

Colloquium

The PSLQ algorithm for empirical data

主講人：馮勇 教授

中國科學院重慶綠色智能技術研究院

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摘要：

The celebrated integer relation finding algorithm PSLQ has been successfully used in many applications. However, the PSLQ was only analyzed theoretically for exact input. When the input data are irrational numbers, they must be approximate ones due to finite precision in computer. However, when the algorithm takes empirical data (inexact data with error bounded) instead of exact real numbers as its input, how do we theoretically ensure the output of the algorithm to be an exact integer relation? In this paper, we investigate the PSLQ algorithm for empirical data as its input. First, we give a termination condition for this case. Secondly we analyze a perturbation on the hyperplane matrix constructed from the input data and hence disclose a relationship between the accuracy of the input data and the output quality (an upper bound on the absolute value of the inner product of the exact data and the computed integer relation), which naturally leads to an error control strategy for PSLQ. Further, we analyze the computational complexity of the PSLQ algorithm for empirical data. Examples on transcendental numbers and algebraic numbers show the meaningfulness of our error control strategy.