Flow Measurement Uncertainty in Hydrocarbon Reservoir Management

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Introduction
Observed production data has an important role in reservoir management (Figure 1). However, observed data always has errors. These errors can affect production of oil and gas as a result of their impact on history matching and optimisation processes. In this work, effect of random and systematic flow measurement errors on history matching has been studied.

Methodology and Results
In this study, synthetic production flow rate data with different ranges of systematic and random errors (Figure 2) was used in history matching to modify an uncertain reservoir model. The outputs of the modified model were later compared to the data from a reference model to show the effect of the systematic and random flow measurement errors on the results of history matching (i.e. estimated porosity, permeability, oil and gas production). Figure 3 illustrates the results.

Conclusions
In this case study:
• the effect of random flow measurement errors on history matching was seen to be insignificant
• On the contrary, systematic errors had considerable effects on the results
• The results show the importance of regular calibration and maintenance schedules for old flow meters as they reduce systematic errors
• The study suggests that investment on regular calibration and maintenance of flow meters can potentially be a more effective and more economic alternative to installing new flowmeters for improving history matching results

References

Figure 1: Closed-Loop Reservoir Management or CLRM (Jansen et al., 2009)

Figure 2: (a) Different possible states of a data set in terms of its trueness and precision and (b) the values of errors in the 15 data sets in this research

Figure 3: Final errors of the history matching in estimating (a) oil production, (b) gas production, (c) porosity, and (d) permeability for all the employed data sets ("sys" and "rand" refer to systematic and random error, respectively).