**Numerical Simulation of Multiphase Flow in Multiscale Heterogeneous Reservoirs Using Multimesh Computing Methodology**

S. Atan, E. Ozkan, and H. Kazemi.

**Abstract:** Despite the improvements in recovery from complex reservoirs, on the average, two-thirds of the original oil in place will be left behind. To improve the recovery further, successful reservoir monitoring and accurate modeling of fluid movement are essential. Reservoir monitoring requires building reservoir models that integrate various scales of data; typically geostatistical, seismic, saturation, and pressure/rate measurements. The common simulation approach is to treat all physical processes governing the fluid motion on the same spatial and temporal scale. This requires rescaling of the data to a convenient scale for simulation purposes. However, the upscaled properties, whether it is based on geostatistics or dynamic measurements from flow test, in general, do not provide satisfactory answers for simulation of complex, heterogeneous reservoirs. To accurately account for heterogeneity, multimillion grid simulators may be required, but this brings us to the question of practicality and may not be the correct recourse to deal with data-scale problems. An alternative is to develop reservoir models that use the natural scales of convective flow and pressure diffusion in an integrated computational scheme, known as multimesh computing methodology. In multimesh computation, the first step is to solve the pressure equation on the coarse grid, which is composed of several fine-grid cells per coarse grid cell. The second step is to compute the flow velocities at the boundaries of the coarse grid cells based on the pressure solution and interpolated onto the fine grid cells. Finally, the phase saturation is computed for each fine grid. In general, we solve the convective component flow problem on a fine-grid scale, as small as what geocellular models are. Consequently, we can obtain very accurate tracking of fluid movement in the reservoir reflecting the heterogeneity of the reservoir accurately.