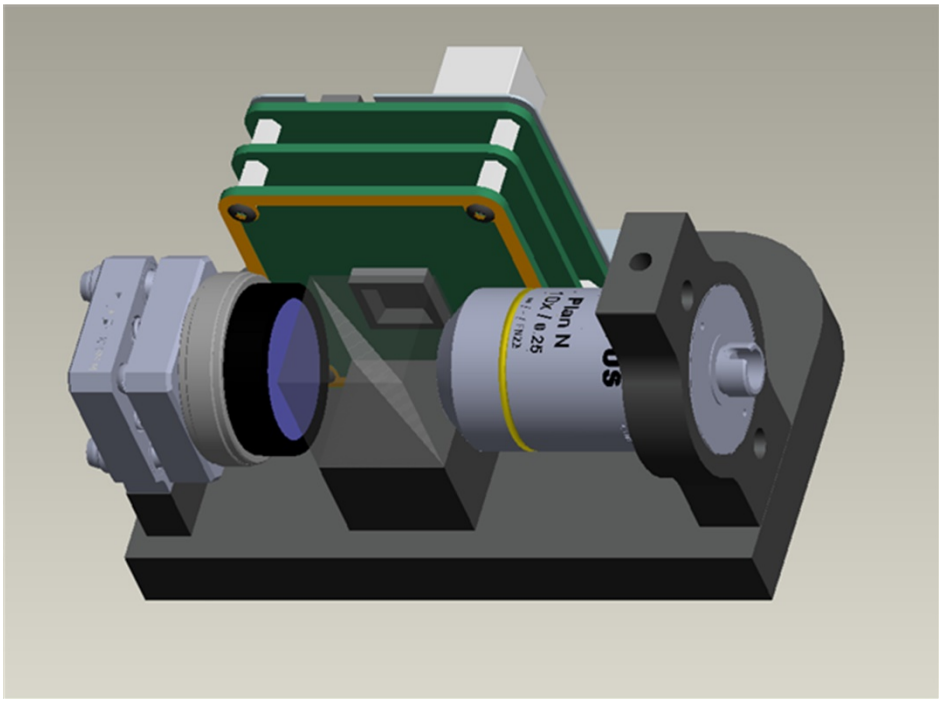
Dual-wavelength Lensless Digital Holographic Microscope for Dynamic Inspection on Micro-electro-mechanical Systems (MEMs)



Technology Overview

The invention of dual-wavelength lens digital holographic microscopy system is used to do a 3D dynamic inspection of the MEMS device-under-test to verify its geometric characteristics. This inspection is necessary to optimise production process parameters, if necessary. Presently, dual-wavelength digital holographic microscope and lensless digital holographic microscope exists in separate designs. Existing system using dual-wavelength are complicated in design while existing lensless design uses a single-wavelength laser. By re-configuring the optical setup, both designs can be combined to achieve a lensless dual-wavelength digital holographic microscope.

The enhanced features of this invention are: (1) simple optical path which eliminates multi-reflections between the visual components,(2) less optical components are required, hence the system is lower in price and more compact as compared with existing designs, (3) system enlarges the axial measurement range from half-wavelength to several micrometers. The invention uses a combination of laser line filter and convex reflective mirror in its arrangement. It introduces a physical phase compensation for the phase curvature in both wavelengths. Thus enabling the system to provide dynamic 3D inspection for height or thickness in micron-range with a single captured image.

Technology Features & Specifications

This technology consists of a series of proprietary steps to make the lensless dual-wavelength real-time imaging and measurement device. The lights of the first and second wavelengths are directed in an imaging path through an optical fiber to image an object, and also are directed in a reference path to provide reference beams. The technology employs a combination of a laser line filter and a convex reflective mirror in the reference path, where a convex reflective mirror is used to reflect light of the first wavelength while the laser line filter is used to reflect light of the second wavelength and to transmit light of the first wavelength through the laser line filter to the convex reflective mirror to be reflected by the convex reflective mirror.

The present invention introduces a physical phase compensation for the phase curvature introduced by both object wave and reference wave. The purpose of the laser line filter as a reflective mirror for the second wavelength and the role of the convex mirror after the filter as a reflective mirror for the first laser wavelength allows physical phase compensation in both wavelengths. With few optical elements used, the setup is easy to adjust and inexpensive to manufacture.

Potential Applications

This technology is applicable in the following industries:

MEMs & MOEMs

- Quantitative 3D imaging of structures on MEMS & MOEMs devices
- Real-time dynamic vibration analysis and reconstruction of membranes on MEMS & MOEMs devices
- Process monitoring of MEMS & MOEMs device manufacturing

Semiconductor

- Surface profiling with nanometer resolution of structures on wafer
- Surface roughness measurement of the whole wafer

Micro-optics

- Characterization of single lens
- Surface profiling with nanometer resolution of the structures on the optics wafer
- Surface roughness measurement

The product can be marketed based on this technology is the dual-wavelength lensless digital holographic microscope.

Customer Benefits

Presently, dual-wavelength digital holographic microscope and lensless digital holographic microscope exist as separate designs. Existing systems using dual-wavelength are complicated in design, while existing lensless design uses a single-wavelength laser. By re-configuring the optical setup, both designs can be combined to achieve a compact lens dual-wavelength digital holographic microscope. The enhanced features of this design are:

- Simple optical path which eliminates multi-reflections between the optical components;
- Less optical components is required, hence lower cost and more compact as compared with existing designs;
- Enlarged axial measurement range from half-wavelength to several microns;

the system is able to perform the measurements in one step, thus allowing real-time dynamic measurement and monitoring.

OVERVIEW

- Technology Category Electronics - Lasers, Optics & Photonics
  Manufacturing - Assembly, Automation & Robotics
- Technology Status Available
- Technology Readiness Level TRL4

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