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Physics-based Residual Kriging for oil production rates prediction

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Oil production rates forecasting is crucial for reservoir management and wells drilling planning. We here present a novel approach named Physics-based Residual Kriging, which is here applied to forecast production rates, modelled as functional data, of wells operating in a mature conventional reservoir along a given drilling schedule. The presented methodology has a wide applicability and it incorporates a physical model - expressed by a partial differential equation - into a Universal Kriging framework through a geostatistical analysis of the model residuals. The approach is formulated to deal with sequential problems, where samples of functional data are iteratively observed along a set of time intervals, as is the case with subsequent wells drilling. These dynamics are accounted for through an incremental modeling of the residuals from the predictive models used to correct the predictions along the time intervals. We apply the method in two different case studies. The first considers a single-phase reservoir driven by fluid injection, while the second analyzes a single-phase reservoir driven by rock compaction.

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