10th World Congress on Structural and Multidisciplinary Optimization
May 19 -24, 2013, Orlando, Florida, USA

MULTIDISCIPLINARY OPTIMIZATION WITH VISUALDOC

Santosh Tiwari[1], Hong Dong[1], Srinivas Lankalapalli[1], and Juan Pablo Leiva[1]

[1] Vanderplaats Research & Development, Inc., Novi, MI, USA, {stiwari, hdong, slankal, jp}@vrand.com

Abstract

In this paper, we describe how to formally and systematically perform multi-disciplinary optimization (MDO) using VisualDOC. Typically, when performing MDO studies, the user is required to identify the linking/coupling variables, dependent and independent inputs/outputs, formulate the system-level and sub-system level optimization problems, integrate different disciplines and sub-systems together, and model the data flow and link the modeled problems with optimization to perform the design study. It is specifically demonstrated how VisualDOC can automate this entire process without requiring the user to write a computer program or manually perform the integration. With VisualDOC, the user is only required to identify the linking/coupling variables and formulate the system-level and sub-system level optimization problems. This paper primarily focuses on the specific challenges in process integration, data transfer between different systems, and coordinated execution of optimization to perform the design study. The available computational and algorithmic tools and their solution as provided by VisualDOC are presented. For the purpose of demonstration, a heat exchanger design problem is considered with designable structural and thermal components. The computational model for heat exchanger is treated as black-box (i.e. no information is available to the optimizer about the analysis program and it is not possible to decompose/split the analysis for any system/sub-system) and is provided as a computer simulation. Different MDO techniques such as i) multiple disciplines feasible (MDF), ii) individual disciplines feasible (IDF), iii) collaborative optimization (CO), iv) concurrent sub-space optimization (CSSO), and v) bi-level integrated system synthesis (BLISS) are modeled in VisualDOC. A complete flowchart using standard VisualDOC components is presented for each MDO technique. The performance, efficiency, and suitability of each of these techniques are compared and their advantages and disadvantages are discussed. It is shown that the proposed approach for model creation and design process integration enables one to perform such design studies easily and reliably.