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Shape reconstruction of additively manufactured waveguides with smooth thickness variation using laser-induced Lamb modes

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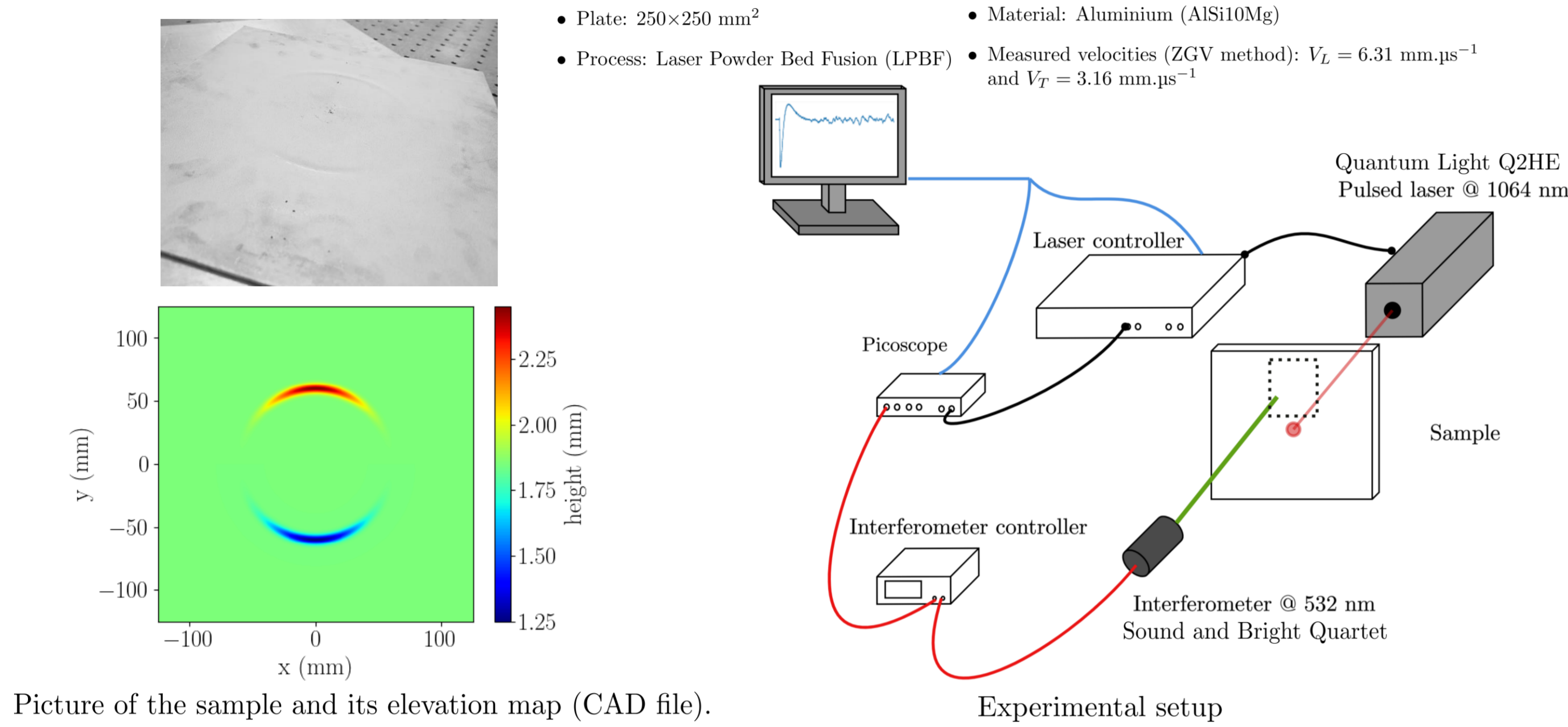
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Background

The increasingly widespread use of the metallic additive manufacturing process enables the design of components with intricate geometry, such as structures featuring waveguides, which may exhibit “complex” dispersion due to their inhomogeneous characteristics. There is a high demand to characterize the geometric defects associated with phenomena occurring during the manufacturing of the sample, such as thickness variations. Through experimental investigations, we explore the propagation of ultrasonic waves in additively manufactured elastic plates, with a specific emphasis on accurately reconstructing its shape using two methods based on propagative Lamb modes induced by laser. Our results demonstrate strong agreement between the calculated profiles and the references.

