Inversion, history matching, clustering and linear algebra

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The inversion of large-scale ill-posed problems introduces multiple challenges, including identifying appropriate noise model, prescription of a suitable prior information, incorporation of heterogeneous sources of data, and definition of an appropriate optimization scheme. In this study, the inherent uncertainty of the problem is mitigated by devising efficient and comprehensive approaches for prior sampling. In particular, geo-statisticians may often propose large sets of prior samples that regardless of their apparent geological distinction are almost entirely flow equivalent. As an antidote, a reduced space hierarchical clustering of flow relevant indicators is proposed for aggregation of these samples. The effectiveness of the method is demonstrated both with synthetic and field scale data. In addition, numerical linear algebra techniques that exploit the special structure of the underlying problems are elucidated.