Reaction Report XIII: PANDORA: Polarization-Aided Neural Decomposition Of Radiance

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Identify one idea in the paper that you feel is a major contribution or a major limitation, explain it, and discuss why it is important

The paper proposes a new method to decompose scene radiance using multiple-view polarized images, as polarization strongly depends on surface normals and is distinct for diffuse and specular reflectance. This method can extract an object's 3D geometry, its surface, and even incident illumination without artifacts, even in practical unstructured scenarios. I believe the core contribution of this work is the idea of using polarization as a cue for reflectance decomposition. The pipeline first captures multiple polarized images, then processes them to convert raw sensor data into Stokes vector images. During the process, the camera pose is calibrated by COLMAP using the measurements above, providing all camera positions and ray directions for the input. In the learning part, the authors use an SDF network to predict surface normals, diffuse and specular radiance, and incident illumination. The Stokes vector outputs are generated using these predicted parameters and are then compared with the original Stokes in the optimization function. This end-to-end pipeline demonstrates the characteristics of polarized images for a challenging task and could be easily extended for new applications.

Describe one idea of yours that builds on the paper and expand on that idea as much as possible

In this work, the authors assume that the incident illumination is completely unpolarized, the objects are made up of dielectric materials, and only direct illumination is considered (no indirect or occluded light). I think it is possible to handle metallic materials by incorporating a more general reflectance model into the current polarimetric model. As for indirect illumination, taking it into account can lead to more realistic reconstructions. It might be possible to add a component to NeRF to predict indirect illumination effects and integrate them into the optimization function. This way, the method could more accurately capture the full range of lighting interactions.