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Optical Fourier holography with thin films of bacteriorhodopsin for cancer diagnostics

Optical information processing using nonlinear optical materials is receiving a lot of attention due to the ever-increasing demand for photonic device applications. We studied transient Fourier holographic gratings based on photoinduced isomerization properties of thin polymer films of the protein complex Bacteriorhodopsin (bR). Real-time medical image processing is demonstrated by recording and reconstructing the transient photoisomerization grating formed in the bR film using Fourier holography. The diffraction efficiency of the grating is optimum when the intensity of the reference and object beams are matched. In the Fourier processed object beam transmitted through the mammogram high spatial frequencies corresponding to microcalcifications are on the edges and low spatial frequencies corresponding to the dense tissue are at the center. Desired spatial frequencies including both high, mid and low bands in the object beam (corresponding to different sizes of the microcalcifications in the mammogram) are reconstructed by controlling the reference beam intensity. The results are in agreement with a theoretical model based on photoisomerization grating. We exploited this technique for processing mammograms in real time for detecting microcalcifications buried in the soft tissue for possible early detection of breast cancer. A significant feature of the technique is the ability to transient display of a selected band of spatial frequencies in the reconstructing process which enables the radiologists to study the features of interest in great detail. A technician can record a movie of all the features and the radiologist can leisurely look at it leisurely. The hologram can be erased in a few seconds and the same film is ready to record a new hologram.

Biography

D V G L N Rao had a brilliant academic record at Andhra University where he got the degrees BSc (Honors), MSc and DSc physics. He was a Postdoc for two years each at Duke and Harvard Universities and taught at UMass Boston for about fifty years starting in 1968. As Emeritus Professor he continues to guide graduate students. His group has a niche for optical Fourier techniques and low power nonlinear optics with biological materials. He published over 120 papers in prestigious journals like Nature, Physical Review Letters etc. and has ten patents, one of which on Fourier Phase Contrast Microscopy is licensed to industry for marketing the technology.

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