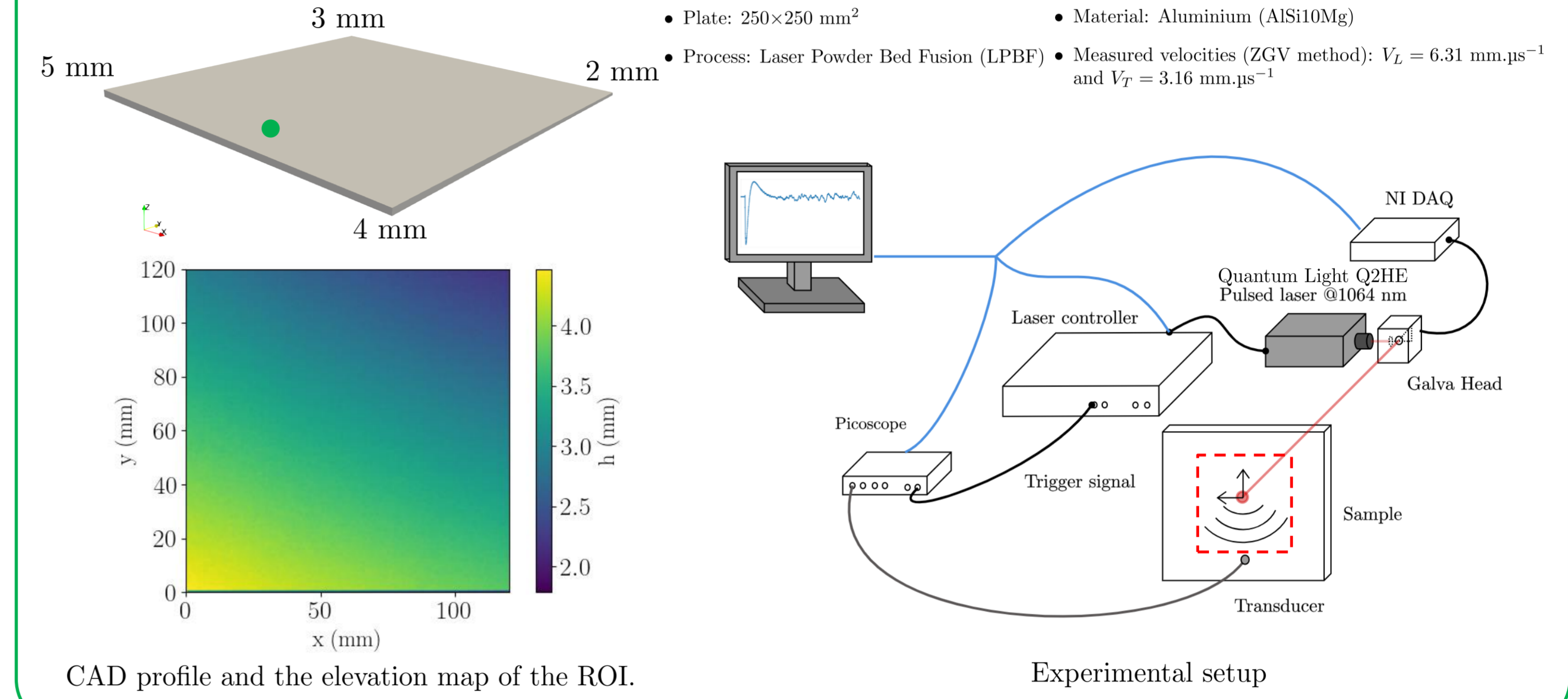
Local phase method using A_0 -mode

Sample and