



MODAL ANALYSIS OF MICROCANTILEVER USING VIBRATION SPEAKER



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INTRODUCTION:

Dynamic Characteristics of Microcantilever Beam and Glass Fiber for resonance frequencies and mode shapes have been found using vibration speaker.

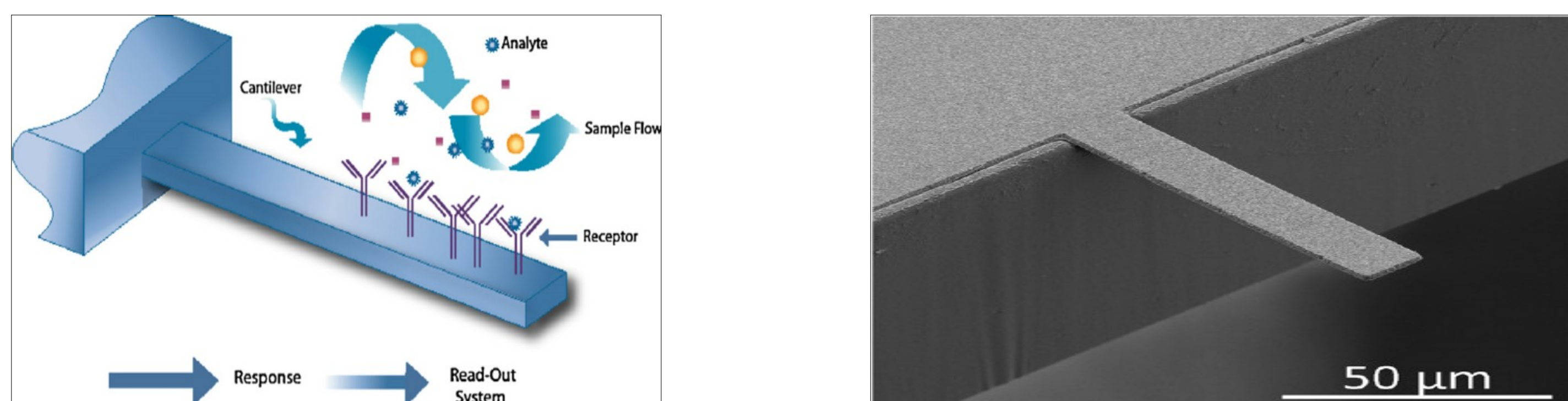


Fig. 1 Dynamic-mode Cantilever Sensing Principle

THEORETICAL MODEL OF MICROCANTILEVER:

Natural Frequency of cantilever for the rectangle geometry,

At Atmospheric air

$$f_n = \frac{1}{2\pi} \sqrt{\frac{E}{\rho}} \cdot \frac{t}{l^2}$$

At Vacuum

$$f_n^{vac} = \frac{(\kappa_n l)^2 h}{2\pi l^2} \sqrt{\frac{E}{12\rho}}$$

NUMERICAL SIMULATION USING COMSOL:

Microcantilever has been analyzed using Eigenfrequency study and resonance frequencies and mode shapes are identified.

Beam Dimensions & properties:

