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EXTENDING THE MULTISCALE ARLEQUIN FRAMEWORK TO COUPLING OF MODELS IN DYNAMIC REGIME

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Due to cyclic loadings or to shocks, damage evolution, namely evolution of micro-defects, in a given structure, can transform into macro-defects or cracks which could propagate either gradually or in a brittle way. In the latter scenario, dynamic phenomena occur. They generally cannot be ignored. Indeed, the brutal increase of cracks releases sudden energies that generate high frequency waves, propagating from the crack front to the whole structure. We call here this region a critical zone. The modeling of these phenomena requires very fine physical insights that could require local representation of the material behaviour at very fine scales. Since the numerical modeling of the hole structure at these fine scales is out of reach and since, in many practical situations, only low frequency waves are needed far from the crack front, the most appropriate way to model reasonably the whole structure consists on using multiscale approaches to couple fine models, used in the critical zone, to coarse models in the remainder of the structure. However, it is quite well-known that this coupling generates pathological phenomena, like high frequency waves trapping in the critical zone, inducing a pollution of the solution of the problem in this zone. This pollution has to be solved appropriately and the issue is how to do it?

The Arlequin framework [1, 2] has been proved to be a flexible engineering tool to couple very different models and scales (e.g. [3]). Overall, this framework was mainly experienced in static or quasi-static regimes, for linear and non linear behaviors, but also for the tracking of the evolution of damage and crack fronts [4]. Nevertheless, it has also been used in dynamic regime in [5], where different Finite Difference Schemes and different weightings of the superposed models were adopted in the coupling zone to damp the reflected waves. In [6], where it was labelled the “BD Method”, the Arlequin framework was applied for the first time (to the author’s knowledge) to couple molecular dynamics and continuum models, with a strong version coupling. It has also been used more recently in [7], while using the weak-coupling of the Arlequin method; the reflecting waves being damped in [7] by a *PML*-like tool.

In our communication, we will present an enhanced dynamic Arlequin formulation to address the issue of high frequency wave’s reflection by macroscopic boundaries of the coupling volume zones. Our development will be based on previous works by the second author of this contribution.

The numerical solution algorithm will be detailed during the conference. Furthermore, the global approach will be applied to simulate bidimensional crack’s propagation.

Numerical results will be given to enlighten the global methodology.

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