

A Differential Approach to Shape from Polarization - SUPPLEMENTARY MATERIAL

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1 Synthetic data generation

In this section, we introduce some additional well-known notions for polarisation imaging to explain what affects the quality of the level-set retrieved using

$$z_x \left(-I_{\frac{\pi}{4}} + I_+ \right) + z_y \left(I_0 - I_+ + I_- \right) = 0. \quad (1)$$

1.0.1 Preliminaries

An important quantity that needs to be considered while dealing with polarisation images is the degree of polarisation, generally defined per pixel as

$$\rho = \frac{I_-}{I_+} \quad (2)$$

which can be differently computed depending on the particular material under observation as we show later [10].

Diffuse reflection When the material reflects light in a diffuse way, it can be shown that the degree of diffuse polarisation depends on the zenith angle ϕ and the refractive index of the reflecting medium μ (typically $\mu=1.6$) as follows

$$\rho_d = \frac{\left(\mu - \frac{1}{\mu} \right)^2 \sin^2(\phi)^2}{2 + 2\mu^2 - \left(\mu + \frac{1}{\mu} \right)^2 \sin^2(\phi) + 4 \cos(\phi) \sqrt{\mu^2 - \sin^2(\phi)}}. \quad (3)$$

Specular reflection Instead, when specular reflection comes into play, the degree of specular polarisation can be computed as follows

$$\rho_s = \frac{2 \sin^2(\phi) \cos(\phi) \sqrt{\mu^2 - \sin^2(\phi)}}{\mu^2 - \sin^2(\phi) - \mu \sin^2(\phi) + 2 \sin^4(\phi)}. \quad (4)$$

2 Measurement of level-set quality on real data

In this section we show experimentally how the quality of the level-set given by (1) depends on the degree of polarisation (2).

In Figure 1 the level-set for objects made of different materials have been retrieved. Figure 2 shows that the quality of the isocontours depends on the degree of polarisation that for the owl statue is very low due to the rough material.

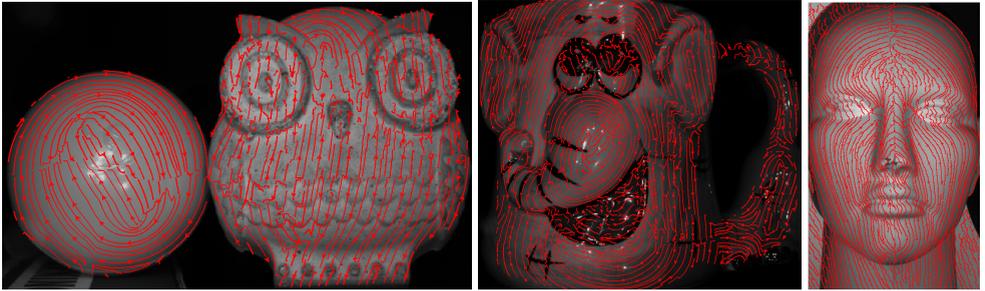


Figure 1: From left to right, real data level-sets of a plastic ball, cement owl statue, ceramic cup and head of mannequin [2].

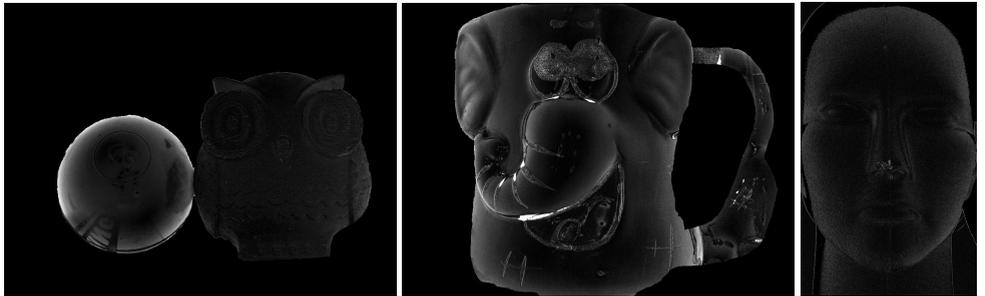


Figure 2: Real data degree of polarisation ρ . The scale is black is $\rho = 0$, white is $\rho > 0.25$. Note that the owl statue and face statues gets a very minimal polarisation compared to the specular cup and ball. In addition, note that ρ is higher at object boundaries where the zenith angle ϕ is higher.

References

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