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Numerical Cubature from Geometry and Coding Theory

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The numerical cubature problem is the generalization to higher dimensions of integration methods such as Simpson's rule. Given a measure μ on \mathbb{R}^n , a t -cubature formula is a finite set C such that the integral of any polynomial P of degree t with respect to μ equals a weighted sum over values on C . The main interest is in cubature formulas with few points, with positive weights, and without points outside of the domain of μ . Gaussian quadrature satisfies all three conditions in one dimension, but the problem is already open-ended in two dimensions and increasingly non-trivial in higher dimensions.

I will discuss new methods for the cubature problem coming from error-correcting codes, symplectic moment maps, and lattice packings of discretized convex bodies. The methods yield many new explicit, efficient, positive, interior, cubature formulas for the most standard choices of μ . In one context, they also lead to an interesting local lower bound on the number of points needed for cubature.

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