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Mixed subdivisions and cellular resolutions of monomial ideals

Let Δ_d denote the d-dimensional simplex, and let $n\Delta_d$ denote its nth dilation. A 'mixed subdivision' of $n\Delta_d$ is a polyhedral complex M with $|M| = n\Delta_d$, and where each face of M is given by the Minkowski sum of subsets of the faces of Δ_d. The faces of M are naturally labeled by monomials in $k[x_1, ..., x_{d+1}]$. We show that certain subcomplexes and coarsenings of (certain) mixed subdivisions of $n\Delta_d$ support minimal cellular resolutions of a large collection of ideals, including 'cointerval' hypergraph edge ideals and a class of Artinian monomial ideals. We use techniques from tropical convexity and the topological study of graph homomorphisms. Parts of this are joint work with Alex Engstrom, Michael Joswig, and Raman Sanyal.