Inverse robustness with application to chemical production plants

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Robustness in optimization refers to the ability of a solution to remain effective under uncertainties in the model parameters. In classical robustness, it is assumed that the scenario set is known a priori. However, real-world applications frequently present only a vague understanding of potential scenarios, with imprecise bounding of these sets. Despite this uncertainty, strict tolerances for optimization outcomes are typically established and must not be exceeded. This leads to the concept of inverse robustness, allowing acceptable deviations in optimization outcomes. By setting a budget for these deviations, we quantify the maximum allowable ranges of uncertain model parameters to adhere to strict tolerances in the objective space. Our approach evaluates the volume of norm balls within the feasible region, tackling a general semi-infinite optimization problem associated with implicitly defined areas. We employ discretization techniques to consider only a finite number of constraints, and an adaptive linear regression-based algorithm demonstrates good results in practical applications.

Future research will explore multi-objective optimization by integrating robustness as an additional objective function. This strategy aligns with the epsilon constraint method, ensuring solutions remain within acceptable performance limits while enhancing robustness.

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