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Obviating the Bin Width Effect of the $1/t$ Algorithm for Multidimensional Numerical Integration

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Abstract

In this work we improve the accuracy and the convergence of the $1/t$ algorithm [1] for multidimensional numerical integration. The $1/t$ algorithm has been proposed as an improved version of the Wang-Landau algorithm [2] which belongs to the class of Monte Carlo methods. After the lower bound y_{min} and the upper bound y_{max} of the integral are determined by a domain sampling run [3], the integral can then be approximated by

$$I = \int_a^b y(x)dx \simeq \sum_{y_{min}}^{y_{max}} g(y).y, \tag{1}$$

where $g(y) \equiv \{x|x \in [a,b], y \leq y(x) \leq y + dy\}$ and dy is the bin width of y. The distribution $g(y)$ can be obtained from the $1/t$ algorithm. However, the errors of estimated integrals saturate because of the bin width effect. To obviate this effect, we introduce a new approximation method based on the simple sampling Monte Carlo method by using the average of y values in the subinterval $[y, y + dy]$, which varies as the number of Monte carlo trials changes, instead of the fixed value of y.

The non-convergence of the $1/t$ algorithm [4, 5] and the convergence of the new method are proved by theoretical analysis. A potential of the method is illustrated by the evaluation of one-, two- and multi- dimensional integrals up to six dimensions. The dynamic behavior of accuracy shows that the numerical estimates from our method converge to their exact values without either error saturation or the bin with effect in contrast with the conventional $1/t$ algorithm.

Key words: Monte Carlo method, Numerical integration, the $1/t$ algorithm, Bin width effect

References

[1] R. E. Belardinelli, S. Manzi, and V. D. Pereyra (2008), *Phys. Rev. E.* **78**, 067701.

[2] Y. W. Li, Wüst, D. P. Landau, and H. Q. Lin (2007), *Comput. Phys. Commum.* **177**, 524.

[3] A. Tröster and C. Dellago (2005), *Phys. Rev. E.* **71**, 066705.

[4] C. Zhou and J. Su (2008), *Phys. Rev. E.* **78**, 046705.

[5] Y. Komura and Y. Okabe (2012), *Phys. Rev. E.* **85**, 010102 (R).