

Experimental Notes for the Underwater Acoustic Metamaterial Project

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1 Introduction

Experiments were conducted to validate the enhanced transmission through an underwater acoustic metamaterial (AMM).

1.1 General settings

Table 1: Comparison of retrieved parameters.

Name	Symbol	Value	Comments
Emitter radius	–	1 inch	–
Metamaterial dimensions	–	29 mm \times 29 mm	–
Center frequency	f_c	445 kHz	–
Wavelength	λ_c	3.3 mm	–
Critical distance	$D_c = a^2/\lambda_c$	68.2 mm	–

2 Experimental logs

Equipment settings are:

- Oscilloscope
 - y division 1 V
 - x division 5 MHz
- Function generator
 - Vpp is 5 V
 - Burst mode, 1 ms period, 5 cycles

2.1 Exp230223B

- DDate: Feb 23, 2023
- Measurement of the transmitted sound field without AMM

2.2 Exp230227B

Specific settings

- Date: Feb 27, 2023
- Measurement of the transmitted sound field with AMM

2.3 Exp230228A

- AMM
- Transmitted sound field over the plane $y = 46$ mm.

2.4 Exp230228F

- AMM
- Transmitted sound field over the plane $y = 45.75$ mm.

2.5 Exp230301D

- AMM
- Transmitted sound field over the plane $y = 45.5$ mm.

2.6 Exp230302A

- Without AMM
- Transmitted sound field over the plane $y = 46$ mm.

2.7 Exp230302B

- Without AMM
- Transmitted sound field over the plane $y = 45.75$ mm.

2.8 Exp230302G

- Without AMM
- Transmitted sound field over the plane $y = 45.5$ mm.

3 Results and discussions

Figure 1 shows the results of something.

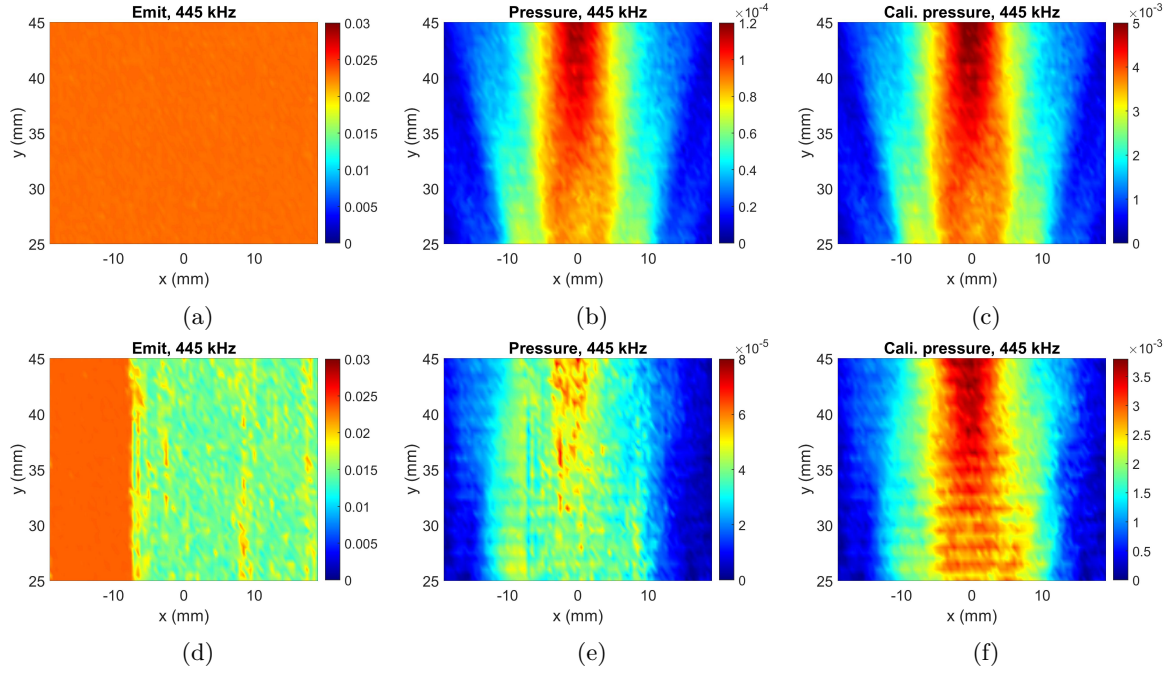


Figure 1: 2D experimental results at 445 kHz. Top row, without AMM (see Sec. 2.1); bottom row, with AMM (see Sec. 2.2). Left column, emitting signal which was fed into the source; middle column, signal received by the hydrophone; right column, calibrated signal of the middle column. To calibrate, the values in the middle column are divided by those in the left column.

