# On the FE·Meshless computational homogenization for the analysis of two-dimensional heterogeneous periodic materials

**G. Giambanco[1], E. La Malfa Ribolla[1], A. Spada[1]**

[1] Department of Civil, Environmental, Aerospace, Materials Engineering
University of Palermo - viale delle Scienze Ed. 8, 90128 Palermo, Italy -
giuseppe.giambanco@unipa.it - emma.lamalfaribolla@unipa.it -
antonino.spada@unipa.it

Over the last few years, substantial progresses have been made in the two-scales computational homogenization. This method is essentially based on the assessment of the macroscopic constitutive behavior of heterogeneous materials through the boundary value problem (BVP) of a statistically representative volume element, named as unit cell (UC). In this framework, the first-order method has now matured to a standard tool and several extensions have been addressed in the literature [1, 2].
In the present study, a first-order homogenization scheme based on a discontinuous-continuous approach is presented. At the mesoscopic level the formation and propagation of fracture is modeled employing a UC consisting of an elastic unit surrounded by elasto-plastic zero-thickness interfaces, characterized by a discontinuous displacement field. At the macroscopic level, instead, the model maintains the continuity of the displacement field. The inelastic effects are enclosed in a smeared way, introducing a strain localization band established on the basis of a spectral analysis of the UC acoustic tensor. Another key-point is the numerical solution of the UC BVP, which is obtained by means of a more cost-effectiveness mesh-free model. Both linear and periodic boundary conditions have been applied to the UC.

## References

[1] V. Kouznetsova, M.G. Geers, W.M. Brekelmans, Multi-scale constitutive modelling of heterogeneous materials with a gradient-enhanced computational homogenization scheme, Int. J. Numer. Meth. Eng. 54 (8) (2002) 1235-1260.

[2] T.J. Massart, R.H.J. Peerlings, M.G.D. Geers, An enhanced multi-scale approach for masonry wall computations with localization of damage, Int. J. Numer. Meth. Eng. 69 (5) (2007) 1022–1059.