11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

REAL TIME SOLUTION OF PARAMETRIZED THERMAL PROBLEMS

Sergio Zlotnik[1], **Pedro Díez**[1] **and Antonio Huerta**[1]
[1] Laboratori de Càlcul Numèric (LaCàN), E.T.S. Ingenieros de Caminos, Universitat
Politècnica de Catalunya, Jordi Girona 1, E-08034 Barcelona, Spain.
{sergio.zlotnik, pedro.diez, antonio.huerta}@upc.edu

Key words: *Reduce Basis, Proper Generalized Decomposition, Geophysics, Parametrized Problems*

A usual inverse problem in geology and geophysics is the recovery of a field based on some indirect or poorly known data. A common example is the need to estimate a temperature field in a cross section where the bottom boundary conditions are unknown, the thermal diffusivities of the involved materials are poorly known and even the exact location of the contacts between bodies are subject to uncertainties. A procedure able to deliver a solution in real time (fractions of seconds) provides the possibility of testing different scenarios and it easies an optimization problem.

In this work we provide a real time solution of a parametrized thermal problem via the Proper Generalized decomposition method. The parameters involve material properties, boundary conditions and also the spacial geometry of the different bodies. The geometry of the model is controlled by some parameters; for example, figure 1 shows the possible geometries generated by the size of an inclusion and its rotation.

An application example, where 13 parameters of three different kinds are present is shown in figure 2. It is based in a seismic line from the Central European Basin in North-West Germany where multiphase salt tectonics is present. The geometry parameters were chosen to investigate how some features poorly resolved on the seismic line could affect the thermal state of the section.

REFERENCES

[1] M. Moht, P.A. Kukla, J.L. Urai and G Bresser. Multiphase salt tectonic evolution in NW Germany: seismic interpretation and retro-deformation. *International Journal of Earth Sciences*, Vol. **94**, 917–940, 2005.

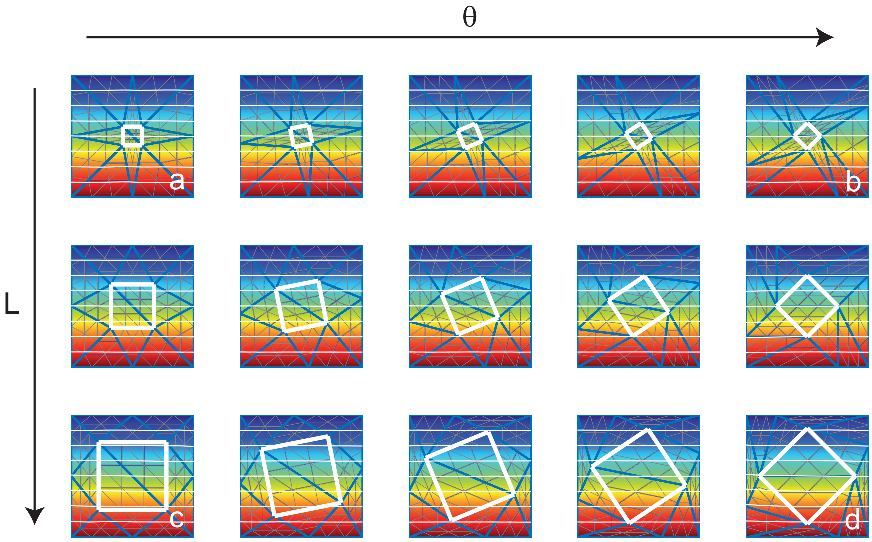

Figure 1: Solution and meshes for different values of the geometry parameters. Colours represent the pgd solution for the case where $k_1 = k_2$. In this case, a linear solution is expected. The example shows the correct solution for any value of the geometrical parameters. Thin white lines are the contour lines of the temperature, gray lines are the finite element mesh, blue lines the geometry mesh, and thick white lines indicate the internal boundary between Ω_1 and Ω_2.

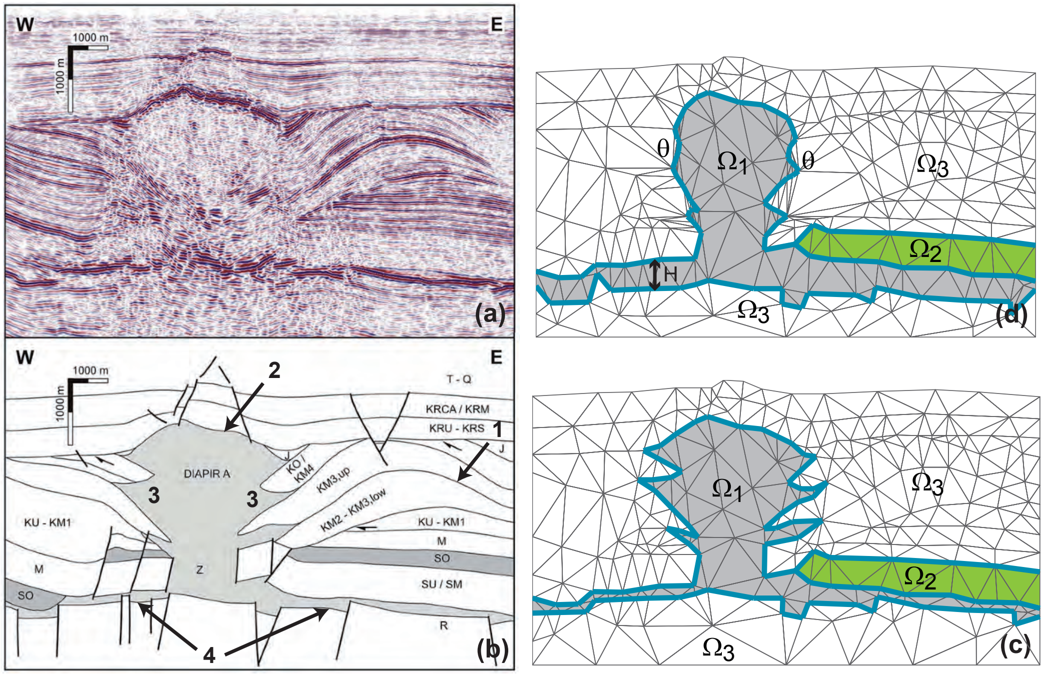

Figure 2: Panels a and b from [1]. Depth migrated seismic section and geological interpretation. Added labels 1 and 2 show two contacts perfectly resolved in the seismic line. Label 3, indicate the poor resolution in the laterals of the Diapir A. Label 4, show the poorly resolved thickness of the gray (Salt) layer at the base of the section. Panel c show the geometry mesh and the simplified structure used in the numerical example consisting of three bodies. Panel d show the geometry variations produce by parameters H and θ.