Tetrahedral mesh updating for subsurface modeling: finite surface insertion

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Résumé

Generating a valid high-quality mesh representing geological interfaces is a difficult task due to the complexity of the geometrical configurations encountered in geosciences. Furthermore, uncertainties regarding the locations or even the existence of geological discontinuities call for mesh updating techniques, operating on a local scale, in a fast and robust manner. To address these challenges, we introduce a novel mesh-update method that enables the insertion of finite surfaces such as faults in existing multi-material tetrahedral meshes. In this approach, the surface to be inserted is defined as the intersection of the zero level sets of two distinct level set functions: one that defines an extension of the surface across the domain into a closed surface, while the second extends its boundary. The level set functions can be obtained via interpolation, subject to a smoothness criterion or by using the fast marching algorithm. Once computed, we use an implicit surface insertion strategy that relies on the open-source MMG remeshing library.

Mots-Clés: Local mesh updating, Fault insertion, Implicit surface modeling, Smooth interpolation, Open surface representation

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