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HIGH-DIMENSIONAL INTEGRATION OF KINKS AND JUMPS – SMOOTHING BY PREINTEGRATION

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In many applications, including option pricing, integrals of d-variate functions with "kinks" or "jumps" are encountered. (Kinks describe simple discontinuities in the derivative, jumps describe simple discontinuities in function values.) The standard analyses of sparse grid or Quasi-Monte Carlo methods fail completely in the presence of kinks or jumps, yet the observed performance of these methods can remain reasonable.

In recent joint papers with Michael Griebel and Frances Kuo we sought an explanation by showing that many terms of the ANOVA expansion of a function with kinks can be smooth, because of the smoothing effect of integration. The problem settings have included both the unit cube and d-dimensional Euclidean space. The underlying idea is that integration of a non-smooth function with respect to a well chosen variable, say x_j, can result in a smooth function of $d-1$ variables.

In still more recent joint work with Andreas Griewank, Hernan Leovey and Frances Kuo we have extended the theoretical results from kinks to jumps, and have turned "preintegration" into a practical method for evaluating integrals of non-smooth functions over d-dimensional Euclidean space. In this talk I will explain both the method and the ideas behind "smoothing by preintegration".