Counting Billiard Paths using Morse Theory

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Abstract

Consider a glass model of a 2-dimensional surface that has been half-silvered, so 50% of the light incident on the surface is reflected and 50% passes through. If we choose two points in the vicinity of this surface, we may ask how many different paths a beam of light may travel from one point to the other. A similar question may be posed for any n-manifold M embedded in $\mathbb{R}^N$. The goal of this talk is to get lower bounds for the number of these paths, in terms of the topology of M. This question is a type of billiard path problem. Frequently these problems are studied by looking at the space of all billiard paths, and asking which have a desired property (in this case, connecting the two points). Here, however, we look at the space of "paths" connecting the two points, and ask which are billiard paths. Answering this question requires us to develop a version of Morse theory for manifolds with corners.

This talk should be accessible to graduate students.