Material : Stainless Steel

L=35000μm, w = 1000μm &

t = 30μm, E = 200GPa,

ν = 0.33, ρ = 7850kg/m³

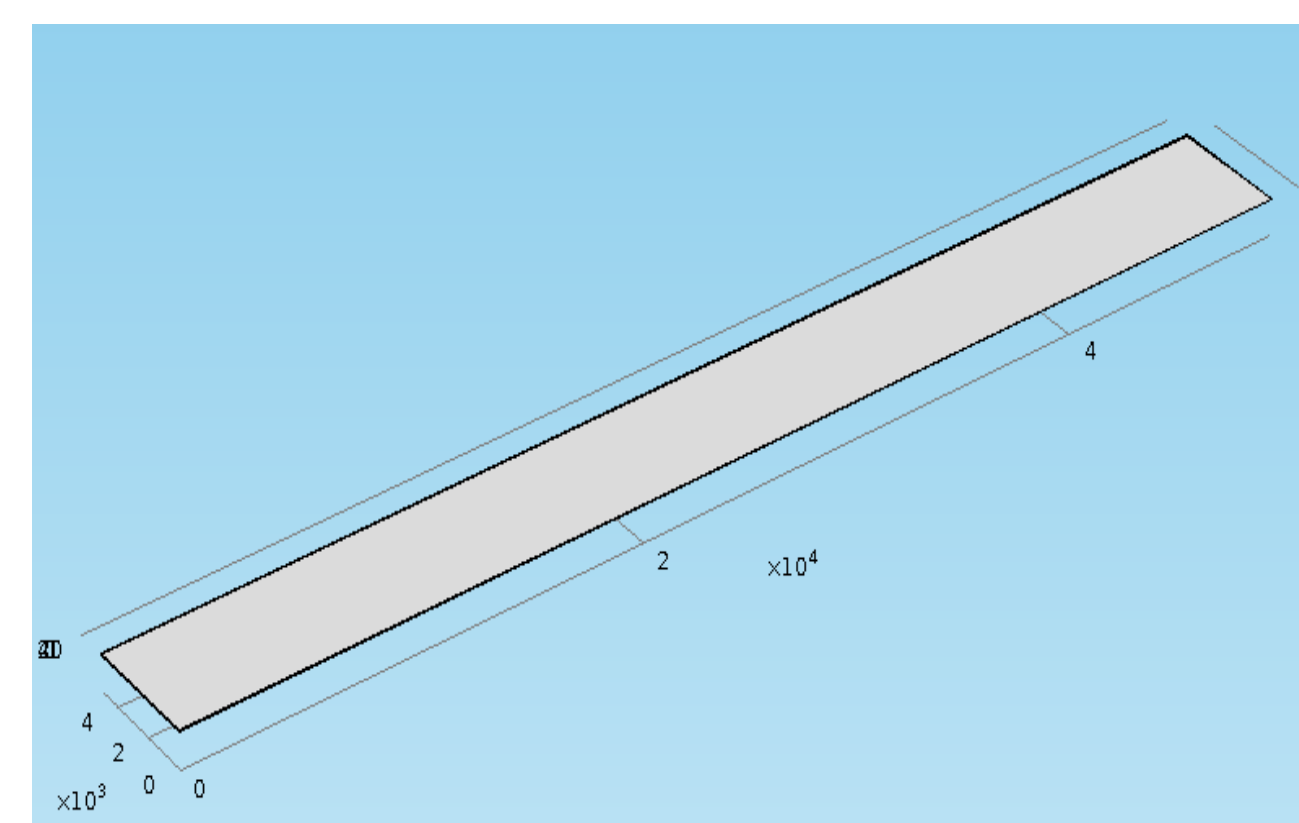


Fig. 2 COMSOL Cantilever Model

EXPERIMENTAL WORK:

Audio input of Sine wave excitation (20Hz to 20kHz) has been supplied to vibration speaker, microcantilever beam is mounted on top of the speaker.

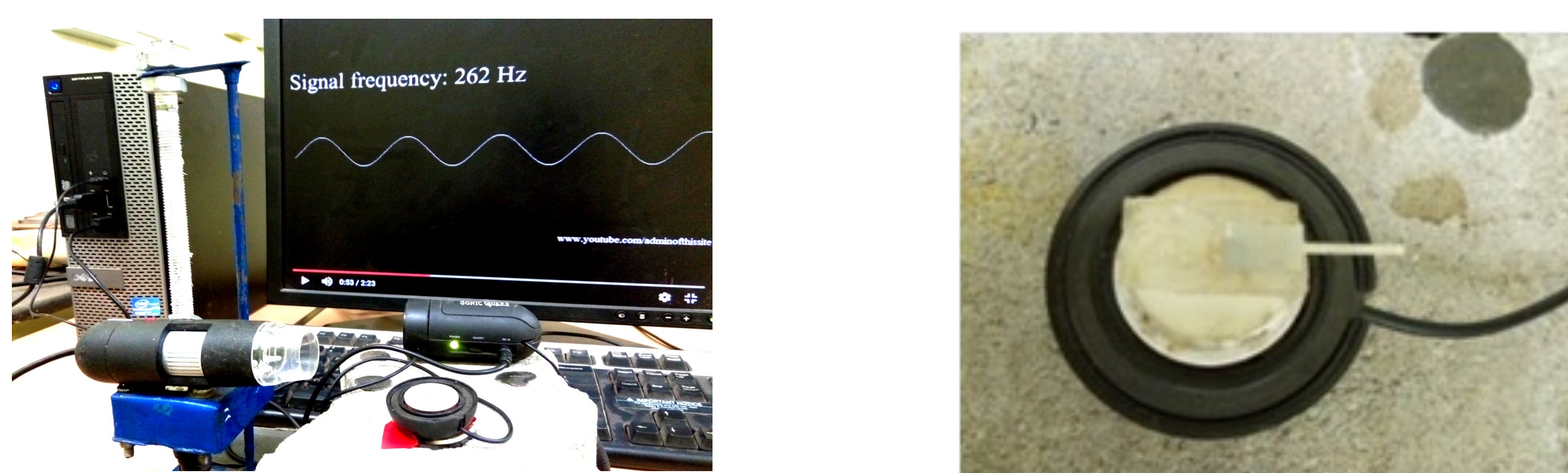


Fig. 3 Vibration Speaker set up

RESULTS AND DISCUSSION:

