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Resolution by Spread Modules over Grid Posets

The representation theory of posets holds great potential for applications in topological data analysis. In traditional persistent homology, a data set is associated with a representation M of a totally ordered poset, and topological information is extracted from the indecomposable summands of M. However, in data sets with varying densities or time dependence, it is natural to consider two-dimensional grid posets.

Higher dimensional grid posets typically have wild representation type, and representations arising from data often exhibit complicated indecomposable summands. Relative projective resolutions offer insights into the structure of a module, without computing a decomposition into indecomposables. These resolutions are analogous to projective resolutions in classical homological algebra.

This presentation introduces the theory of resolutions and approximations, with a focus on spread-resolutions over a grid poset. I provide an upper bound on the spread global dimension of any finite poset. This also gives an upper bound on the spread global dimension of certain infinite posets. Throughout, I will highlight several techniques for bounding the relative global dimension of a finite dimensional algebra.

This presentation is based on recent work by Benjamin Blanchette, Eric Hanson, Luis Scoccola, and me.