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Katharine Turner - The Extended Persistent Homology Transform for Manifolds with Boundary

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The Persistent Homology Transform (PHT) is a topological transform which can be used to quantify the difference between subsets of Euclidean space. To each unit vector the transform assigns the persistence module of the height function over that shape with respect to that direction. The PHT is injective on piecewise-linear subsets of Euclidean space, and it has been demonstrably useful in diverse applications. One shortcoming is that shapes with different essential homology (i.e., Betti numbers) have an infinite distance between them.

The theory of extended persistence for Morse functions on a manifold was developed by Cohen-Steiner, Edelsbrunner and Harer in 2009 to quantify the support of the essential homology classes. By using extended persistence modules of height functions over a shape, we obtain the extended persistent homology transform (XPHT) which provides a finite distance between shapes even when they have different Betti numbers.

I will discuss how the XPHT of a manifold with boundary can be deduced from the XPHT of the boundary which allows for efficient calculation. James Morgan has implemented the required algorithms for 2-dimensional binary images as a forthcoming R-package. Work is also with Vanessa Robins.