

TEMPLE UNIVERSITY

Department of Mathematics

Analysis Seminar

Room 617 Wachman Hall

Monday, November 30, 2015, 2:40 p.m.

Weak solutions to some refraction problems in metamaterials

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Abstract: The notion of negative refraction goes back to the work of V. Veselago in the late 1960's, in which he proposed that light can be bent in such a way that when light strikes a surface, the refracted ray makes a negative angle with the normal. Materials possessing such property do not exist naturally, but have been constructed in the laboratory in the early 2000's. The research on the behavior of these materials, called metamaterials, has been extremely active in recent years, especially for applications to invisibility cloaking and the development of a "superlens", which can in principle image objects at the smallest scales. In this talk, I will discuss certain refraction problems in the setting of metamaterials. In particular, I will show how to obtain weak solutions (defined analogously to Brenier solutions for the Monge-Ampère equation) to these problems. For one variant of these problems, as in the case of positive refractive indices, a fully nonlinear PDE of Monge-Ampère type arises. Along the way, I will show that surfaces possessing a certain uniform refraction property, in the setting of metamaterials, are in general neither convex nor concave, which greatly contrasts with the case of positive refractive indices. This last result is joint work with Cristian Gutiérrez.