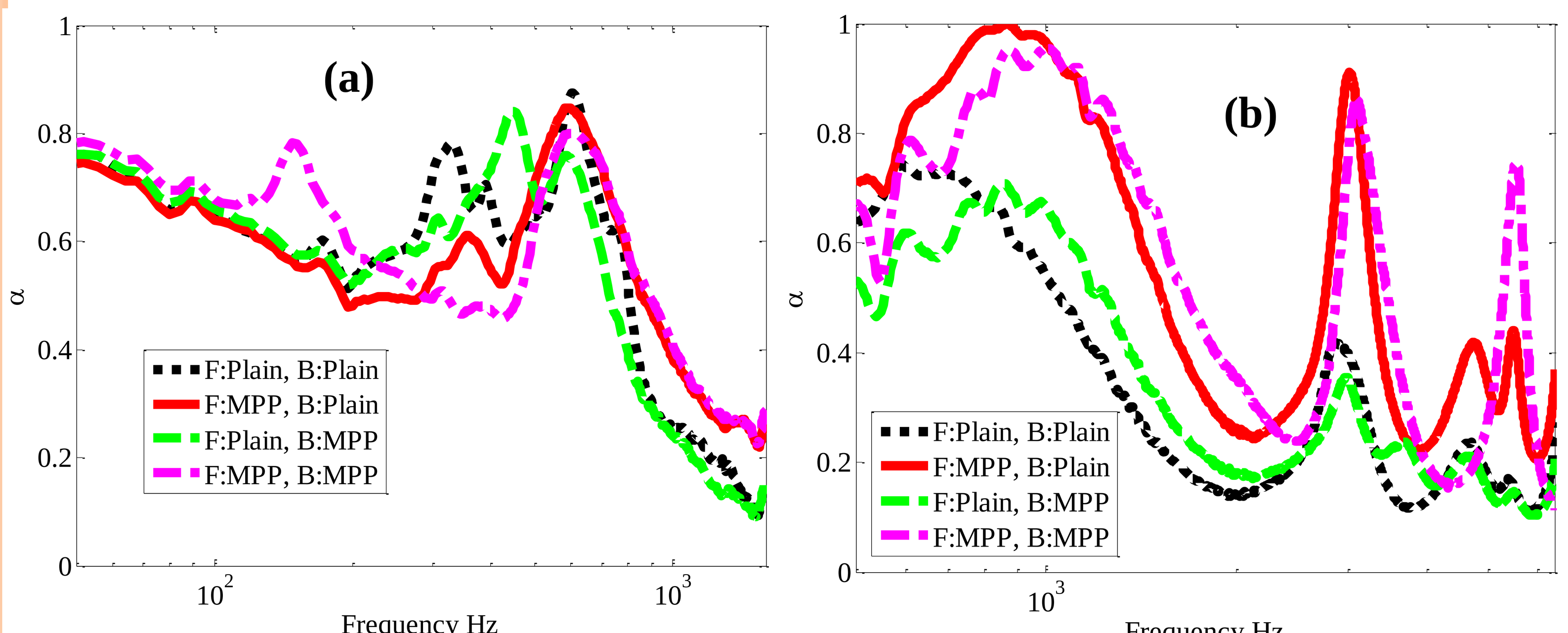


Figure 3: *System 1 Absorption Coefficient: D = 6cm. (a) 10cm Tube Results; (b) 2.9cm Tube Results. (Plain: A Plate without Perforations)*

