FFTMAD (Fast Fourier Transform based homogenization code, MADrid)

Software description

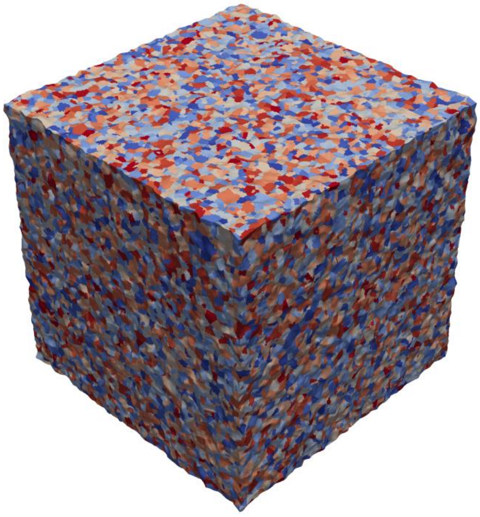
FFTMAD is a software tool for **computational homogenizatio**n based on the **Fast Fourier Transform**. The software aims to obtain the response of any heterogeneous material, as composites, polycrystals or celular materials, by simulating the behavior of a Representative Volume Element of the microstructure. The code is remarkable **more efficient** in CPU time and memory allocation than Finite Element homogenization.

FFTMAD includes **preprocessing** tools for microstructure generation of composites and polycrystals. Any **constitutive equation** can be used for the behavior of the materials by either a material-subroutine Abaqus-UMAT or a pre-programmed model as elasticity, hyperelasticity, elasto-plasticity and crystal plasticity. FFTMAD **solver** is parallelized in *GPUs* or *threads* and includes different schemes for linear and non-linear problems. **Postprocessing** is done using python tools and *Paraview*.

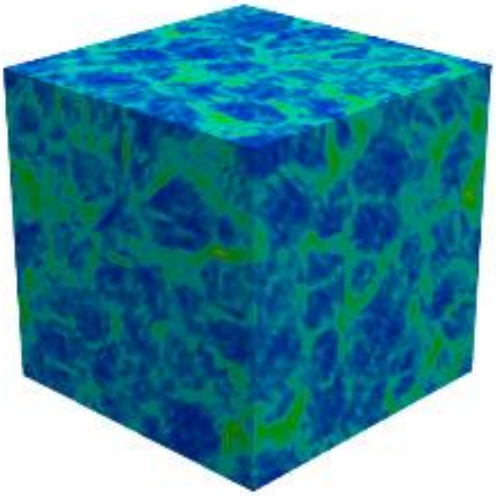
FFTMAD is programmed as **a Python project** including *NumPy, SciPy, PyEVTK, PyFFTW*, and *PyCuda* libraries as well as home made subroutines in Fortran. A simulation in FFTMAD is performed by simple scripts defining the RVE, materials, load histories and postprocessing options.

FFTMAD capabilities

Polycrystalline homogenization

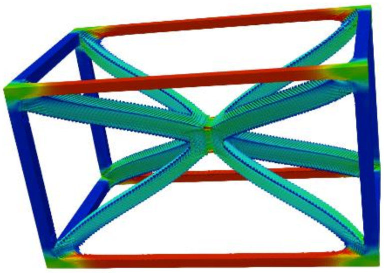


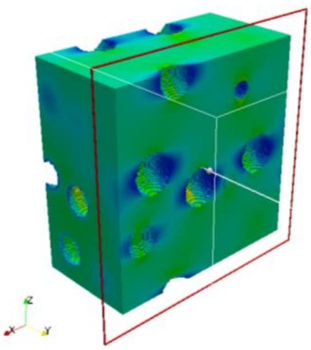
120K grains with a discretization of 256^3: deformed shape after 1% strain



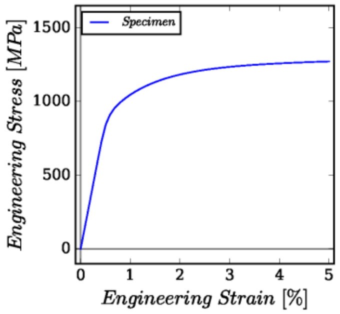
Dislocation density localized at grain boundaries

Composites & Metamaterials homogenization

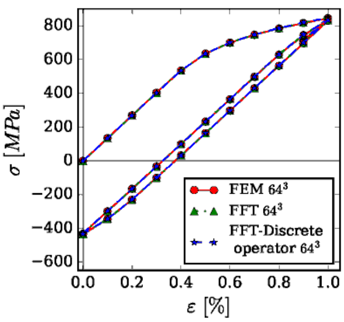




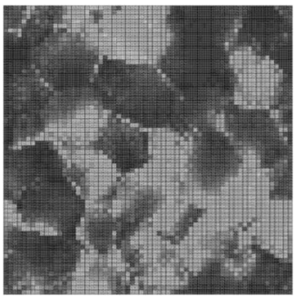
Full sample virtual tests



Fatigue response of metals

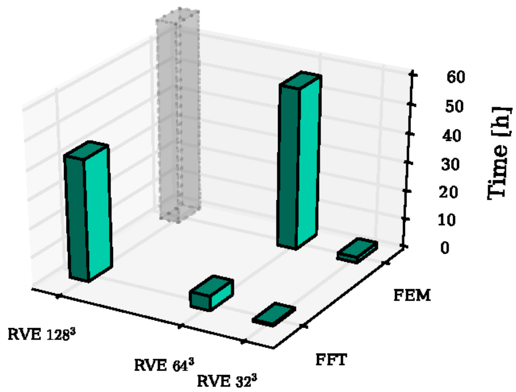


Fatigue stress-strain loops



Damage localization

Time comparative respect to Finite Elements



Supplementary data

Transfer Opportunity: Software license

Reference: S. Lucarini and J. Segurado., "*On the accuracy of spectral solvers for micromechanics based fatigue modeling*", Computational Mechanics, 2018.

Contact

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