RECENT ADVANCES ON THE SIMULATION AND INVERSION OF RESISTIVITY LOGGING MEASUREMENTS FOR ENHANCED RESERVOIR CHARACTERIZATION

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Abstract. A number of 3D simulators of borehole resistivity measurements have been developed during the last two decades for oil-industry applications. These simulators have been successfully used to study and quantify different physical effects occurring in 3D geometries. Despite such recent advances, there are still many 3D effects for which reliable simulations are not available. Furthermore, in most of the existing results only partial validations have been reported, typically obtained by comparing solutions of simplified model problems against the corresponding solutions calculated with a lower dimensional (2D or 1D) numerical method. The lack of 3D simulation results (as opposed to 2D results) is due to major difficulties encountered when solving geometrically challenging problems. Namely, for mesh-based methods (Finite Elements, Finite Differences, Boundary Elements, etc.), the size of the system of linear equations becomes excessively large to be solved in real (logging) time.

In this presentation, we first explain the main mathematical and computational difficulties associated to the simulation of resistivity logging measurements. Then, we analyze the main features that a numerical method should possess in order to overcome the above challenges. Third, we present several methods that exhibit such properties, including an *hp*-Fourier Finite Element simulation method [1, 2].

In the second part of the presentation, we focus on the rapid inversion of resistivity measurements using model reduction techniques. We show how a proper measurement acquisition system together with a pre-computed database enable an accurate real-time inversion of resistivity measurements by using simple model reduction algoritmhs.

For details and the most updated progress on this research, visit:
http://sites.google.com/site/numemagroup.

Keywords: computational electromagnetics, oil applications, model reduction

References

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