NewView Application Note

Measuring Dynamic MEMS Devices

Introduction

Optical profilers are valuable tools for characterizing the surfaces of MEMS devices. Traditionally, an optical profiler such as the NewView 6300™ was used for measuring a wide range of surface features and device parameters. However, one fundamental requirement was that the surface and device be kept in a static condition during measurement. As industries such as MEMS manufacturing matured and began creating more dynamic devices, it also became more important to characterize and understand the functionality of the device while it is in motion. Advancements in optical profiling instruments now make this possible. Using the NewView 6300™ and the new Dynamic Metrology Module (DMM), it is now possible to synchronize the illumination source to the motion of the device, in essence freezing the sample motion and allowing the user to effectively measure as if the part were fixed in space.

Stroboscopic Illumination

When measuring a sample with a white light profiler (such as the NewView 6300™), the sample is typically held in a stationary position. Motion of the part will cause a blurred image, poor data integrity, or even loss of data. For samples such as MEMS devices, however, it can be extremely useful to characterize how the shape of the sample changes when the device is activated and therefore in motion.

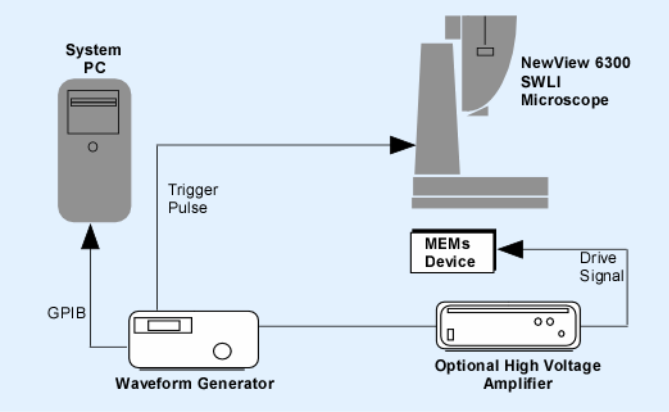

Figure 1 - Schematic of Dynamic Metrology Module (DMM) components

In a dynamic configuration, a strobed LED illuminator is synchronized with the drive signal of the device. By adjusting the strobe frequency of the light source, the motion can be effectively frozen, allowing precision scanning white light interferometer (SWLI) measurements to be made on the dynamic device. Adjustment of the illumination phase delay—the lag between the drive signal and the illuminator strobe—allows the device's full range of motion to be examined. The DMM option includes MetroPro™ software which allows these parameters to be adjusted automatically to 'sweep' through ranges of frequencies and phase delays to fully characterize the device under test. The modularity of the Dynamic Metrology Module also makes it possible to upgrade existing NewView 6300™ systems with these enhanced capabilities.

Why Dynamic Measurements?

Dynamic measurement of a MEMS device is useful for both research and development and production quality control. Sweeping of device drive frequencies and illumination phase delays can be used by the researcher to validate design parameters and examine device resonances. As a quality check, dynamic measurement mimics the MEMS actual usage for a true functional test. Rapid characterization over the full range of motion and frequencies experienced is possible.

Making Measurements

ZYGO's Dynamic measurement option makes the characterization of dynamic MEMS devices just as simple as measuring a static device. All standard MetroPro™ numerical and graphical results can be used to quantify the motion of a dynamic device. These results can also create resonance amplitude and nyquist plots, and all plots are available for creating a movie of the device motion. For power users, custom results can be generated with ZYGO's MetroScript™, an easy-to-use scripting language.

For any dynamic measurement, the user needs to set up the drive parameters for the device including voltage, signal shape, and frequency. Depending on what metrology is required, one of four types of dynamic metrology can then be pursued.

Single measurement

A single measurement can be used to look at a device's behavior at a particular drive signal and phase delay. One application where this would be particularly useful is a DC drive where a static offset would be expected based on the voltage applied. By examining the sample with the voltage turned on and off, the change in the device may be observed.

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