Day 3 (Poster D)

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Title:Finding high-order Hadamard matrices by using quantum computers

Abstract:
Finding a Hadamard matrix (H-matrix) among all possible binary matrices of corresponding order is a hard problem that can be solved by a quantum computer. Due to the limitation on the number of qubits and connections in current quantum processors，only low order H-matrix search of orders 2 and 4 were implementable by previous method. In this paper，we show that by adopting classical searching techniques of the H-matrices，we can formulate new quantum computing methods for finding higher order ones. Furthermore，one of the methods can be developed to find an arbitrarily high order H-matrix by balancing the classical and quantum resources，which is promising for finding unknown H-matrices of practical and scientific interests. We present some results of finding H-matrices of order up to more than one hundred and a prototypical experiment of the classical-quantum resource balancing method that yields a 92-order H-matrix previously found by JPL researchers in 1961 using a mainframe computer. Since the exactness of the solutions can be verified by orthogonality test performed in polynomial time; which is untypical for optimization of hard problems，the proposed method can potentially be used for demonstrating practical quantum supremacy in the near future.

This work was done in collaboration with Andriyan Bayu Suksmono (School of Elec. Eng and Informatics, ITB, Bandung) and Yuichiro Minato (Blueqat Inc., Tokyo, Japan).