Bilevel multiobjective optimization of vehicle layout

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The battery thermal packaging design requires the optimization of the battery position in the vehicle to improve vehicle dynamics, component accessibility and passenger survivability subject to geometric constraints such as collision between the components in the vehicle, and the simultaneous optimization of cell layout inside the battery pack while considering thermal aspects. Since each optimization is driven by multiple performance criteria, the battery design motivates new research in mathematical optimization on the development of approaches to generating the Pareto set of the all-in-one (AiO) bilevel problem by computing the Pareto set of the subproblem on each level.

A MultiObjective Decomposition Algorithm (MODA) is developed for the distributed computation of the bilevel AiO Pareto set based on the block coordinate descent method for addressing decomposition, the method of multipliers for addressing bilevel coordination, and the weighted-sum scalarization for addressing the tradeoff between multiple criteria. The developed mathematical formulation describes the packaging problem with morphing components and, as shown by the numerical runs, the solution algorithm allows the negotiation between the system level criteria and the component level criteria which drive the component shape.