Laser-Ultrasound setup

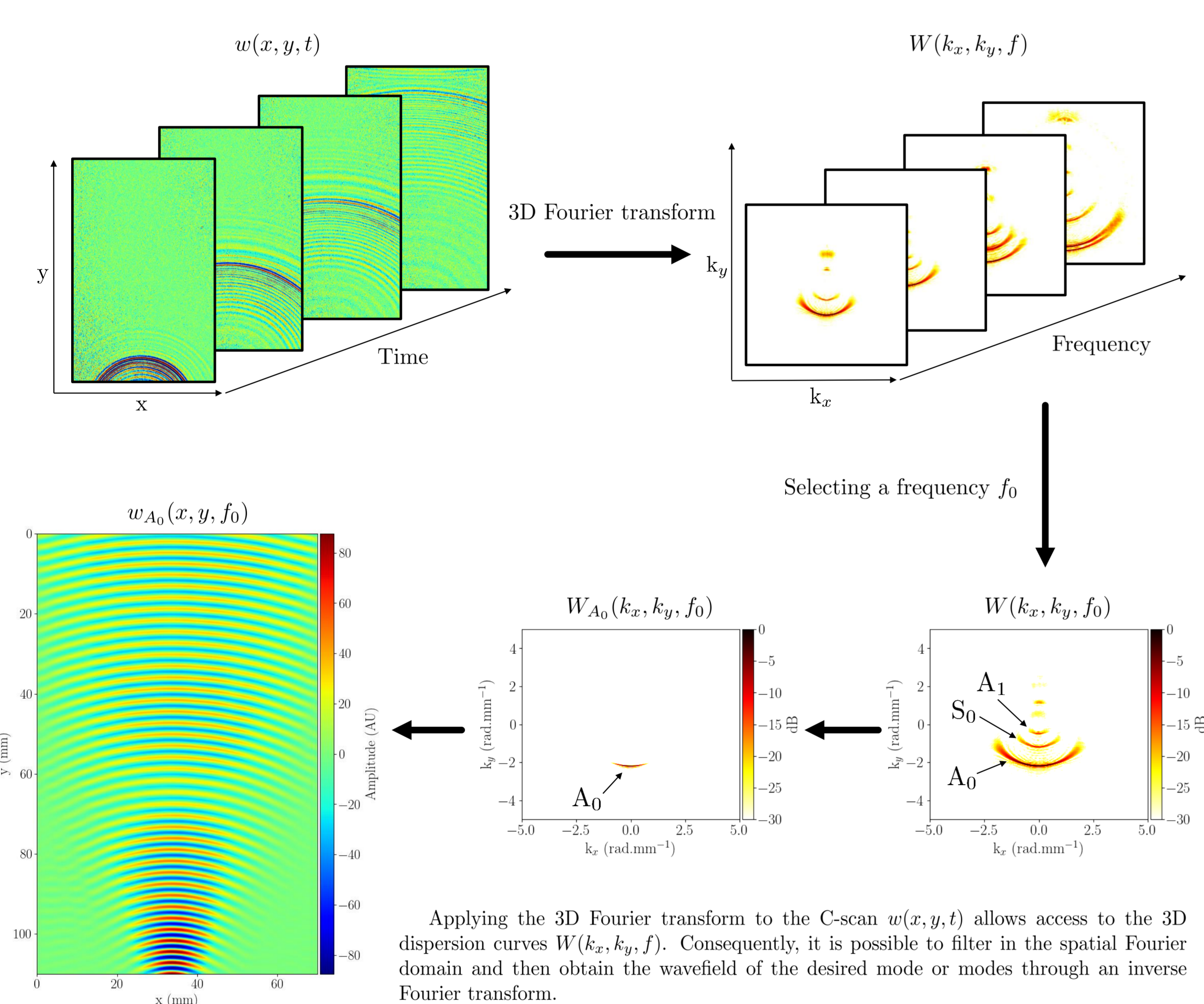


A_1 -cutoff frequency based method