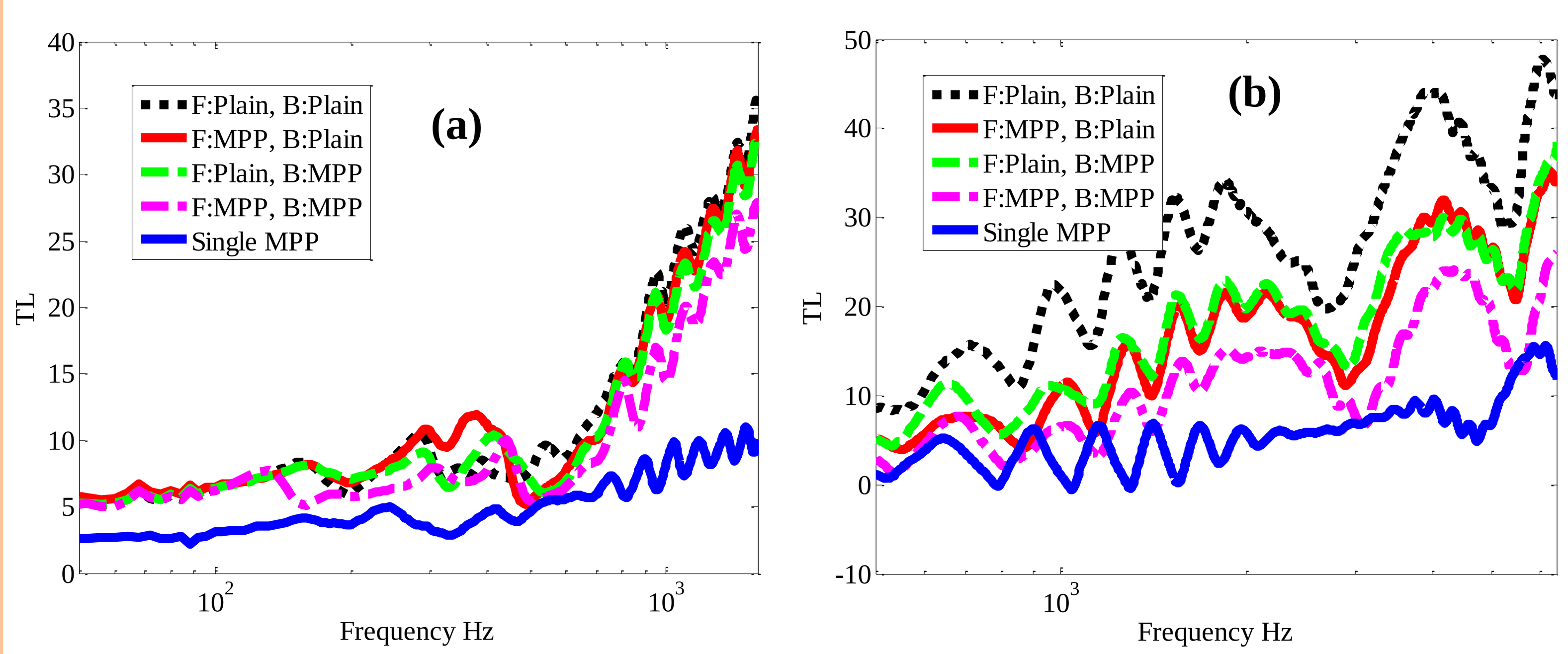


Figure 4: *System 1 Transmission Loss: D = 6cm. (a) 10cm Tube Results; (b) 2.9cm Tube Results. (Plain: A Plate without Perforations, Single MPP: An MPP without Honeycomb Cavity Partitioning)*

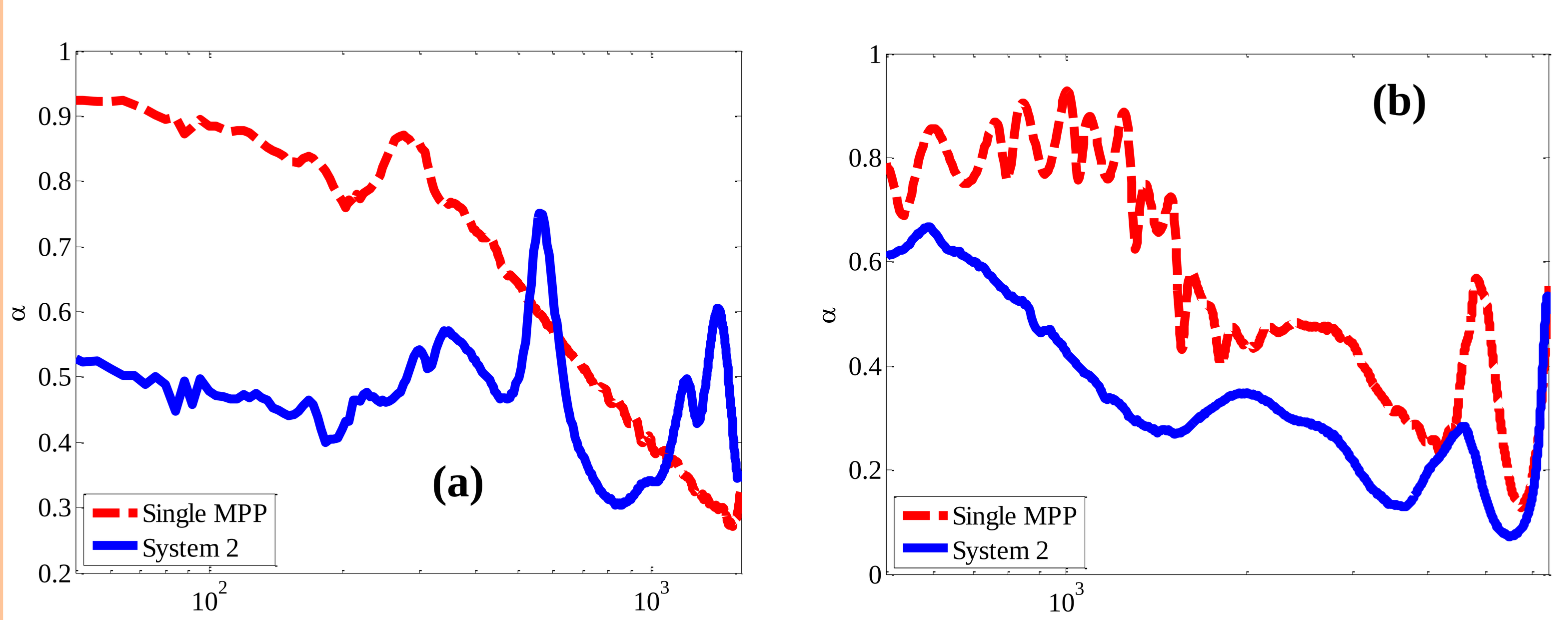


Figure 5: *System 2 Absorption Coefficient: D = 5cm, s = 1cm. (a) 10cm Tube Results; (b) 2.9cm Tube Results. (Single MPP: An MPP without Honeycomb Cavity Partitioning)*

