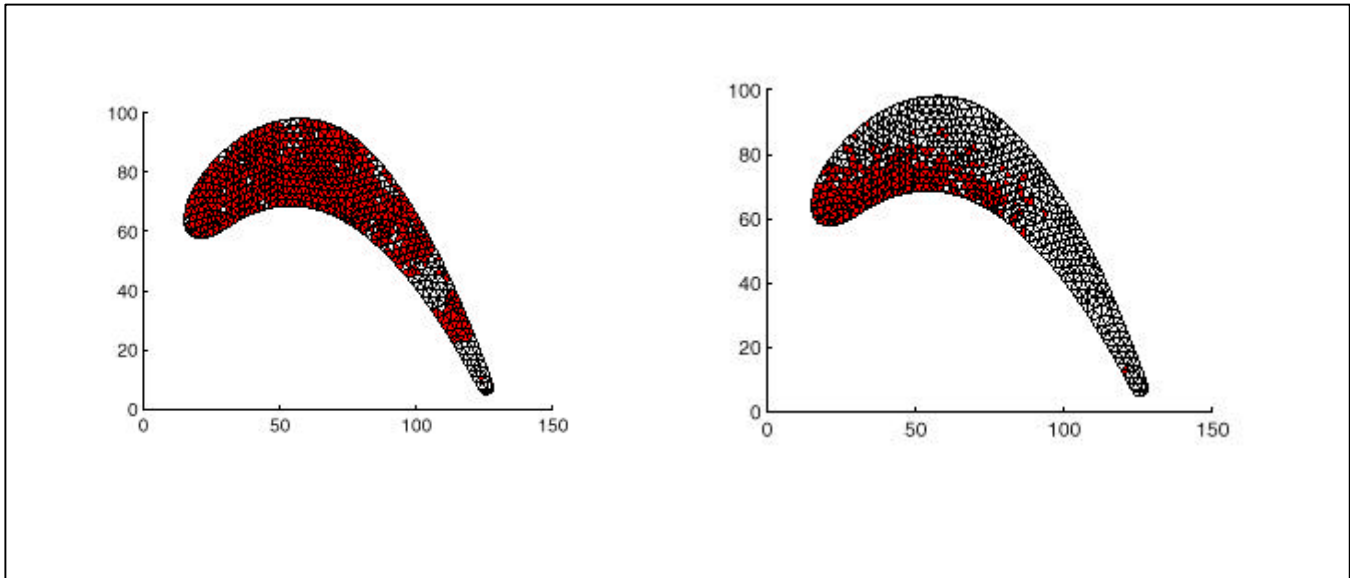


Project Title: TWO OBJECTIVES OPTIMIZATION OF A TURBINE BLADE



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Project status: Completed
Project Duration: Oct 1998 – Mar 1999
Project Partners: LAIP, Optomec, ETH Zurich
Funding: Optomec, Sandia, LAIP

Project Abstract:

Recent developments in the Rapid Prototyping technology establish it as a new manufacturing technique, enabling localized material addition to build a part. Thus, heterogeneous structures, consisting of more than one material can be produced. Since traditional topology and structural optimization methods are developed for homogeneous structures, there is a need for optimization tools for multi-material structures. The aim of this work is to develop an optimization tool to find the best material distribution in a multi-material structure due to given objectives and constraints. The tool is based on genetic algorithms (GA). In order to analyze structures numerically, the modeling of materials is investigated. Since GA's in general are computational intense, significant effort is directed towards making the algorithms fast.

A topology optimization for a cantilever beam was performed first, setting one material as void. The objective was to minimize the compliance subject to a given weight. A connectivity analysis eliminated isolated elements in the design space. This application provided good results for a model with 800 elements. The second application optimizes the distribution of Silicon Nitride and Titanium in a turbine blade. The objectives are to distribute materials according to their possible service temperatures and to minimize thermal stresses. By varying the importance of the two objectives, various material configurations are obtained.

The figures show two configurations with varying weights applied to the objectives of the turbine blade with Silicon Nitride displayed in red, and titanium in white.