**8th. World Congress on Computational Mechanics (WCCM8)**
**5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)**
**June 30 –July 5, 2008**
**Venice, Italy**

# SOLUTION WITH A DOMAIN-DECOMPOSITION SOLVER OF A MULTI-ALTERATED STRUCTURES MODELED IN THE ARLEQUIN FRAMEWORK

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**Key Words :** *multi-alteration, multi-patch, multimodel, Arlequin framework, substructuring, parallel computing, FETI method.*

## ABSTRACT

The design of mechanical structures such as the multiperforated turbine blade (see figure 1) submitted to thermomechanical loads is rather complex. For the latter and from a numerical point of view, the main difficulty relies on the discrepancy between involved scales.

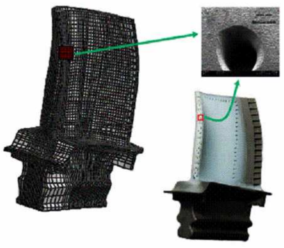

**Figure 1.** a multiperforate turbine blade

Many approaches were developed to tackle this complexity such as micro-macro approaches, mono-model local-global and enrichement methods. In this work, we suggest to use the multi-model Arlequin framework [1] and particularly its mixed version that has been analyzed theoretically [2] and assessed practically (e.g. [3,4]) as a tool able to introduce with an enhanced flexibilty merely any kind of alteration in a given sound model. This is basically achieved by superposing and gluing a local patch containing the alteration to the global sound model, while partitioning the energies in the superposition zone and stressing the appropriate model. Till now, many implementations of the Arlequin method have been designed for sequential codes. To optimize the Arlequin methodology performances as a computational tool of multi-altered structures, an efficient iterative solver adapted to the solution of the linear mixed Arlequin problems by parallel machines is developed in this work. This solver is obtained by an adaptation of the FETI method [5]. To show the effectiveness of our methodology,

a patch containing an heterogeneity (inclusion) is super-imposed to an homogeneous and isotropic linear elastic solid having a cube shape (see figure 2-(a)). The cube is clamped on one of its faces and submitted to a non axial density of loads on the opposite face. The deformed Arlequin model is represented in figure 2-(b). The solution is obtained by using a FETI-like solver and the improvement of the performance of this solver by using a mecanical consistent preconditioner is shown in figure 3-(a,b) (for differents thiknesses of gluing zone) .

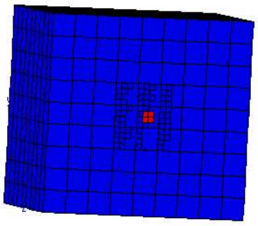

**Figure 2-(a).** Cube and heterogeneous patch meshes

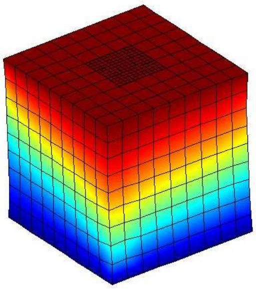

**Figure 2-(b).** Displacement solution

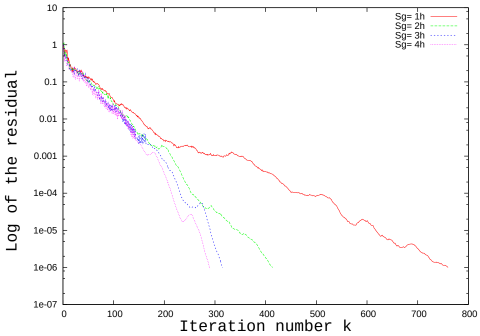

**Figure 3-(a)** Convergence without preconditioner

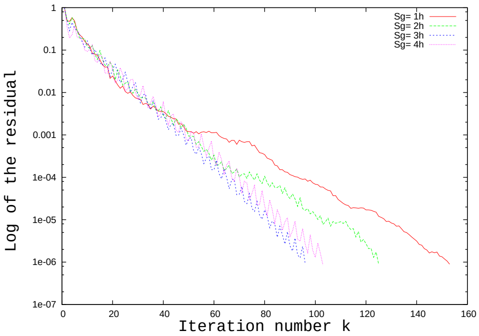

**Figure 3-(b)** Convergence with preconditioner

The Arlequin framework can be used in a straightforward manner to super-impose several patches. However, the FETI-like solver has to be adapted to take into account rigid body movements of the "floating" patches. Numerical results will be shown during the congress.

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