Farooq, Harris; **Ryckelynck, David**; **Forest, Samuel**; **Cailletaud, Georges**; **Marano, Aldo**
A pruning algorithm preserving modeling capabilities for polycrystalline data. (English)
Zbl 1479.74118
Comput. Mech. 68, No. 6, 1407-1419 (2021).

Summary: We are exploring the idea of data pruning via hyperreduction modeling. The main novelty of this paper is a lossy data compression/decompression approach for ploycrystalline data, which is based on a hyperreduction scheme that preserves data driven modeling capabilities after compression. We assume to know a mechanical model whose equations are satisfied by the data. It is shown that the proposed reconstruction of the data performs an oblique projection of selected original data. This is achieved by the solution of reduced mechanical equations. High resolution crystal plasticity finite element simulations demand computational and storage resources that are unusual, especially in cases where hundreds of grains are interacting under cyclic loading. The development of image-based modeling via computed tomography highlights the problem of long-term storage of simulation data by using data pruning. The present paper focuses on modeling cyclic strain-ratcheting as an example of numerical modeling that the proposed algorithm preserves. The size of the remaining sampled data can be user-defined, depending on the needs concerning storage space. The relevance of the pruned data is tested afterwards for statistics on the predicted strain, as if full finite element data were available. The proposed method is compared to the Gappy POD method, when no additional modeling step is expected after data pruning.

MSC:

74S05 Finite element methods applied to problems in solid mechanics
74E15 Crystalline structure
74C20 Large-strain, rate-dependent theories of plasticity

Keywords:

model order hyperreduction; crystal plasticity; ratcheting; data compression; finite element method; material database

Software:

MUMPS; SciPy; Voro++; Python; Z-set

Full Text: DOI

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