A Decomposition Approach for a New Test-Scenario in Complex Problem Solving

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Abstract

Over the last years, psychological research has increasingly used computer-supported tests, especially in the analysis of complex human decision making and problem solving. The approach is to use computer-based test scenarios and to evaluate the performance of participants and correlate it to certain attributes, such as the participant's capacity to regulate emotions. However, two important questions can only be answered with the help of modern optimization methodology. The first one considers an analysis of the exact situations and decisions that led to a bad or good overall performance of test persons. The second important question concerns performance, as the choices made by humans can only be compared to one another, but not to the optimal solution, as it is unknown in general. Additionally, these test-scenarios have usually been defined on a trial-and-error basis, until certain characteristics became apparent. The more complex models become, the more likely it is that unforeseen and unwanted characteristics emerge in studies. To overcome this important problem, we propose to use mathematical optimization methodology not only as an analysis and training tool, but also in the design stage of the complex problem scenario. We present a novel test scenario, the IWR Tailorshop, with functional relations and model parameters that have been formulated based on optimization results. We also present a tailored decomposition approach to solve the resulting mixed-integer nonlinear programs with nonconvex relaxations and show some promising results of this approach.

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