CONFOCAL PROFILING OF SPHERICAL CAVITIES

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Interpretation of reflected confocal images of surface profiles is difficult since a single surface will generate two signals via both backscattering and specular reflection [1]. Although the signals are separate and appear in two different geometric locations, distinguishing the signals and the true location of the surface remains ambiguous. To resolve this ambiguity, an imaging scheme using semicircular entrance and exit pupils has been developed to create contrast between the backscattered and specular reflected light [2].

Spherical surfaces are important special cases of general interfaces. Spherical surfaces are especially useful since the geometric conditions for backscattering and specular reflection can be solved analytically. For a spherical surface, specular reflection occurs when the focus is on the surface of the cavity while backscattering occurs when the focus is at the geometric center of the sphere. In theory, the maximum intensity occurs during backscattering which leads to an artifact in the retrieved profile since in this case the focus is at the geometric center of the cavity rather than at the surface itself. In practice, the relative intensities of the backscattered and specular reflected light depend on the scattering properties of the surface. Previously, theory has been developed and experiments performed for the case of convex spherical samples detected with semicircular pupils to reject either the backscattered or specular reflected light [3].

We are now extending this work to concave surfaces. Confocal images are obtained of a concave hemispherical cavity in a flat substrate fabricated in PDMS stamped with a 175 micron ball lens. As in the case of convex surfaces, the technique of semicircular pupil is implemented in order to distinguish the specular reflected light from the surface of the cavity from the backscattering at the center of the cavity.

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