

Digital Holographic Microscopy for 3D Optical Metrology with Real-time, Full-field, Nanometer Resolution

High Resolution Surface Imaging Using Optical Phase Information

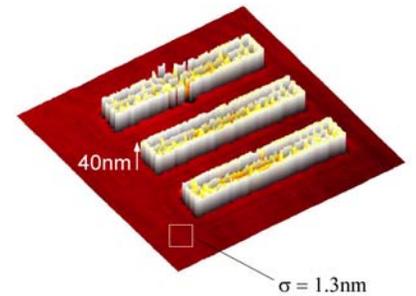
Researchers at ORNL have developed and patented a number of prototype microscopic imaging systems based on the technology of *Digital Holographic Microscopy*. These systems provide 3-D quantitative information of the surface height topology with nanometer precision. The method involves recording the complex wave-front from a sample directly onto the surface of a CCD camera in a single image. Unlike phase-shifting profilometry methods, the phase and amplitude of the imaged surface can be determined rapidly from just a single recorded digital image with high throughput using Fourier analysis. The phase information recorded is directly related to both the surface height of the object as well as the refractive index. A number of other unique capabilities make digital holography very appealing for application in a diverse range of areas including industrial inspection as well as biological microscopy.

Base Technology

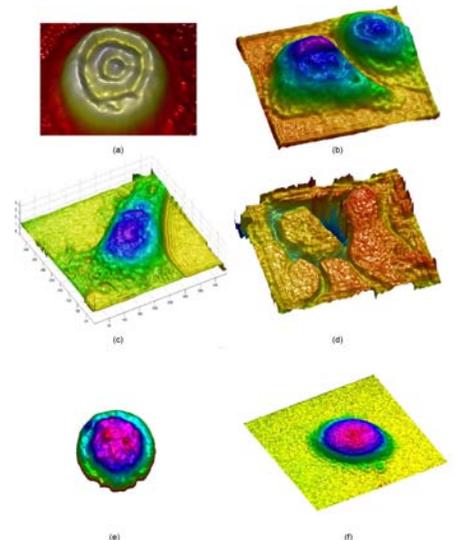
Prototype digital holographic instruments have been developed in both reflection and transmission modes. The axial resolution along the vertical (z) axis is on the order of a nanometer. The transverse resolution (in the x-y plane) is determined as in classical microscopy by the numerical aperture of the microscope objective. Video rate acquisition and fast digital reconstruction (30 fps) allow for real-time imaging

Specifications and Features

- High speed imaging and throughput (30 fps rate)
- Full field imaging(no scanning requirements)
- Nanometer precision axial resolution (~1nm)
- Extended depth of focus(3-D volume information)
- Digital image focusing control
- Complete digital aberration and sample tilt correction
- Non-invasive imaging



The current system resolves 1nm axial resolution in the axial direction. Shown is a element from a USAF resolution test target. Quantitative height profiles of biological cells



The next generation of ...

Digital Holographic Microscopy

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