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Detecting low-rank structure is often key for understanding data. This task, however, is particularly challenging in the presence of an unknown nonlinearity — i.e., where one must detect the existence of a factorization $C_{il} = f(\sum_{a=1}^d A_{ia}B_{al})$ with small d , where $f(x)$ is an unknown monotone nonlinearity.

It turns out that homological features of the Dowker complex associated to the matrix C can be used to detect such a factorization, but the reason is somewhat mysterious. To understand why this works, we consider the relationship between the Dowker complex of C and a convex code associated to the factors A and B . A convex code is a subset of $2^{[n]}$ that arises from intersection patterns of convex sets in some Euclidean space - in this case, the codewords correspond to selected chambers of a hyperplane arrangement. I will give a short introduction to the connection between Dowker complexes, convex codes, and matrix factorizations, reviewing our recent results and some open problems.

Joint work with Chad Giusti (University of Pennsylvania).