SYSTEM ENGINEERING

一种新颖的鲁棒动态数据校正方法

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摘要　Outlier in one variable will smear the estimation of other measurements in data reconciliation (DR). In this article, a novel robust method is proposed for nonlinear dynamic data reconciliation, to reduce the influence of outliers on the result of DR. This method introduces a penalty function matrix in a conventional least-square objective function, to assign small weights for outliers and large weights for normal measurements. To avoid the loss of data information, element-wise Mahalanobis distance is proposed, as an improvement on vector-wise distance, to construct a penalty function matrix. The correlation of measurement error is also considered in this article. The method introduces the robust statistical theory into conventional least square estimator by constructing the penalty weight matrix and gets not only good robustness but also simple calculation. Simulation of a continuous stirred tank reactor, verifies the effectiveness of the proposed algorithm.

关键词　nonlinear dynamic data reconciliation　robust　M-estimator　outlier　optimization
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A novel robust nonlinear dynamic data reconciliation

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Abstract Outlier in one variable will smear the estimation of other measurements in data reconciliation (DR). In this article, a novel robust method is proposed for nonlinear dynamic data reconciliation, to reduce the influence of outliers on the result of DR. This method introduces a penalty function matrix in a conventional least-square objective function, to assign small weights for outliers and large weights for normal measurements. To avoid the loss of data information, element-wise Mahalanobis distance is proposed, as an improvement on vector-wise distance, to construct a penalty function matrix. The correlation of measurement error is also considered in this article. The method introduces the robust statistical theory into conventional least square estimator by constructing the penalty weight matrix and gets not only good robustness but also simple calculation. Simulation of a continuous stirred tank reactor, verifies the effectiveness of the proposed algorithm.

Key words　nonlinear dynamic data reconciliation; robust; M-estimator; outlier; optimization

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