# Nonlinear Vibration Approach to Aerosol-Jetted PZT-Actuated MEMS Scanner for Imaging and FPGA assisted Display

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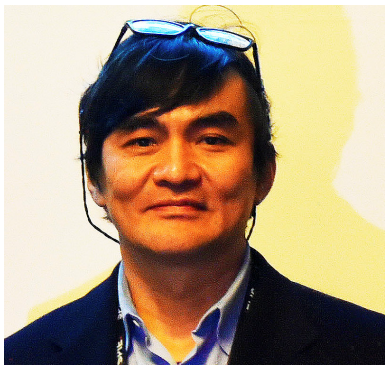
Abstract:

This study introduces an innovative advancement in imaging technology through the implementation of a state-of-the-art hybrid MEMS (Microelectromechanical Systems) scanner system designed for compact microscopic imaging. The scanner, featuring a tapered optical fiber waveguide and cutting-edge aerosol-jetted PZT (lead zirconate titanate) bimorph push-pull actuators on a stainless-steel substrate, effectively mitigates issues such as fracture and layer separation commonly associated with PZT on silicon substrates. By harnessing nonlinear vibration, the scanner achieves a spiral scan pattern from a single signal input, alongside the anticipated two-dimensional scanning and target illumination from two phase-shifted inputs.

This capability is further enhanced by a novel process that tapers the optical fiber, reducing illumination scattering and tuning the fiber to the resonant frequencies of the scanner. The specialized tapered tip facilitates large fields of view while enabling independent 2-axis scanning through one degree-of-freedom actuation. Experimental validation demonstrates the successful generation of a spiral scan pattern with a 60 μm diameter scan area and a 10 Hz frame rate. The system effectively reconstructs scanned images of 5 μm lines, cross patterns (15 μm in length with a 5 μm gap), and structures of a Psychodidae wing. Additionally, the study includes the application of micro display using Field-programmable gate array (FPGA).

Short biography:



Wei-Chih Wang* is currently an Associate Professor in Power Mechanical Engineering and Institute of Nanoengineering and Microsystems at the National Tsinghua University and an affiliated Associate Professor in the Department of Mechanical Engineering and an Adjunct Associate Professor in the Department of Electrical Engineering at the University of Washington. His research interests are in the area of developing polymer based micro sensors and actuators for industrial and biomedical applications. More recently, his work has expanded to THz, IR and visible band metamaterials, and amorphous and metamorphous structure and material study for wave manipulation.