Three decades of multilevel optimization strategies

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Multilevel approach has become common in many applications involving optimization problems. Many of these problems may consist of millions of discrete state variables and are known to be NP-hard. In many theoretical and industrial fields, this class of problems is often addressed and actually poses a computational bottleneck, e.g., graph visualization, facility location problem, VLSI layout, etc. We have developed fast multilevel solvers for a variety of such combinatorial optimization problems including graph and hypergraph problems. In particular, we suggest a local measure, the algebraic distance, for the graph coarsening process yielding a multiscale graph organization. Another problem we introduce is an optimization problem of continuous state variables under non-linear global constraints describing the movement of a soft robotic arm inspired by the octopus extension and fetching movements.