Well conditioned spherical $t$-design and its application in numerical integration

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Abstract

We draw our attention on the unit sphere in three dimensional Euclidean space. A set $X_N$ of $N$ points on the unit sphere is a spherical $t$-design if the average value of any polynomial of degree at most $t$ over $X_N$ is equal to the average value of the polynomial over the sphere. The last forty years have witnessed prosperous developments in theory and applications of spherical $t$-designs. Let integer $t > 0$ be given. The most important question is how to construct a spherical $t$-design by minimal $N$. It is commonly conjectured that $N = \frac{1}{2}t^2 + o(t^2)$ point exists, but there is no proof. In this talk, we firstly review recent results on numerical construction of spherical $t$-designs by various methods: nonlinear equations/interval analysis, variational characterization, nonlinear least squares, optimization on Riemanninan manifolds. Secondly, numerical construction of well-conditioned spherical $t$-designs are introduced for $N$ is the dimension of the polynomial space. Consequently, numerical approximation to singular integral over the sphere by using well-conditioned spherical $t$-designs are also discussed.

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All are welcome