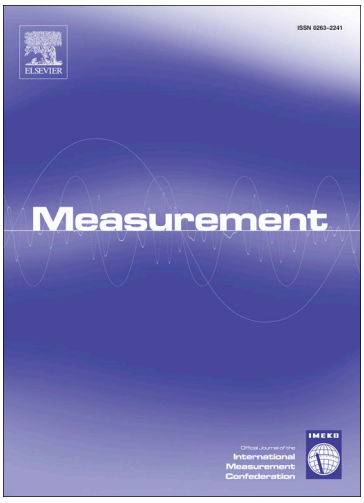

Support vector regression modeling of coal flotation based on variable importance measurements by mutual information method

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Support vector regression modeling of coal flotation based on variable importance measurements by mutual information method

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Abstract

Support vector regression (SVR) modeling was used to predict the coal flotation responses (recovery (*R**) and flotation rate constant (*k*)) as a function of measured particle properties and hydrodynamic flotation variables. Coal flotation is a complicated multifaceted separation process and many measurable and unmeasurable variables can be considered for its modeling. Therefore, feature selection can be used to save time and cost of measuring irrelevant parameters. Mutual information (MI) as a powerful variable selection tool was used through laboratory measured variables to assess interactions and choose the most effective ones for predictions of *R** and *k*. Feature selection by MI through variables indicated that the best arrangements for the *R** and *k* predictions are the sets of particle Reynolds number-energy dissipation and particle size-bubble Reynolds number, respectively. Correlation of determination (R^2) and difference between laboratory measured and SVR predicted values based on MI selected variables indicated that the SVR can model *R** and *k* quite accurately with R^2=0.93 and R^2=0.72, respectively. These results demonstrated that the MI-SVR combination can quite satisfactorily measure the importance of variables, increase interpretability, reduce the risk of overfitting, decrease complexity and generate predictive models for high dimension of variables based on selected features for complicated processing systems.

Keywords: Variable importance measurement; Flotation rate constant; Recovery; Mutual information; Support vector regression

1. Introduction

Processing of fine coal particles due to growth of demand for high quality products is being inevitable [1]. Froth flotation as a physicochemical separation technique is a well-established beneficiation method for treating such fine particles (typically below 500 μm) [2-7]. Although coal is naturally hydrophobic, heterogeneous properties (organic part: petrography and macerals and inorganic: minerals) make its processing quite complicated [8-9].Coal flotation is a complex