Analytical, Experimental and Simulation Results

Natural Frequency	Analytical (Hz)	COMSOL (Hz)	Experimental (Hz)
Mode Shape 1	39.157	39.306	41
Mode Shape 2	245.4	246.462	249
Mode Shape 3	687.133	690.729	695

MODE SHAPES COMPARISON:

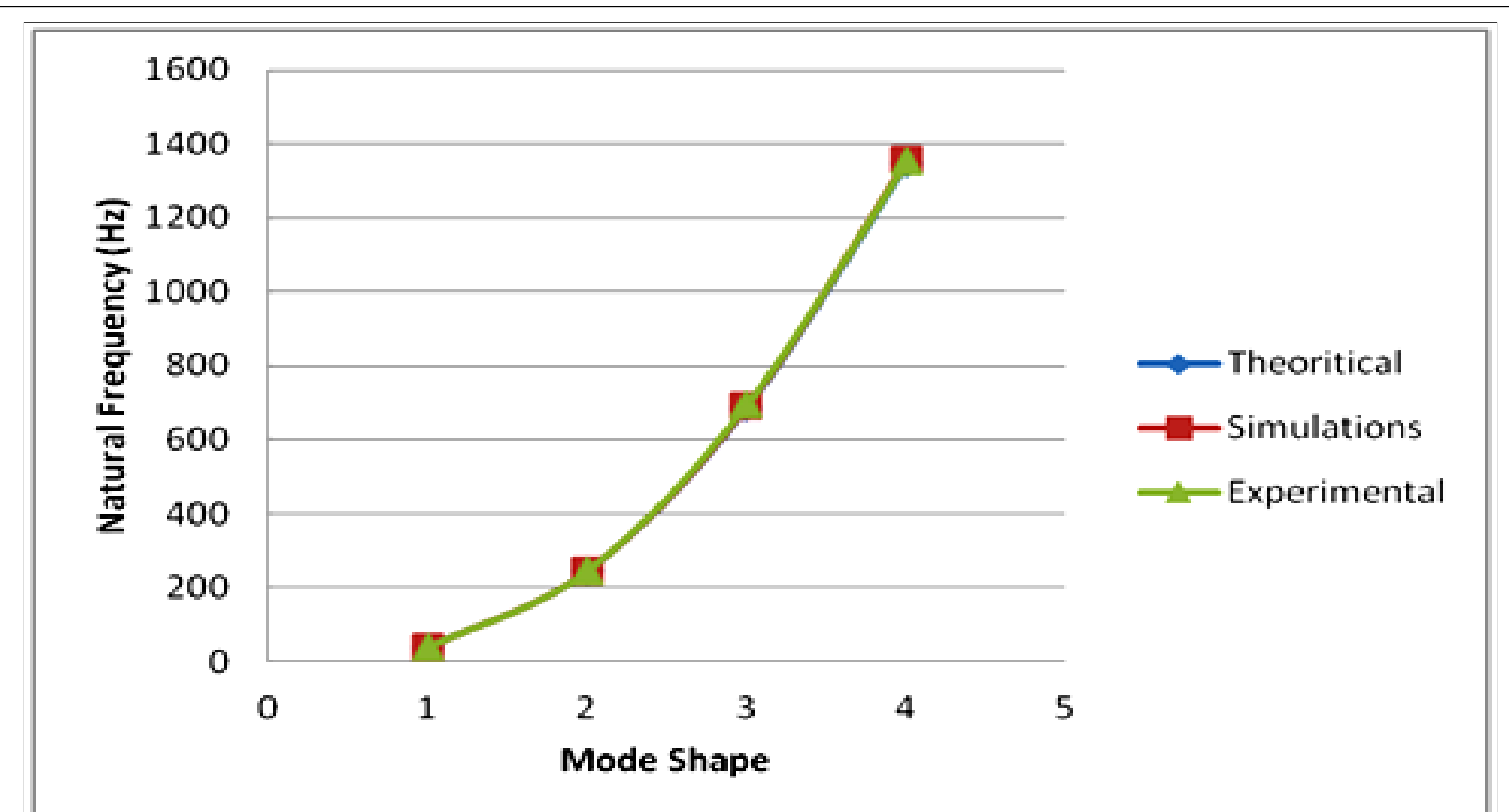
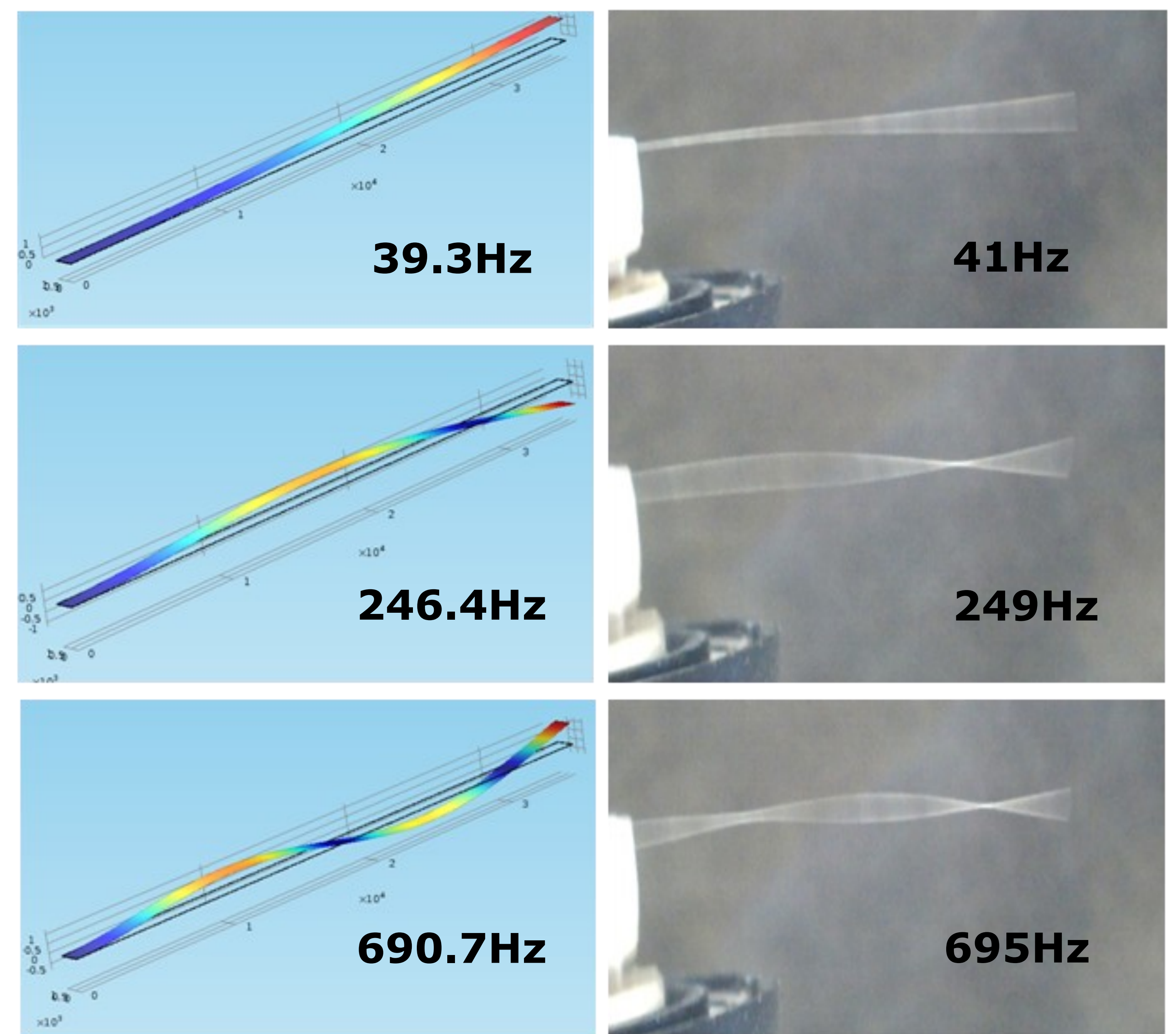


Fig. 4 Natural Frequencies vs Mode Shapes

CONCLUSIONS

- ◆ Microcantilever beam has been simulated by Eigen Frequency analysis in COMSOL
- ◆ The results of natural frequencies and mode shapes of the microcantilever beam in COMSOL have been validated with the analytical and experimental results.