Multiresolution Techniques

Session at the *5th Dolomites Workshop on Constructive Approximation and Applications*

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List of contributions

Schedule

	Mon. 6th	Tue. 7th	Wed. 8th	Thu. 9th	Fri. 10th
10:30 – 12:30					B. Jeong J. Ruiz Álvarez J. Liandrat N. Sharon
14:30 – 16:30					

Kernel-based Quasi-interpolation for Approximation of Multivariate Functions on Sparse Grids

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Abstract: In this talk, we present a new class of quasi-interpolation methods for the approximation of multivariate functions on sparse grids that are discrete blends of directionally uniform grids. Each method in the class is based on shifts of kernels constructed from one-dimensional radial basis functions such as multiquadrics. The kernels are amended near the boundaries of the computational domain to prevent deterioration of the fidelity of approximation. We implement the proposed method using the standard single-level scheme as well as the multilevel technique designed to improve rates of approximation. Our sparse approximation achieves almost the same level of convergence order as the optimal approximation on the full grid related to the Strang–Fix condition, while significantly reducing the amount of required data compared to full grid methods. Moreover, the singlelevel approximation performs nearly as well as the multilevel approximation, with much less computation time. A rigorous proof for the approximation orders of our quasi-interpolations is provided. In particular, compared to another quasi-interpolation method in the literature based on the Gaussian kernel using the multilevel technique, we show that the proposed methods provide remarkably better rates of approximation. Lastly, some numerical results are presented to demonstrate the performance of our methods.

Joint work with Scott N. Kersey[†] and Jungho Yoon[‡].

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WENO methods with progressive order of accuracy

Juan Ruiz Álvarez
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Abstract: In this work we will talk about the construction and analysis of new nonlinear optimal weights for WENO interpolation that are capable of raising the order of accuracy close to discontinuities. The new nonlinear optimal weights are constructed using a strategy inspired by the original WENO algorithm, and they work very well for corner or jump singularities, leading to optimal theoretical accuracy. We will also analyze the performance of the new algorithm proposed for univariate function approximation.

Enforcing convergence of derivatives for L^∞ approximations of a regular curve

Jacques Liandrat
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Abstract: Simultaneous convergence of a sequence of approximations of a curve and its derivatives is often desirable but rarely ensured. We propose and analyze a constructive approach that, given a converging sequence of polygons and an estimate of its L1 distance to the limit curve, provides another sequence of polygons for which the convergence of discrete differentials occurs as well. It is based on subdivision multiresolution and non linear filtering. Applications are developed for the estimate of solid friction in a drillling pipe.

Joint work with Emilien Garcia.

Geometric Hermite interpolation via circle-preserving averaging

Nir Sharon
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Abstract: The classical Hermite interpolation problem is when we are given the function's derivative values in addition to the function's values. Many variants of this problem appear in recent years, including point-normal interpolation of curves or surfaces in 2D or 3D, manifold-values Hermite, and more. In this talk, we introduce a new circle-preserving subdivision scheme that solves the problem of approximating a curve in Euclidean space (of any dimension) from its values and tangent vectors. We describe the construction, some of the properties, and the approximation benefit of using tangent vectors and specifically when applying our scheme upon them. In addition, as time permits, we will discuss a few open questions from the broader context of interpolating such complex samples of a curve.