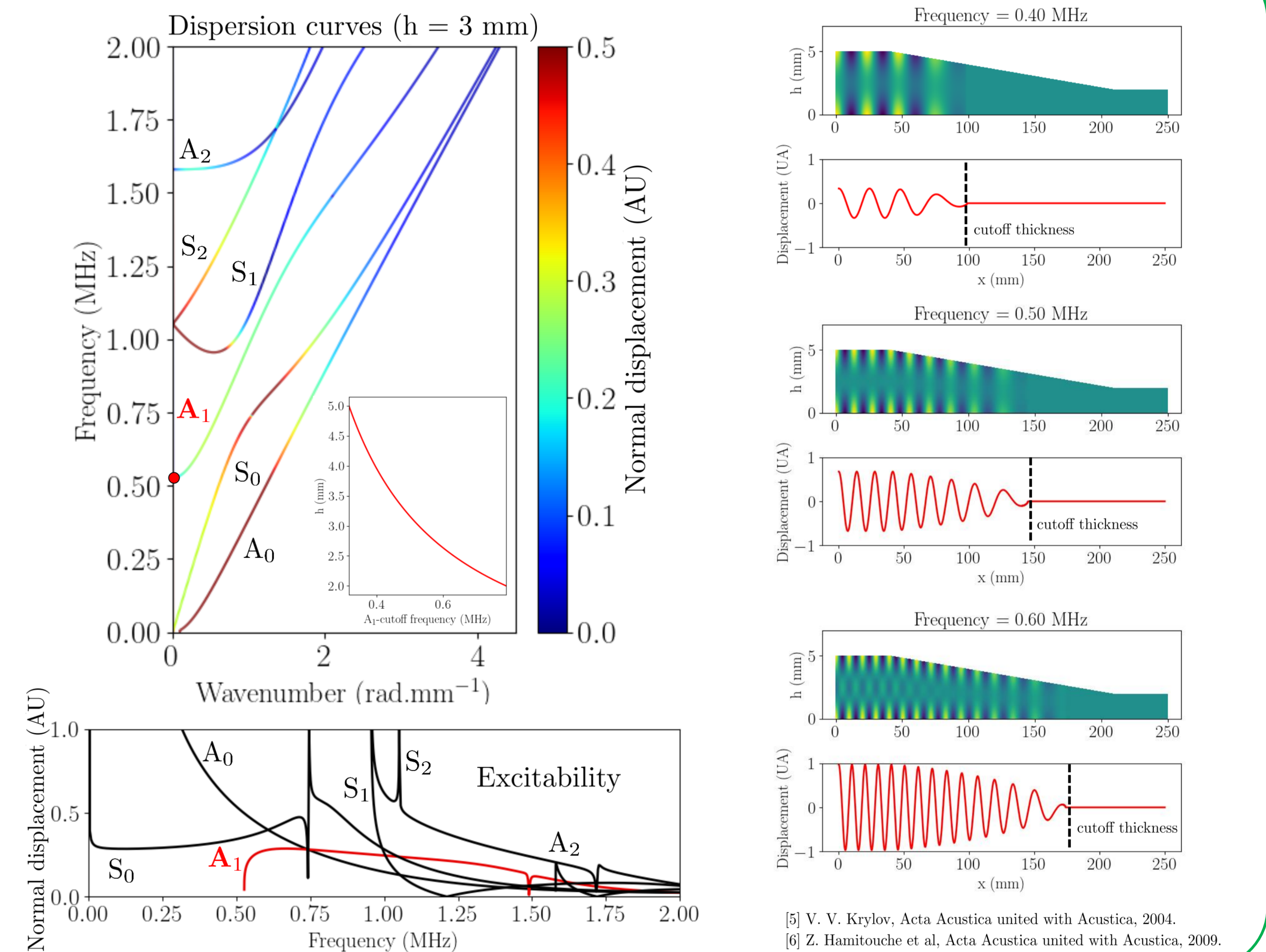
Sample and LU setup with reciprocity principle



