Title:
"Control-Relevant Upscaling"

Authors:
Ali Vakili, Delft University of Technology (DUT),
Jan Dirk Jansen, DUT and Shell International Exploration and Production

Abstract:
In this work we argue that, from a system-theoretical point of view, there is only a limited degree of freedom in the input-output dynamics of a reservoir system. This means that, for a given configuration of wells in the reservoir, a large number of combinations of the state variables (pressure and saturation values in the grid blocks) are not actually controllable and observable, and accordingly, they are not affecting the input-output behaviour of the model. Therefore, we propose a “control-relevant-upscaling” (CRU) approach that determines equivalent parameters of a coarse-scale model based on the actual system’s input-output behaviour. The coarse-scale parameters are obtained as the solution of an optimization problem that minimizes the distance between the input-output behaviours of the fine- and the coarse-scale models. Moreover, we address the potential benefits of using proper orthogonal decomposition (POD) in combination with our CRU method to obtain a reduced-order CRU algorithm that accelerate the upscaling procedure.