History Matching
Using Hybrid Parameterisation and Optimisation Methods

ABSTRACT
Reservoir models are commonly used in the oil and gas industry to predict the reservoir behaviour and forecasted production. Conditioning reservoir models to dynamic production data is known as history matching, which is usually carried out to enhance the predicted reservoir performance. Uncertainty quantification is also an important aspect, and encompasses identifying multiple history matched models, constrained to a geological concept. History matching and uncertainty quantification can be accomplished by identifying and utilising efficient and speedy optimisation techniques. The assisted history matching process usually includes two processes; the first is parameterisation which consists of reducing the number of matching parameters, in order to avoid adjusting too many parameters with respect to the amount of production data available. Any over-parameterisation would lead to an ill posed formulation of the inverse problem. The second process involves optimisation which aims to reduce a misfit or objective function and the success of this stage is greatly dependent on the previous one.

The technique of choosing the matching parameters, reducing the search space, by defining correlations between reservoir parameters has a direct impact on the efficiency of history matching optimization. By proposing and analysing various parameterisation methods, combined, and tested with diverse optimisation algorithms lead us to suggest hybrid approaches addressing the two processes of assisted history matching in an iterative approach. Four different parametrisation methods that are derived from the prior information were tested utilising five well known and frequently used history matching optimisation algorithms, these included: Evolution Algorithm (EA), Bayesian Optimisation Algorithm (BOA), Particle Swarm Optimisation (PSO) and Differential Evolution (DE). The testing and sensitivities are carried out in an iterative manner; the results are then screened and evaluated based on the lowest global and partial misfit per well, final geological properties and forecast match and uncertainty.

In this presentation, we demonstrate that hybrid iterative approaches that combine parameterisation and optimisation should be considered to achieve a more effective history match. The hybrid methods offer a novel technique that incorporates effective parameterisation which defines an optimal parameter search space, and at the same time does not compromise the effectiveness of the misfit minimisation. We present a comprehensive study using a synthetic case.

Bio: Part-time PhD student currently working for SDX Energy in London. Completed my MSc in Petroleum Engineering form Imperial College London in 2005. Over 17 years’ experience in the oil and gas industry, working for international service and oil companies, which included Schlumberger, Total, ENI and Eon E&P.