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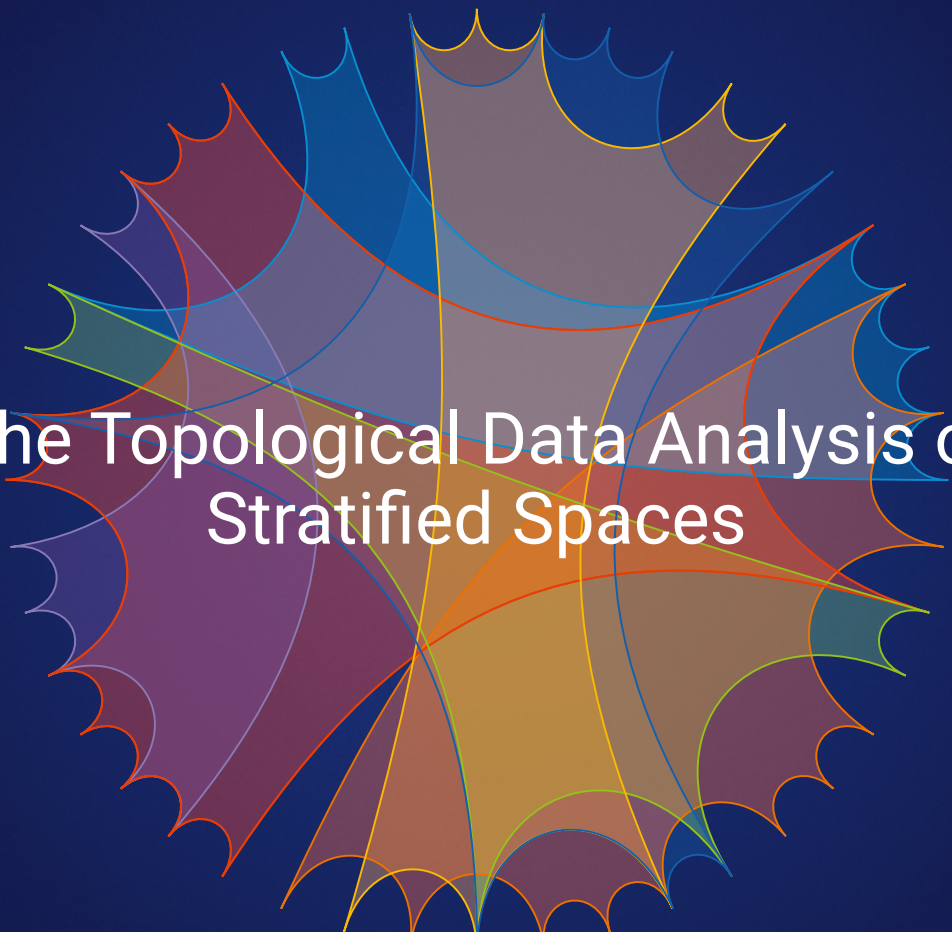
STRUCTURES JOUR FIXE

Lukas Waas & Tim Mäder

IMa, Uni Heidelberg



The Topological Data Analysis of Stratified Spaces

Pretalk by Lukas Waas starts at 1 pm

December 08, 2023, 1:30 PM, Phil 12 GHs

COFFEE & SNACKS IN ROOM 106

ZOOM: Meeting ID: 935 6549 3662, Code: 928036

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ABSTRACT

Stratified Homotopy Theory in Application - Lukas Waas

Persistent homology has proven to be a successful approach to detecting global topological features in data. Since homology is a homotopy invariant, persistent homology can only detect features which are present already at the homotopy theoretic level, i.e. in the so-called persistent homotopy type. However, many interesting features of spaces, in particular singularities, are not preserved under homotopy equivalences. If one is interested in detecting such features in data, then finer invariants are needed.

Using methods from the homotopy theory of stratified spaces, we present the notion of persistent stratified homotopy types, a stratified analogue to classical constructions such as filtered ˇCech complexes which is particularly suited to investigating data with singularities. The talk will feature an introduction to the (homotopy) theory of stratified spaces and then move on to explaining our central results on the persistent stratified homotopy type. Namely, just as persistent homology (homotopy types), it is computable and fulfills stability and inference results.

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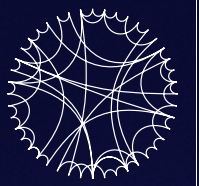

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ABSTRACT

Algorithmic Stratification Learning: Theory, Methods and Applications - Tim Mäder
One of the key challenges of the topological data analysis of singular spaces lies in equipping nonlabeled data with stratifications inherent to its geometry. This process is called stratification learning. In the most fundamental case, this amounts to the classification of points as singular or regular. Usually, this is done by quantifying the degree of singularity of a point from local data surrounding it. Such a quantification depends on a choice of singularity measuring function which can be built from local invariants such as local persistent homology. While successful in practice, so far there has been a lack of theoretical guarantees for this approach.
Here, we provide such guarantees for non-stratified data sampled from a broad class of two-strata Whitney stratified spaces. We present a fully implementable process which is modular in the choice of singularity measure. We explore two potential methods: one based on Hausdorff distances and another based on local persistent homology. In addition, we examine real-world data examples, highlighting the practical utility of the insights gained through the analysis of stratified structures.

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