Constructive non-polynomial approximations of spherical functions: Algorithm, analysis, fast evaluation and application

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The fast Fourier transform (FFT) based matrix-free ansatz interpolatory approximations of periodic functions are fundamental for fast and efficient realization in several applications It is not possible to design a similar matrix-free interpolatory approximation on the sphere in the space of spherical polynomials. Using a special class of non-polynomial finite dimensional subspaces of a Sobolev space on the sphere, we design, analyze, and implement FFT-type matrix-free interpolatory approximations of spherical functions. We demonstrate the construction and Sobolev estimate analysis for a wave propagation model.