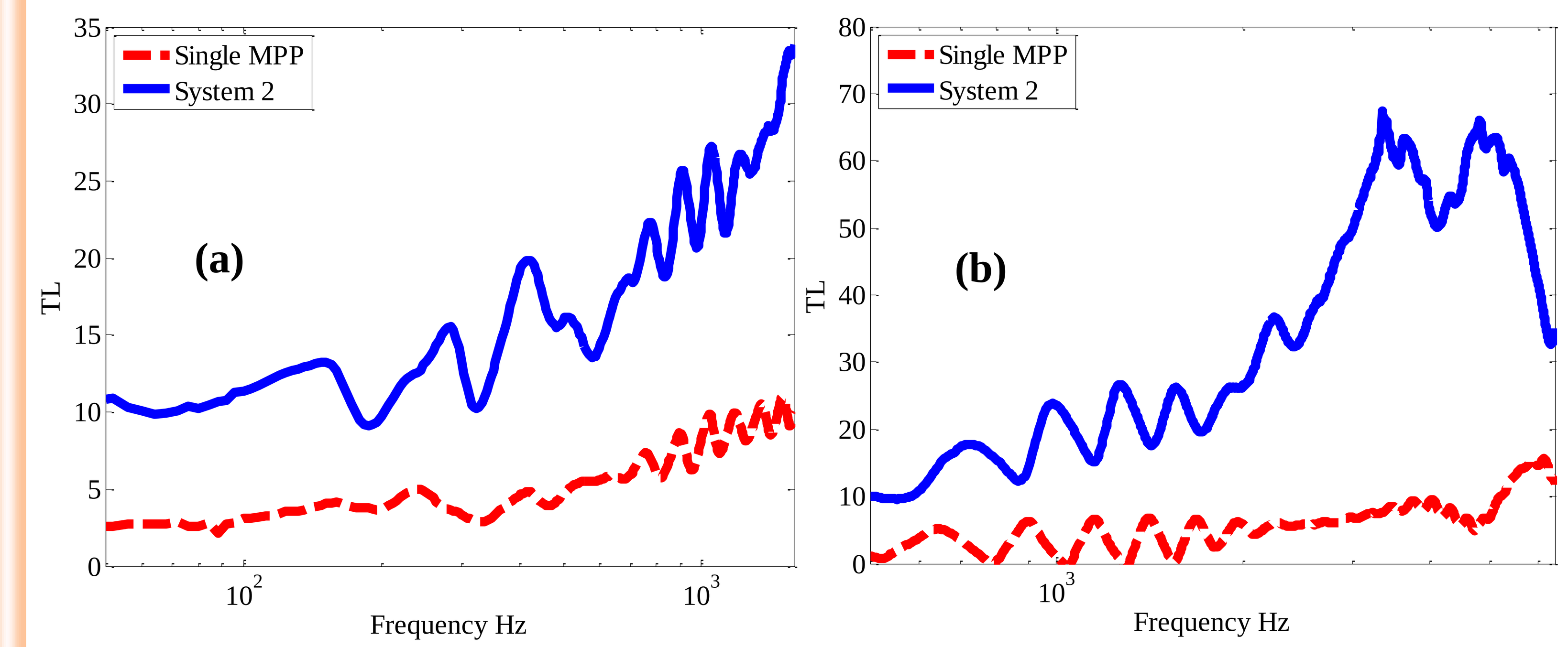


Figure 6: *Transmission Loss: D = 5cm, s = 1cm. (a) 10cm Tube Results; (b) 2.9cm Tube Results. (Single MPP: An MPP without Honeycomb Cavity Partitioning)*

Conclusions and Future Work

- The larger the diameter of the MPP perforations, the smaller the absorption coefficient, and the higher the peak frequency.
- If the thickness of the MPP increases, then the acoustical performance deteriorates, and the maximum absorption coefficient shifts to a lower frequency.
- Changing the length of the backing cavity does not change the maximum absorption coefficient. However, its peak shifts to a lower frequency.
- A hard facing panel can improve the sound transmission loss.
- An MPP facing panel can improve the sound absorption coefficient.
- The honeycomb structures can greatly improve the sound transmission loss.
- Future Work:
  - Investigate the acoustic performance of the MPPs at oblique angles of incidence.
  - The backing space (s) should be longer for System 2.
  - 3-D printers with better accuracy are needed.

References

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