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STOCHASTIC TOPOLOGY OPTIMIZATION: COMPARING POLYNOMIAL CHAOS APPROACHES TO DIRECT SPARSE QUADRATURE

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Abstract: Recent work by Keshavarzzadeh, Meidani, and Tortorelli, and by Keshavarzzadeh, Fernandez, and Tortorelli, illustrates the computational efficiency of polynomial chaos expansions in representing uncertainty in stochastic topology optimization as compared to Monte Carlo approaches. In this polynomial chaos approach, sparse quadrature methods are used to compute coefficients of a series expansion in uncertainty space. However, in many cases, these same quadrature methods could be used to compute objective functions and constraints directly, without passing through a polynomial chaos expansion. We contrast the relative efficiency of these two approaches, tradeoffs, and algorithmic specializations necessary to expose parallelism and improve performance while maintaining numerical stability.