

Recent developments in computer aided analysis of lighting in realist fine art

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Computer vision methods such as lighting estimation and shape-from-shading have been applied to a number of problems in the history and interpretation of art (Fig. 1). The occluding contour algorithm, used in forensic photography analysis, estimates the direction of illumination from the pattern of luminance (lightness) along the outer boundary or occluding contour of a diffusely reflecting object.¹ Sophisticated extensions to this algorithm characterize the lighting in arbitrarily complex lighting environments.² Computational methods for inverting the forward appearance model of planar surfaces reveal the location of the source of illumination.^{3,4} Bayesian statistical methods integrate lighting estimates from disparate sources in a statistically optimal way.⁵

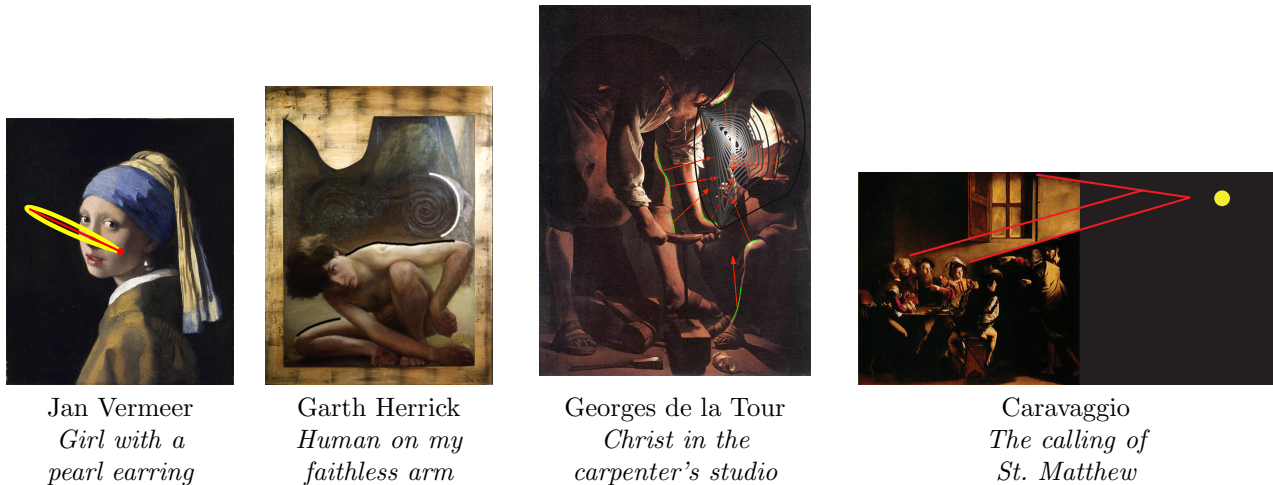


Figure 1. Vermeer: The lighting direction estimated by the occluding contour algorithm, shape-from-shading, and four other methods agree to within 4° in *Girl with a pearl earring*.¹ Herrick: The complex diffuse lighting field estimated from the background scroll differs from that on the figure, revealing that these portions in *Human* were indeed executed under different lighting conditions.² de la Tour: Bayesian statistical methods integrate diverse types of lighting evidence throughout the tableau to compute a contour graph showing that the most likely location of the illumination is at the candle.⁵ Caravaggio: Computational inversion of the forward appearance model of the rear wall in *Calling* reveals the light source was likely a few meters outside the frame of the painting.^{3,4}

These computer methods allow art scholars to study rigorously the consistency in lighting throughout a tableau, to identify inconsistencies that elude even expert visual detection, and to better understand artists' style and studio praxis, such as whether an artist may have used optical aids. This talk will focus on the assumptions that underly the use of these methods, explain how they are used, and describe the types of art historical and interpretive questions to which they can be addressed.⁶ As with all computer methods in the study of art, it is essential that these methods be guided by deep knowledge of the target art work, its artist's oeuvre and working methods, as well as its cultural context.

ACKNOWLEDGMENTS

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