Linear Order Matrix Inversion Method with Help from Quantum Searching Algorithm

Atsushi Miyauchi

Research Organization for Information Science and Technology (RIST)
2-2-54 Nakameguro, Meguro-ku, Tokyo 153-0061, Japan
miyauchi@tokyo.rist.or.jp

Here we propose matrix inversion method utilizing quantum searching algorithm. In this method, huge Hilbert space as a whole spanned by myriad of eigen states is searched and evaluated efficiently by sequential reduction in dimension one by one. This technique, we call it *dimensional reduction*, enables us to obtain exponential speed-up over naive implementation and keeps sufficiently high probability of success. Required computation time linearly depends on problem size, and achieves the order of cubic acceleration over classical algorithms. These results might open a possibility of quantum computer in future industrial use. Actually, our proposal is nothing but a primary desktop calculation and we need further investigation. For example, to identify particular gate configuration, to estimate performance stringently through emulation of gate operation and to understand susceptibility to error caused by truncation and decoherence are left as future works.

References

[1] L. K. Grover, "Quantum mechanics helps in searching for a needle in a heystack", *Phys. Rev. Lett.*, **79**, pp. 325-328 (1997), Also LANL-archive quant-ph/9706033

[2] V. Vedral, A. Barenco and A. Ekert, "Quantum networks for elementary arithmetic operations", *Phys. Rev. A*, **54**, pp. 147-153, (1996), Also LANL-archive quant-ph/9511018

[3] C. H. Bennett, "Logical reversibility of computation", *IBM J. Res. Dev.*, **17**, pp. 525-532 (1973),

[4] M. Boyer, G. Brassard, P. Høyer and A. Tapp, "Tight bounds on quantum searching", *Fortsch. Phys.*, **46**, pp. 493-505 (1998), Also LANL-archive quant-ph/9605043

[5] W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, *Numerical Recipes in C: The Art of Scientific Computing*, Cambridge University Press (1993)