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Reformulating Chance-Constrained Optimization as Neural Network Learning

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Chance-constrained optimization (CCO) problems are stochastic optimization problems with probabilistic constraints defined by a confidence level α. A standard solution approach is to transform the CCO problem into a deterministic optimization problem, which is then solved by a numerical solver. However, this approach becomes computationally expensive when dealing with multiple confidence levels, as it requires solving from scratch for each confidence level.
To overcome this inefficiency, we present a deep learning algorithm for efficiently solving the CCO problem over multiple confidence levels. The proposed algorithm can be summarized in the following key steps:
1) Through neurodynamic optimization, we model the CCO problem as an initial value problem (IVP) containing a system of ordinary differential equations.
2) We use physics-informed neural networks (PINNs) to solve that IVP.
3) We use the PINN solution for the confidence level α^i as an initial prediction for the next confidence level α^{i+1}, which is improved by retraining the PINN.
Experimental results show that the proposed algorithm provides accurate solutions for the CCO problem at multiple confidence levels, and is significantly more computationally efficient than standard numerical solvers.

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