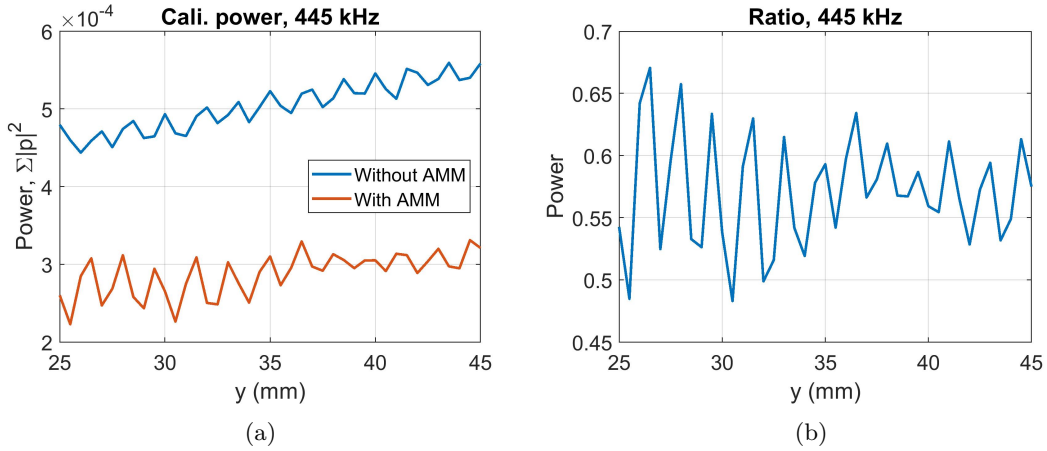


Figure 2: (a) Calibrated acoustic power, approximated by a summation of the squared pressure along the line parallel to x axis, with and without AMM. (b) The ratio of the power with AMM to that without AMM.

Appendix A Derivation of Eq. (??)

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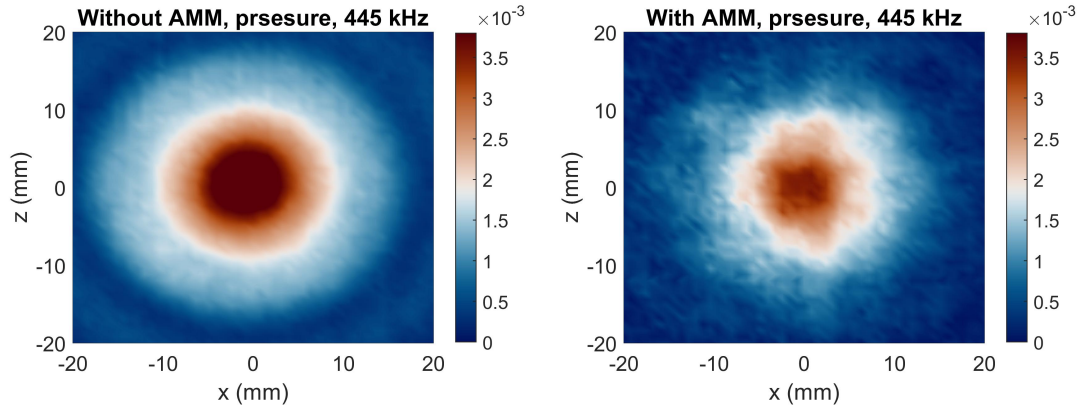


Figure 3: 2D pressure distribution at 445 kHz without (left) and with (right) the acoustic metamaterial (AMM). The region is located at 45 mm away from the transducer.

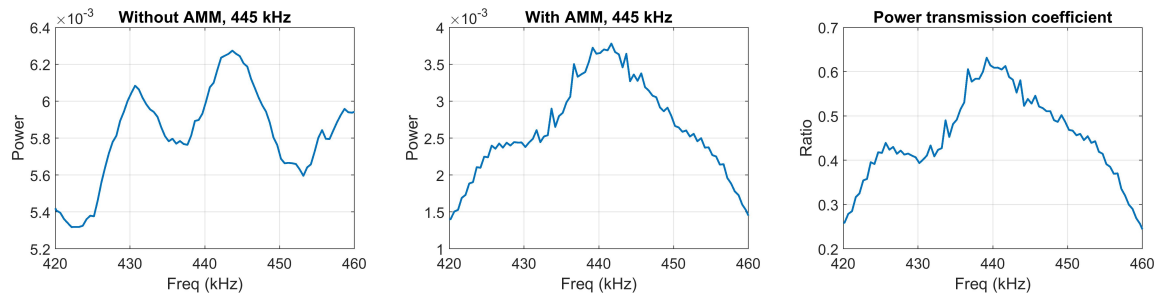


Figure 4: Sound power (left) without and (middle) with the AMM. (Right) Power transmission coefficient. The region is located at 45 mm away from the transducer.

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Appendix B Illustration of Fig. (1)

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References