ABSTRACT TITLE:

AMBIENT HUMIDITY CONTROL FOR MAXIMISING REPLAY INTENSITY AND RESOLUTION IN ABERRATION-COMPENSATED OFF-AXIS HOLOGRAMS OF UNDERWATER OBJECTS

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SUBMIT TO:
Optical Holography and its Applications - Holographic Recording Materials

PRESENTATION:
Preference for "Oral presentation"

BIOGRAPHY:
Dr Henry Nebrensky received his PhD from the University of Edinburgh for work on the application of holographic interferometry to mass transfer measurement, particularly the extension of the swollen polymer technique into the natural convection flow regime in air. He is currently employed as a full-time researcher at Brunel University, a partner in the Holomar collaboration which is a multi-national and multi-disciplinary EU MAST-III project aimed at developing holography for the recording and subsequent analysis of marine organisms and particles.

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A current design for an underwater holocamera for in-situ marine particulate studies requires holograms be exposed in a zero-humidity atmosphere (dry nitrogen, to avoid condensation in the submersible casing), and that off-axis holograms recorded at 532nm be replayed at 442nm to correct the aberrations of the real image associated with the change in refractive index from water into air.

This change in replay wavelength, combined with the resulting change in illumination angle, means that the Bragg condition is no longer satisfied during replay, so that even with a 180mW HeCd laser it is difficult to see the particle images with the standard machine vision CCD camera to be used for automatic analysis of the particle images. Changing the replay beam angle to better satisfy the Bragg condition makes the particle images brighter, but also renders them unrecognizable by introducing severe optical aberrations.

A possible solution is to alter the Bragg properties of the hologram. In particular, the emulsion thickness can be conveniently controlled by altering the humidity of the atmosphere surrounding the hologram without causing any long-term changes or damage to the holographic plate.

The real image of a USAF 1951 resolution target has been projected from holograms recorded on Agfa 8E56 glass plates and mounted in a glass-sided enclosure. With the enclosure held at various humidities, the brightness and perceived resolution of the reconstructed image have been measured using a CCD camera with fixed electronic parameters. The results have been compared with a simple model.

Ambient humidity control is thus felt to be a viable technique for controlling the emulsion thickness of holograms on silver-halide materials, and so simultaneously optimising replay for both minimum aberrations and maximum diffraction efficiency.

Abstract submitted to: *Optical Holography and its Applications*
Kiev, Ukraine; 28th September – 2nd October 2000