Robert Kirby  
Mathematics Department  
Baylor University  

Fast Simplicial Finite Elements via Bernstein Polynomials  

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226 Jones Laboratory, 5747 S. Ellis Avenue  
Host: Ridgway Scott  

ABSTRACT  

For many years, sum-factored algorithms for finite elements in rectangular reference geometry have combined low complexity with the mathematical power of high-order approximation. However, such algorithms rely heavily on the tensor product structure inherent in the geometry and basis functions, and similar algorithms for simplicial geometry have proven elusive.  

Bernstein polynomials are totally nonnegative, rotationally symmetric, and geometrically decomposed bases with many other remarkable properties that lead to optimal-complexity algorithms for element-wise finite element computations. The also form natural building blocks for the finite element exterior calculus bases for the de Rham complex so that $H(\text{div})$ and $H(\text{curl})$ bases have efficient representations as well. We will also their relevance for explicit discontinuous Galerkin methods, where the element mass matrix requires special attention.