

## **VOLVO TECHNOLOGY VEHICLE STRUCTURAL OPTIMIZATION ENVIRONMENT.**

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### **ABSTRACT**

With the ever increasing capability in computer power, optimizing a full vehicle structure including most of the crash load cases will be a real possibility in the near future. For example, the Cell chip used in PS3 or the availability of recent GPU of high end PC graphics cards delivers 100 – 1000 GFLOPS. The bottleneck in this scenario will not be the computer power, instead the problem will be how to feed the computers with models and input decks to analyze in a reliable and stable way with little or no manual interventions.

At Volvo Technology, we have, in different research and internal projects, developed a Vehicle Structural Optimization Environment that has the capability to enable the use of global optimization, in the development and evolution of vehicle structure. This environment integrates and manages the analysis software, the optimizer, our Linux cluster together with its queuing system, the model and concept generator, and finally the management of all generated models and analysis results. Currently we are using LSdyna for crash and static analysis, LSopt for controlling the optimizations and AML for creating models and input decks.

An important factor in this environment is to have a stable model and input deck generator, without any manual interaction, capable of generating input decks for analysis for all types of concept that is of interest. Except for just changing thicknesses we may want to: find the most effective material to use, both from a weight and a cost perspective, determine the best layout for tailor welded blanks, change the cross section dimensions, find needed stiffeners or investigate new way of subdividing the design in parts.

As an example, a global optimization of a BIW, including approximately 100 design variables, analyzing the Euro NCAP crash cases for five stars, handling, comfort and cost, running approximately 10-12 iterations for the optimization, will result in approximately 2500-3000 crash analysis, 1500-2000 eigenvalue analysis, and 4000-

5000 static analysis. On our current Linux cluster the time to find an improved point is 5-6 weeks. If the computer power is increased by a factor of 10, then the improved point will be found in 3-4 days, as we have no manual interactions in the process.

For an effective way of analyzing new concepts or updates of a current design, not just structural objectives needs to be analyzed, also models capable of analyzing such aspects as cost and manufacturability have to be included in the environment.