6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 15 June 2018, Glasgow, UK

PROPER GENERALIZED DECOMPOSITION (PGD) FOR THE FATIGUE NUMERICAL SIMULATION OF POLYCRYSTALLINE AGGREGATES

Camille Robert*[,1], Franck Morel[1], Amine Ammar[1] and Mohamed Aziz Nasri[2]

[1] LAMPA, Arts et Métiers ParisTech, 2 bd du Ronceray 49000 Angers France
[2] LEM3 UMR CNRS 7239, Arts et Métiers ParisTech, Ile de Saulcy 57078 Metz France
*corresponding author: camille.robert@ensam.eu

Key words: *PGD, FEM, polycrystalline aggregats, crystal plasticity, cubic elasticity*

The macroscopic behaviour of polycrystalline materials is largely influenced by the shape, the arrangement and the orientation of crystallites. Different methods have thus been developed to determine the effective mechanical behaviour of such materials as a function of their microstructural features. This work focuses on polycrystalline metallic materials with an FCC crystal arrangement. A PGD model reduction framework is used within the finite element method.

The first part of this work is the modelling of the aggregate with a cubic elastic behaviour. Elastic constants are chosen as parameters for the PGD in order to determine the mesoscopic (grain average) and macroscopic responses as functions of the crystal anisotropy. These results are then analysed considering high cycle fatigue criteria.

The second aspect is the modelling of the non linearity of the material by using crystal plasticity. In this case, the PGD is used in terms of position/time. The finite element method is written in order to have only one mode for the stiffness matrix. This stiffness constant allows low RAM consumption and high CPU time reduction since only one factorisation of the stiffness matrix is needed during all the computation. Different monotonic loading cases are presented and the macroscopic response is analysed on a precision level versus the incremental method as well as in terms of CPU time.

REFERENCES

[1] Robert, C. and Mareau, C. *A comparison between different numerical methods for the modeling of polycrystalline materials with an elasticviscoplastic behavior* (2015) Computational Materials Science, Volume 103, Pages 134-144,

[2] Ammar, A., Chinesta, F., Cueto, E. and Doblar, M. *Proper generalized decomposition of time-multiscale models* (2012) Int. J. Numer. Meth. Engng, 90: 569-596.