UNIVERSITY OF NOTRE DAME

Topology Seminar

Department of Mathematics



Guest Speaker: Erin Chambers

University of Notre Dame

Lecture Title:

Braids and monodromy in topological data analysis

Date: Tuesday, November 17, 2026

Time: 2:15 PM

Location: 258 Hurley Hall

Abstract:

In this talk, we will discuss recent work that connects two fundamental but generally distinct areas in computational topology, topological data analysis (TDA) and knot theory. Given a function from a topological space to $\mathbb{R}$, TDA provides tools to simplify and study the importance of topological features: in particular, the lth-dimensional persistence diagram encodes the topological changes (or l-homology) in the sublevel set as the function value increases into a set of points in the plane. Given a continuous one-parameter family of such functions, we can combine the persistence diagrams into an object known as a vineyard, which tracks the evolution of points in the persistence diagram as the function changes. If we further restrict that family of functions to be periodic, we identify the two ends of the vineyard, yielding a closed vineyard. This framework allows for the study of knots and braids in vineyards, as well as introducing the concept of monodromy to TDA, which in this context is an obstruction to topological feature tracking, since it means that following the family of functions for a period permutes the persistence diagram in a non-trivial way. Interestingly, the presence of monodromy in a vineyard also connects in a fundamental way to singularity theory, namely the medial axis and symmetry set of the shape. After reviewing the basic constructions of persistence diagrams and vineyards, we will show a construction which generates arbitrary knots and monodromy in a vineyard, and (time allowing) will classify why this behavior arises from specific types of singularities in the symmetry set.