

# Applied Mathematics

## On Perspective Photometric Stereo

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Photometric stereo is a classical problem in Computer Vision where the shape and reflectance of an object are estimated from a single view (fixed camera position) and varying light sources, under the assumption of Lambertian reflectance. It has traditionally been solved in two steps: recovery of normal directions to the object surface, and then integration of the estimated normal field to obtain a surface patch. In the work we take the differential approach where we optimize directly for a surface. We first study the least-squares problem. We show that a minimizer exists, though the least-squares problem is non-convex and non coercive. We discuss two strategies to compute a (local) minimizer. Because of potentially complex noise, violations of the Lambertian reflectance assumption, as well as limitations in the geometry, a more robust approach, using  $L^1$  norms terms, is desirable. We show how to efficiently compute minimizers for it, which provide state-of-the-art results.

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