Title: Bayesian Optimal Design for iterative refocussing

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History matching is a global search approach that attempts to find input parameter values to achieve a consistency between real-world observations and computer model outputs. History matching is most effective when it is performed in waves, i.e. refocussing steps. At each wave a new ensemble is obtained within the current Not Ruled Out Yet space (NROY), the emulator is updated and the procedure of cutting down the input space is performed again.

Generating design for each wave is a challenging problem due to unusual shapes of NROY space. A number of approaches (Williamson and Vernon, 2013; Gong et al., 2016, Andrianakis et al., 2017) are focused on obtaining space-filling design over the NROY space. In this talk we present a new decision-theoretic method for a design problem for iterative refocussing. We employ a Bayesian experimental design and specify a loss function that compares a volume of NROY space obtained with an updated emulator to the volume of `true' NROY space obtained using a `perfect' emulator. The derived expected loss function contains three independent and interpretable terms. In this talk we compare the effect of proposed Bayesian Optimal Design to space-filling design approaches on the iterative refocussing performed on simulation studies.

We recognise that adopted Bayesian experimental design involves an expensive optimization problem. Our proposed criterion also could be used to investigate and rank a range of candidate designs for iterative refocussing. In this talk we demonstrate the mathematical justification provided by our Bayesian Design Criterion for each design candidate.