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**Determining the Impact of Computational Resolution
Using a Mixed-Integer Hybrid Optimization Technique**

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Tackling water resources management problems routinely requires the pairing of subsurface simulators and optimization algorithm. Inherent challenges lie in choosing the appropriate realization of the subsurface, formulating the objective function and constraints, and applying a suitable optimization algorithm. The objective function and constraints rely on output from the simulator, and the simulator often requires the numerical solution to a system of nonlinear partial differential equations thus derivative-free methods have emerged as the optimization algorithms of choice.

Various assumptions can be made to simplify either the objective function or the physical system including the use of coarsely discretized grids to improve the computational efficiency the underlying simulation tool. Previous studies have shown that solutions obtained using a course grid simulation become suboptimal as the grid resolution is improved. Moreover, optimization algorithms that previously succeeded in identifying those are no longer suitable as the physical domain approaches reality either due to the computational burden or the impact of increased constraint violations.

In this work, we describe a derivative-free hybrid approach, which allows us to combine the beneficial elements of multiple methods, and more efficiently search the design space. We will use this method to demonstrate a study of a groundwater supply problem on a series of increasingly fine grids. Specifically, we will show that solutions on the coarse grid are infeasible on a finer grid and subsequently show how the hybrid approach can be applied to find a new solution on the fine grid.