# Handling Uncertainty in Numerical Models of Sedimentary Deposition: A Stochastic Approach


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**Abstract**

Forward stratigraphic models simulates the process of sedimentary deposition over geological time periods and helps geoscientists and engineers to understand the location of reservoir rocks and stratigraphic traps. The most popular and commonly used models are diffusion-based. A major draw-back with such models is that diffusion coefficients, that largely control the outcome of the simulations, are highly uncertain and difficult to derive., This clearly reduces their usefulness at describing the evolution of a basin. Diffusion coefficients represent conglomerations of physical processes in sedimentation and basin morphology that depend, for instance, on slope. By considering the diffusion coefficients as randomly distributed fields, the uncertainty in the morphology of a basin can be constrained.

We use a Polynomial Chaos Expansion (PCE) to approximate the model at each spatial and temporal point of interest. The Probabilistic Collocation Method (PCM) is used to calculate the coefficients of the PCE, based on a few, specifically chosen, calculations of the underlying model of sedimentation. In contrast to the Monte Carlo approach, which may require hundreds or thousands of runs of the simulator, the PCM requires only a dozen or so, depending on the number of inputs and the desired accuracy.

Furthermore, the PCM is not tied to a particular implementation of a sedimentation model, as it treats the model as a blackbox, and can be placed upon any depositional simulator. This method allows for the quantification of the stochastic moments of the height and the fractional distribution of the materials. By understanding the spatial distribution of the uncertainty in basin evolution, these depositional models can begin to have real meaning in industrial applications. Our approach is not dependent on depositional modelling, but can be applied to any process-oriented geological simulation.