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FFT-BASED METHODS FOR MICROSCALE PLASTICITY

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ABSTRACT

Since their development in the 90's by Moulinec & Suquet [1], FFT-based solvers have become increasingly popular, and are nowadays a well-established numerical method for micromechanical simulations of heterogeneous materials. FFT-based methods are well adapted to investigate the mechanical response of complex microstructures with non-linear constitutive behavior, e.g. described by crystal plasticity models in the case of polycrystalline materials, as they allow a naturally meshless and parallel implementation offering a near-linear scaling due to the FFT algorithm efficiency. Recent developments have contributed to broaden their scope to a large variety of constitutive models, such as field dislocation mechanics or gradient plasticity, providing a versatile framework to investigate microscale plasticity phenomena.

The aim of this session is twofold: discuss theoretical and numerical advances in this field, as well as present applications of FFT-based methods providing new insights on microscale plasticity. Specific topics of interest for this session include:

- The method itself, including theoretical background, algorithm, Green's operators, high performance computing implementations.
- Extensions of the method to various plasticity models for composites and/or polycrystals, ranging from classical to non-local plasticity to dislocation mechanics theories.
- Application of the method to investigate plasticity of crystalline materials at the microstructure scale, including different deformation regimes (glide, climb, diffusion, localization, damage, etc.) as a function of temperature and applied stress.
- Coupling FFT-based solvers with in-situ microstructure characterization and micromechanical experiments

REFERENCES

Moulinec, H., & Suquet, P. (1998). *A numerical method for computing the overall response of nonlinear composites with complex microstructure*. Computer methods in applied mechanics and engineering, 157(1-2), 69-94.