Supplementary Information

TinyLev: an Inexpensive and Reliable Single-Axis Acoustic Levitator.

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1- Pressure and Force Model

The complex acoustic pressure *P* at point ***r*** due to a piston source emitting at a single frequency can be modelled as:

$$P(\boldsymbol{r}) = P_0 V \frac{D_f(\theta)}{d} e^{i(\varphi + kd)}$$

Where P_0 is a constant that defines the transducer output power and V is the excitation signal peak-to-peak amplitude. D_f is a far-field directivity function that depends on the angle θ between the piston normal and ***r***. Here, $D_f = 2J_1(ka\sin\theta)/ka\sin\theta$, the directivity function of a piston source, where J_1 is a first order Bessel function of the first kind and a is the radius of the piston. This directivity function can also be simplified as $D_f = sinc(ka\sin\theta)$. The term $1/d$ accounts for divergence, where d is the propagation distance in free space. $k = 2\pi/\lambda$ is the wavenumber and λ is the wavelength (8.5mm in air at 25C).

Gorkov

1 – Transducers Analysis

Model	Diameter (mm)	Power (Pascal/meter*volt)	Phase Standard Deviation (degrees)	Price per unit (USD)
Manorshi MSO-P1640H10TR	16	0.25 SD=0.04	8.7	0.44
MSO-A1640H10T	16	0.36 SD=0.02	9.2	0.34
MSO-P1040H07T	10	0.13 SD=0.02	13.9	0.34
Ningbo FBULS1007P-T	10	0.14 SD=0.02	13.9	0.38
Murata MA40S4S	10	0.17 SD=0.01	3.8	0.98
MultiComp MCUST10P40B07RO	16	0.25 SD=0.04	33.1	2.1
MCUSD16A40S12RO	16	0.21 SD=0.03	18.3	2.1

Table 1. Evaluation of different commercially available 40kHz air transducers. The measures were repeated for 10 items.

Power consumption.

The current consumption of the system was measured, it is shown in Fig. 9. The current consumption was slightly different depending on the phase difference between the top and bottom arrays showing the very slightly resonant behaviour of the system.

