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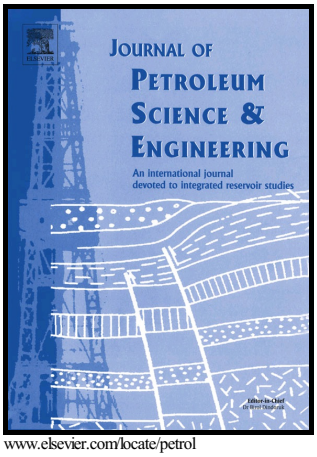

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Fast Marching Method Assisted Sector Modeling: Application to Simulation of Giant Reservoir Models

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Abstract

Primary geological model of reservoirs provided by geo-modeler usually contains complex structures and millions of grid cells. Despite the recent advances in computational resources, these highly detailed models are not suitable for flow simulation purposes due to enormous simulation costs. Upscaling is necessary to reduce the number of grid blocks in geological model while preserving the static and the dynamic properties of the fine grid model. Upscaling is dependent on the flow process and it is often difficult to ensure that all the fine scale details are preserved in the upscaling process. This adds to another level of uncertainty in dynamic performance. Since so much effort has been put in constructing the detailed geological model, it is often desirable that the simulation be carried out in the fine scale model.

This work proposes a new strategy regarding the simulation of fine grid models using a single well modeling concept. The proposed method is currently suited for primary depletion process. The approach is relatively straight forward. We first identify the drainage Volume associated with each well using Fast Marching method. Fast Marching Method is extremely fast and can determine the drainage volume in large geological model within minutes. We then assume that the drainage volume does not change significantly over the life of the well. We then model each well separately as an independent well within a drainage volume and predict the performance of the well. Because the simulation model size is significantly reduced, the well performance can be predicted very quickly and is amenable to parallel simulations. By adding individual well performances, we can then combine performance to predict the field performance. This method is also suitable for history matching since by observing the drainage volumes of individual wells, we can reasonably determine if the model is suitable for history matching before the history matching process starts.

We have tested the methodology for both the synthetic and the field cases and we have observed that the method works well while significantly reducing the computational costs.

Keywords: Single Well Modeling, Drainage Area, Fast Marching Method, Streamline Simulation,