The Real Benefits of Choosing Superior Optimization Technology

Introduction

Does it matter which optimization technology an engineering team chooses? The answer is, unequivocally, yes. Choosing a superior optimization technology can

- reduce design cycle time
- improve design performance
- increase innovation
- support efficient use of resources

Prior to automated, mathematics-based optimization, engineers performed manual search based primarily on intuition. In this process, a key indicator of success was the education and experience of the lead project engineer. A smarter and more efficient engineer could often develop far better designs in much less time than someone with less training and experience.

In the same way, a smarter and more efficient mathematical search algorithm can add significant value to an automated design optimization process, particularly when it comes to finding better designs in less time. In real terms, this equates to higher quality designs at lower cost, greater innovation, increased competitive advantage, and more.

A Real-World Case Study

A major automotive supplier was investigating new concepts for a structural system. In order to more thoroughly explore the concept and shorten the design cycle time, an automated multi-objective Pareto optimization study was performed. The goals of this study were to find the trade-offs between minimizing mass and cost, satisfy regulatory requirements for rear crash events, and meet targets on the natural frequencies of the system. A total of 11 design variables were used, which included shape, material and gauge thickness variables.

Each design evaluation included a nonlinear dynamic crash simulation and a linear vibration analysis, the sum of which required several hours of CPU time. Considering the lengthy evaluations, the project timeline, and the available computing resources, the design team restricted the allowable number of evaluations to 200.

An initial study was performed using a popular multi-objective optimization algorithm as implemented in a commercial optimization software package. Simultaneously, on a separate computing resource, the study was duplicated using the MO-SHERPA multi-objective optimization algorithm available within the HEEDS Professional software package.

The results of these two studies clearly revealed the importance of advanced optimization technology. After only 160 evaluations, the MO-SHERPA algorithm identified significantly better designs than those found by the competing algorithm using 200 evaluations. The team selected a design based on the MO-SHERPA run – a design that was both 12% lighter and 10% less expensive than the best design found by the competing method (which used 25% more CPU time).

The 10% reduction in cost amounted to a substantial financial gain, while the additional 12% mass reduction contributed to a significant competitive advantage. These benefits were realized with the same engineers and analysis models, and equivalent computing resources. The only difference was superior optimization technology.

Summary

All optimization algorithms are not created equal. Many work well only on certain types of problems, and some are very inefficient at finding optimal solutions. The difference between a robust, efficient algorithm and an inferior one can be substantial in terms of real measures such as product cost, mass, and performance, as demonstrated by the above case study.

Numerous benchmark studies have demonstrated that the proprietary SHERPA and MO-SHERPA optimization algorithms are substantially more efficient and robust than other algorithms over a wide range of problem classes. For examples, see the following papers:

- http://www.redcedartech.com/pdfs/SHERPA.pdf
- http://www.redcedartech.com/pdfs/MO-SHERPA_paper.pdf

Does optimization technology matter? If the bottom line matters, then the answer is yes.