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INFLUENCE OF THE LOADING PATH ON THE MECHANICAL BEHAVIOR OF METALLIC MATERIALS

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Abstract

Commercial finite element software packages are widely used for the numerical simulation of sheet metal forming processes. However, most of existing software packages present some limitations. In particular, they are essentially based on phenomenological constitutive models and, accordingly, they do not precisely account for physical mechanisms of plasticity that take place at finer scales, or the associated microstructure evolution. In this context, we propose to couple the Abaqus finite element code (see [1, 2, 3, 4]) and the LAM3 code with micromechanical simulation techniques based on crystal plasticity and a self-consistent scale-transition scheme ([5, 6, 7]), as schematized in figure 1.

This coupling strategy will be applied to the simulation of rolling processes in order to assess the influence of the loading path on the evolution of the mechanical

properties of the material. By following some appropriately selected strain paths (see Figure 2) along the rolling process, one can predict the texture evolution of

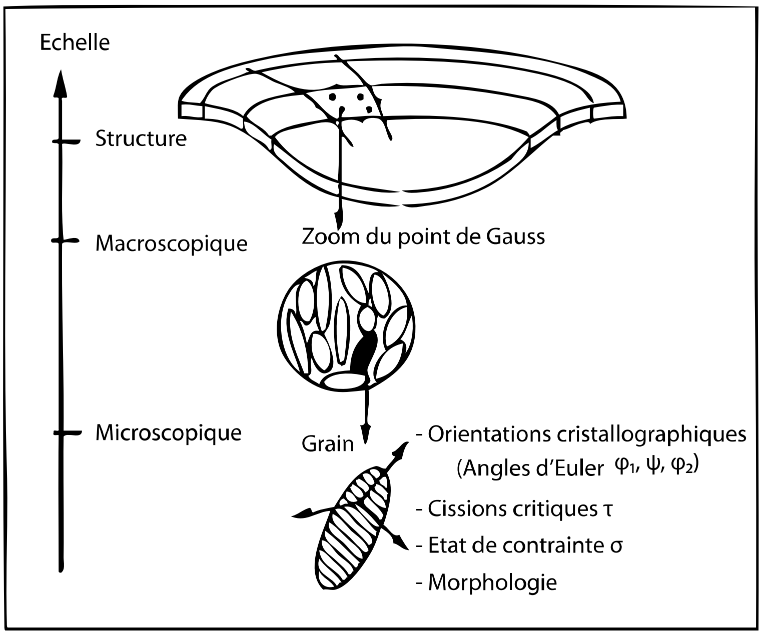

Figure 1: Schematic diagram of direct coupling strategy applied to the polycrystalline plasticity model by Scacciatella [8].

the material as well as other parameters related to its microstructure. Our numerical results are compared with experimental data in the case of ferritic steels elaborated by the steel maker ArcelorMittal.

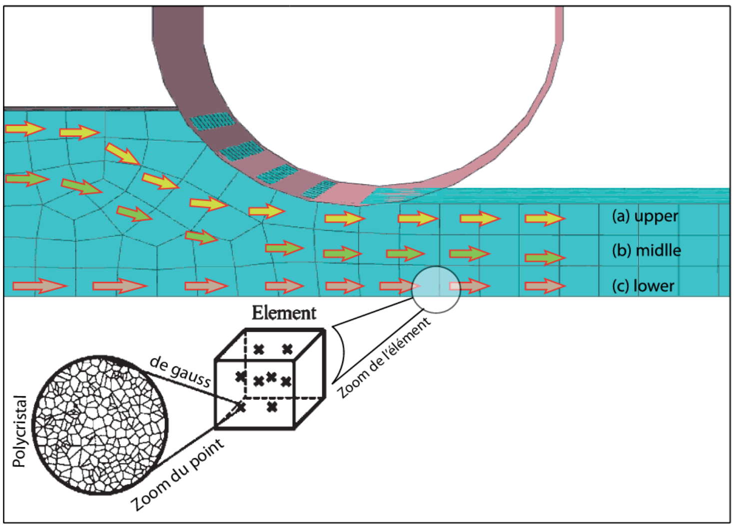

Figure 2: Schematic of the rolling simulation following the (a) upper, (b) middle, and (c) lower deformation path during the rolling process.

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