Accounting for micro-inertial effects in full-field polycrystal plasticity simulations under dynamic conditions

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We will present an extension of the Fast Fourier Transform (FFT)-based technique, to consider micro-inertial effects in polycrystalline materials with evolving porosity under dynamic loading conditions. The FFT-based model was originally conceived [1-2] as an efficient method to compute the micromechanical fields of heterogeneous materials directly from voxelized microstructural images, by solving−using the Green's function method−the partial differential equation of stress equilibrium that governs the micromechanical response of heterogeneous materials under quasi-static deformation. We have extended this spectral formulation to dynamic problems, solving the partial differential equation of motion, to consider micro-inertial effects due to material acceleration, particularly in the vicinities of voids growing in dynamically deformed polycrystalline materials. We will compare results of the proposed extension with homogenization-based solutions [3] and conduct parametric studies to isolate and quantify the effect of micro-inertia for different microstructures.

References

1- H. Moulinec and P. Suquet. Comput. Methods in Appl. Mech. Eng. 157, 69 (1998).
2- R.A. Lebensohn, Acta Mater. 49, 2723 (2001).
3- A. Molinari, S. Mercier. J. Mech. Phys. Solids 49, 1497 (2001).