Analysis and Differential Geometry Seminar

A solution to a problem of determining the sides of a lens

Hasan Palta
Emory University

Abstract: Suppose that a beam of light with the positive vertical direction $\mathbf{k}$ is crossing a domain Ω in the horizontal plane $z = 0$ with some intensity $I \in L^1(\bar{\Omega})$ and is refracted at both sides of a lens in such a way that the final direction is also $\mathbf{k}$ and that the beam illuminates a set T_d in the plane $z = d$ with intensity $L \in L^1(\bar{T}_d)$. Let n_1 and n_2 be the refractive indices of the ambient environment and of the lens, respectively. Such a construction generates a mapping $P : \Omega \to T$ where T is the orthogonal projection of the domain T_d onto $z = 0$. We consider the inverse problem of recovering the two sides $z \in C(\bar{\Omega})$ and $w \in C(\bar{T})$ of the lens for given domains Ω and T_d and the corresponding intensities I and L. In analytic formulation, this problem requires a solution to a nonlinear partial differential equation of Monge-Ampère type. In this talk, we present a different approach to this problem, describe an algorithm giving approximate solutions using general properties of geometric optics and give some examples.

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