Analytic approximation and differentiability of joint chance constraints

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Abstract

Nonlinear chance constrained optimization (CCOPT) problems are known to be difficult to solve. This work proposes a smooth approximation approach consisting of an inner and an outer analytic approximation of joint chance constraints. CCOPT is approximated by two parametric nonlinear programming (NLP) problems which can be readily solved by an NLP solver. In [1] it is shown that any optimal solution of the inner approximation problem is a priori feasible to the CCOPT with single chance constraints. The solutions of the inner and outer problems, respectively, converge asymptotically to the optimal solution of the CCOPT in case of single chance constraints [2].
The case of joint chance constraints can be dealt very similar using the product of the ansatz function. However different ansatz functions are necessary for the inner and outer approximation to ensure the monotony in both cases. As in the case of single chance constraints the differentiability of the chance constraints is shown by proving the uniform limit of the smooth inner or outer approximation to the chance constraint and the existence of the uniform limit of their gradients. Essential is the smoothness of the stochastic set defining constraints and the validity of the linear independent constraint qualification (LICQ) for them.

References

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[2] A. Geletu, M. Klöppel, A. Hoffmann, and P. Li, *An inner-outer approximation approach to chance constrained optimization*, SIAM J. Optimization, 2017 (accepted, 24pp).

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