**SEMINARIO**

**Mecánica Matemática y Problemas Inversos**

**TITULO**

# Simulation and inversion of resistivity and sonic logging measurements for the characterization of the Earth's Subsurface.

**EXPOSITOR**

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**ABSTRACT:**

A number of $3D$ simulators of borehole logging 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 ($2Dor1D$) 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 and sonic 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 logging measurements using model reduction techniques. We employ a reduced model based on a one-dimensional transversely isotropic (TI) planarly layered media to show how to efficiently invert logging-while-drillng (LWD) resistivity measurements in real time.

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