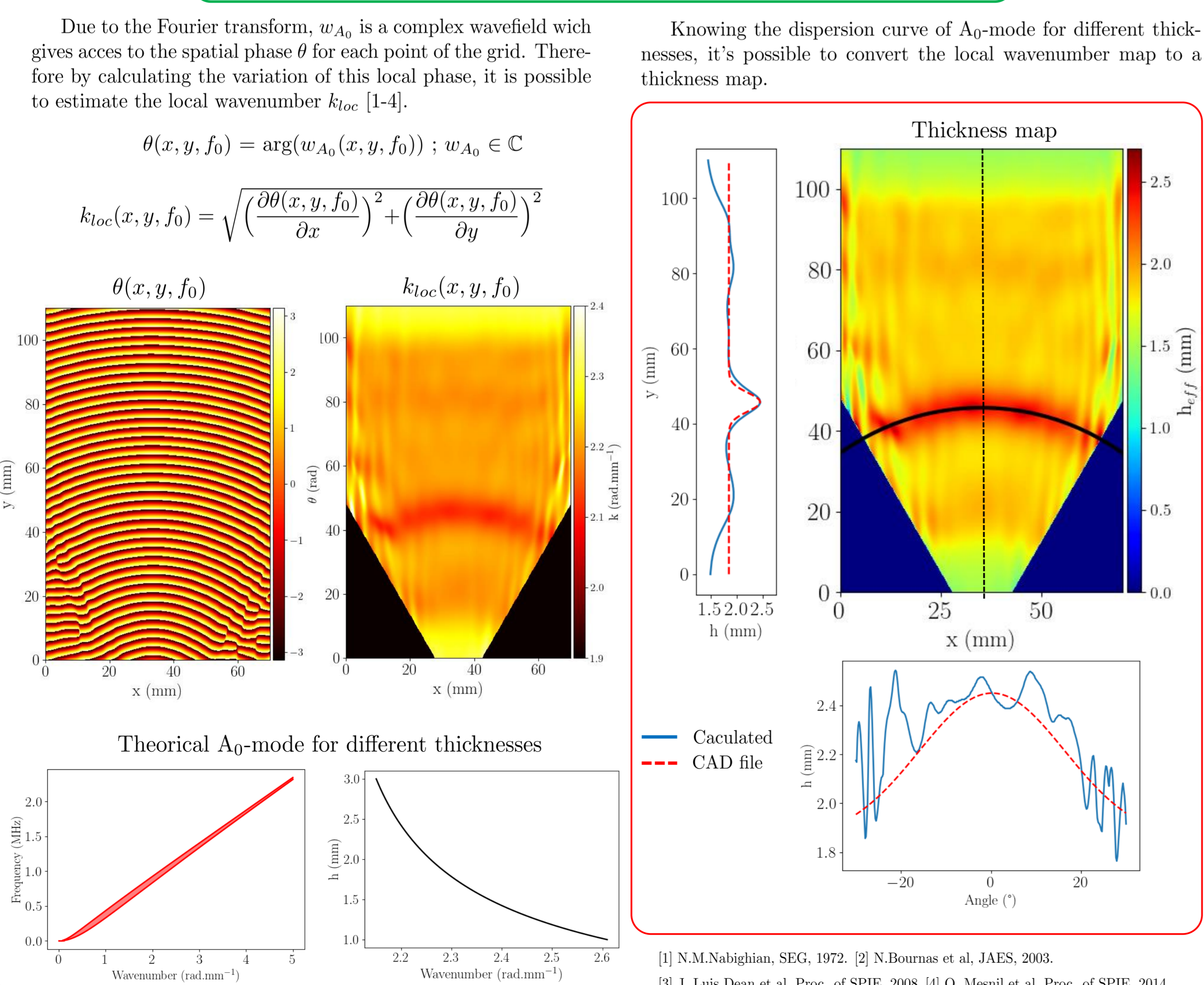
Contribution of the incident A_0 -mode



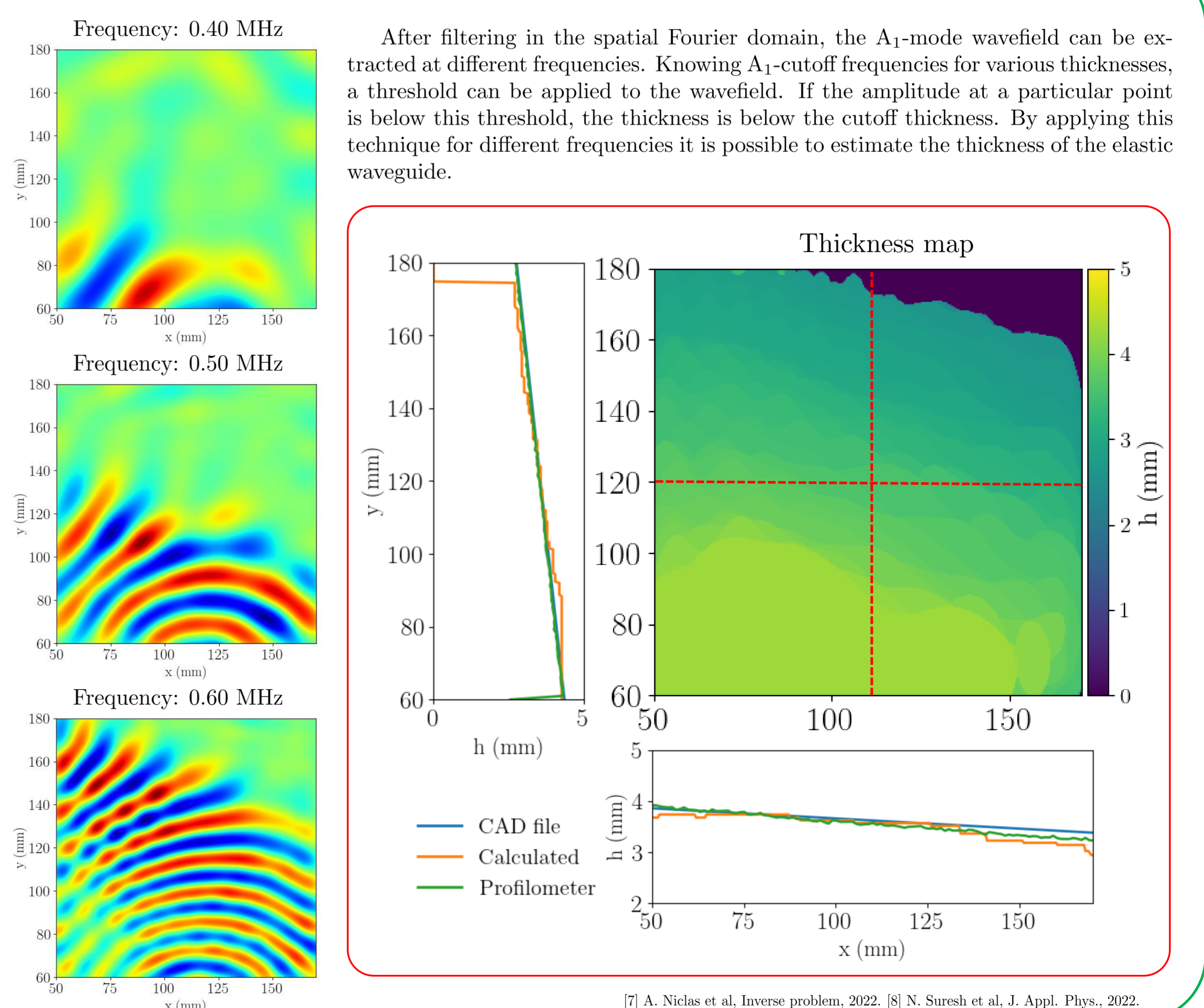
A_1 -mode and the cutoff thicknesses



Local wavenumber map to thickness map



A_1 -mode displacement wavefield to thickness map



[7] A. Niclas et al, Inverse problem, 2022. [8] N. Suresh et al, J. Appl. Phys., 2022.

Conclusion and future works

- Reconstruction of waveguide shape using propagative A_0 -mode and A_1 -mode.
- Take into account the bias due to the plates' curvature.
- Parametrical study by varying the thicknesses of the waveguide numerically, which leads to the study of the transmission/reflexion matrix.
- Apply two different methods: Local phase method and A_1 -cutoff frequency based method.