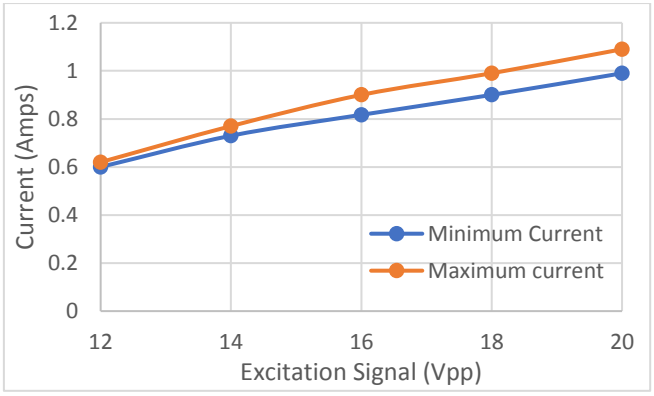
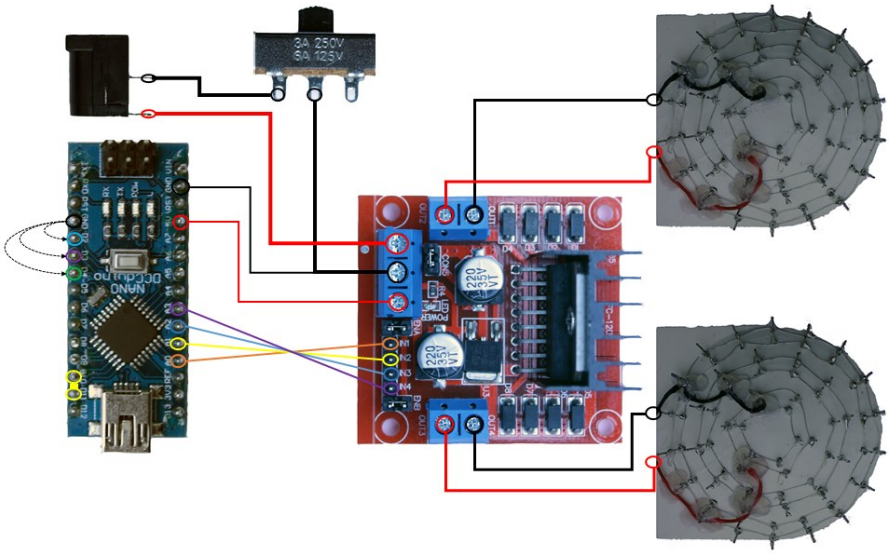
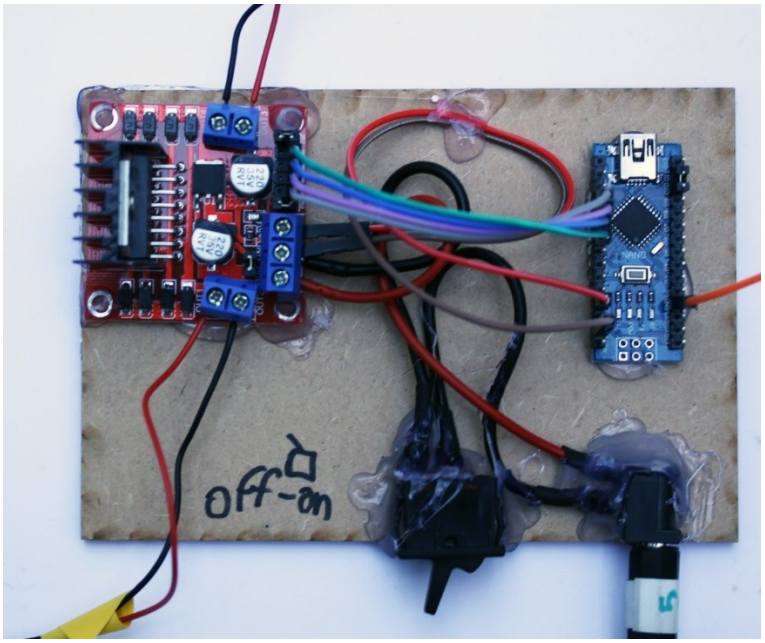


Figure 9. Current consumption of the levitator.

Circuit





Transducer Response

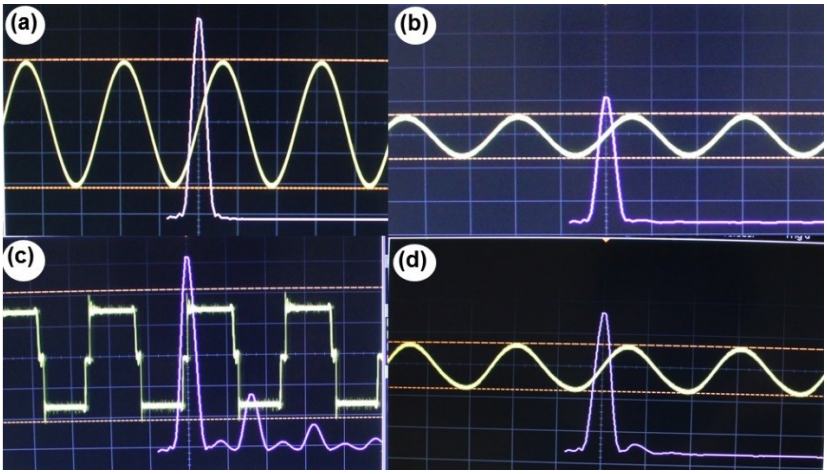


Figure 6. a) 20Vpp sinusoidal excitation signal generated with a signal generator and (b) output from the transducer measured with a microphone. c) excitation signal from the driver and (d) output from the transducer. The yellow line is the signal in the time domain and the purple line in the frequency domain with 40kHz at the central frequency and 200kHz span.

Evaporation Test

Transducers Packing

Levitation of Samples