Advantages and Constraints of Unstructured Gridding

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Abstract

This study demonstrates the benefits of applying unstructured gridding to generate a robust 3D structural framework. The technique was implemented in a gas bearing reservoir with erosional truncations and faulting. It uses arbitrary polyhedral cells aligned along structural or stratigraphic discontinuities. The resulting unstructured grid was compared to a conventional structured grid built using a traditional corner point method with the same input data. Reservoir properties were then populated in both unstructured and structured grids by means of stochastic simulation algorithms. The geological formation is moderately faulted with non-deposition areas in several zones, which give significant thickness variations. The input data included surfaces, fault interpretations, well tops, and petrophysical well logs. We built a detailed reservoir model using fault sticks for the fault planes and surfaces and well tops for the reservoir zonation. We then implemented a volume-based modeling approach to generate the unstructured grid, which was later converted to a depositional grid. To preserve the reservoir structural features, we constructed the grid based on the stratigraphy of the accommodation space. A stratigraphic layering method was used to model conformable and pinched-out features. Geological features were more pronounced with stratigraphic layering, as this approach combines the proportional layering with parallel to top or base method. The results of the study concluded that the unstructured grid retained the original shape of faults without introducing zigzag geometry, and had improved cell geometry compared with the classic pillar grid. In addition, the time required for 3D grid construction was reduced as there was no need for extensive fault modeling and pillar gridding. The geostatistical simulation algorithms were better constrained with the unstructured grid due to better preservation of non-deposition zones. We must caution that the computational time to execute unstructured gridding gets significantly longer compared to the pillar gridding as the geological model cell number increases. In addition, geological complexities in non-deposition areas may lead to uncertain results, as observed by the mismatches between the input data and the unstructured grid. Nevertheless, as unstructured gridding continues to improve, it will be the recommended technique of choice for constructing enhanced 3D structural models.