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Bounds for bilinear averages and associated maximal functions

Let S^{2d-1} be the unit sphere in $\mathbb{R}^{2d}$, and σ_{2d-1} the normalized spherical measure in S^{2d-1}. The (scale t) bilinear spherical average is given by

$$\mathcal{A}_t(f,g)(x) := \int_{S^{2d-1}} f(x-ty)g(x-tz)\, d\sigma_{2d-1}(y,z).$$

There are geometric motivations to study bounds for such bilinear spherical averages, in connection to the study of some Falconer distance problem variants. Sobolev smoothing bounds for the operator

$$\mathcal{M}_{[1,2]}(f,g)(x) = \sup_{t\in[1,2]} |\mathcal{A}_t(f,g)(x)|$$

are also relevant to get bounds for the bilinear spherical maximal function

$$\mathcal{M}(f,g)(x) := \sup_{t>0} |\mathcal{A}_t(f,g)(x)|.$$

In a joint work with B. Foster and Y. Ou, we put that in a general framework where S^{2d-1} can be replaced by more general smooth surfaces in $\mathbb{R}^{2d}$, and one can allow more general dilation sets in the maximal functions: instead of supremum over $t>0$, the supremum can be taken over $t\in\tilde{E}$ where $\tilde{E}$ is the set of all scales obtained by dyadic dilation of fixed set of scales $E\subseteq[1,2]$.