Micromachining simulation using a crystal plasticity model: ALE and CEL approaches

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Abstract. Nowadays, micro-machining is an expanding field because it is often used in the manufacture of electronic components and miniaturized medical systems. Unlike conventional machining, micro-machining is very sensitive to the microstructure of the material because the size of the tool is comparable to that of the grains. Moreover, at this scale, it is difficult to capture the physical fields involved in the process experimentally. Thus, numerical simulation is a helpful way to understand micro-machining. In recent years, some numerical simulations of the literature on the modeling of micromachining include a model of crystal plasticity to reproduce the behavior of the machined material. These models use a lagrangian formulation and a damage model necessary to create a chip. Recently, a comparative study of the literature has shown that ALE and CEL approaches are interesting to simulate the machining with a continuous chip without including a damage model. Nevertheless, these approaches have never been combined with a model of crystalline plasticity. In this work, the ALE and CEL approaches have been compared to simulate micromachining. Both approaches already proposed in ABAQUS/EXPLICIT software are combined with a model of crystalline plasticity which has been implemented in a VUMAT subroutine. The study reveals the advantages and drawbacks of these methods in micro-machining simulations.