Reservoir Continuity Assessment with Mass Moments of Inertia: Application to SAGD Performance Prediction

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Abstract

The size and continuity of non-net reservoir intervals is of great practical importance in petroleum engineering. Well placement and prediction of fluid flow responses are affected. The thickness of non-net intervals provides some indication of lateral extent and connectivity; however, there is significant uncertainty in the size of these intervals. There is a need for a geologically-sound and repeatable approach to quantify the relationship between the length and thickness of non-net reservoir intervals.

This paper develops one such approach based on a novel idea of incorporating mass moments of inertia in calculating the size of non-net intervals. The idea is as follows. The irregularly shaped non-net intervals are replaced by a non-net ellipsoid that has equivalent moment of inertia tensor. Then, calculation of the thickness and length of given non-net interval is done indirectly but in straightforward manner: the thickness of a non-net interval is calculated as a vertical radius of the ellipsoid and the length of the non-net interval is calculated as the average of the two ellipsoid radii in the horizontal plane.

The proposed methodology is illustrated with several examples. All examples are based on Sequential Indicator Simulation (SIS) of binary codes, that is, net (0) and shale (1), with different proportions of net/non-net facies and different indicator variogram models of non-net.

Results are visually compared and summarized as probability curves for length as a function of thickness. These curves can be used to predict the length or give a probability interval for the length of non-net intervals for a given observed thickness, see illustration below. This information is important for the performance assessment of SAGD.