Multivector fields thoery for data analysis

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The recently developed multivector fields theory is an approach that provides means for a combinatorial representation of a vector field. It extends and is inspired by Forman's combinatorial vector fields that naturally arose from the discrete Morse theory. We incorporated multiple notions from the continuous theory of dynamical systems to make multivector fields a legible combinatorial counterpart of continuous vector fields. Among others, we adapted the concept of isolated invariant sets, Conley index theory, limit sets, and Morse decomposition. Except for the theoretical motivations, the theory is developed to be a new tool for analyzing empirical data with dynamical nature, e.g., a sampled vector field. To this end, we use persistence homology to study the structure and/or evolution of Morse decomposition or the Conley index.

In this talk, I will present the general idea of the multivector fields theory, some numerical experiments, and future ideas of its applications.