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A bias correction method for improving regularized solution in linear inverse ill conditioned models

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Geodetic downward continuation and inverse problems are often ill conditioned, and regularization is used for deriving stable and better solutions. However, the regularized estimates of parameters and residuals are well known to be biased. Theoretically the biases of the estimated parameters and residuals can only be computed with the true values of parameters. Since we do not know the true values of parameters in practice, we attempt to improve the regularized estimates by using the regularized estimates themselves to replace the true parameters for estimating the biases and then removing the computed biases from the regularized estimates. Furthermore the biases are also removed from the residuals, and then the variance of unit weight of the observation noises is estimated with the bias-reduced residuals. We derive the analytical conditions for bias correction and show that the bias-corrected regularization performs better than the ordinary regularization in terms of mean squared errors. However, for estimating the variance of unit weight, the biases still need to be full removed from the residuals. We then present the numerical examples of gravity downward continuation to demonstrate the performance of our bias correction method for improving regularized solution. The results show that our bias correction method can successfully reduce the absolute biases of the regularized estimates, and improve the accuracies with more than 5 per cent. Moreover, by removing the biases from the residuals, the derived variance of unit weight is almost unbiased.

キーワード: Linear ill-conditioned model, Regularization solution, Bias correction, Gravity downward continuation, Variance of unit weight
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