

## An Attempt to Optimize an Integrated Impingement Cooling Structure Using Genetic Algorithm

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### 1. Introduction

The aim of the present paper is to show the development of an optimization tool based on *GA*. The authors believe that this study is one of the first attempts to use *GA* for the optimization of internal cooling system for turbine nozzles.

### 2. Problem Description

The numerical model that represents the target cooling system to be optimized is shown in Figure 1. The cooling system consists of arrays of impingement holes, discharging holes and pins. The numerical model is determined by taking advantage of the symmetric configuration of the system.

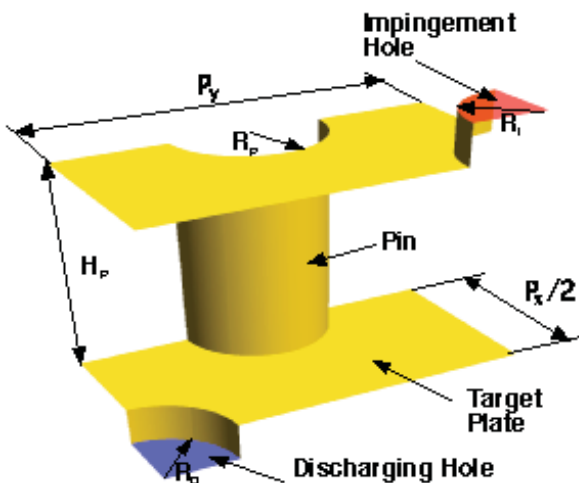


Figure 1 Cooling system to be optimized by GA

### 3. Optimization by GA

The use of *GA* for multi-parameter optimization has become a popular technique in many engineering fields, such as aerodynamic design of blade profiles or wings and, more recently, gas turbine related applications. The reason for adopting such technique is found by the fact that it is robust, simple to implement and innovative. The simplicity in translating the *GA* method into a computational code is also one of its great advantages. A *GA* code consists of basic mathematical

operations which can be parallelized in a very straightforward manner.

Selection of the objective is a very important point in the optimization. This study employs the ratio of area-averaged heat transfer coefficient to the pressure loss as the objective function.

### 4. Optimization and Its Results

A FORTRAN code is developed by the authors in order to automate the computational grid generation. For every chromosome, the code reads the decoded real values for the design parameters, generates a multi-block grid system and exports it to the *CFX-4.4* solver through an *ASCII* file.

The grid system is highly optimized in order to reduce the number of nodes. Several coarse grids were run and results were compared to finer grid ones and experiments. After a reasonable agreement was found the final configuration is defined. The number of grid points is kept constant (59,520) so that the *CPU* time for one run would be approximately one hour.

Figure 2 shows the optimum configuration of the cooling system and the heat transfer coefficient distribution, in comparison with the datum.

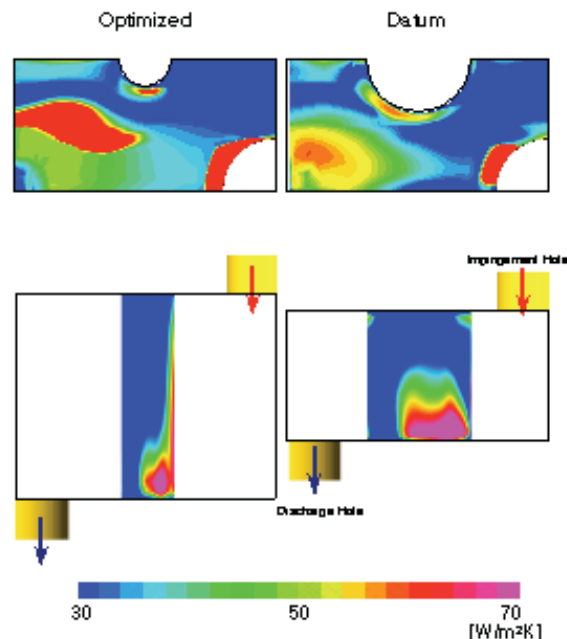


Figure 2 Optimized configuration of the cooling system, compared to the datum.

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