ABSTRACT

The experimental implementation of quantum algorithms on a quantum computer requires the breakdown of unitary operators. Here we considered this as an opti- mization problem and used genetic algorithms. Genetic algorithms are stochastic search algorithms and a global optimization technique which mimics the behavior of biological evolution in nature. This optimization technique has been widely used for quantum computing applications. We apply this optimization techniques for an NMR quantum information processor and optimized the three-qubit unitary matrices. The algorithm for an NMR quantum information processor was modified and de- signed in such a way that the unitary matrices can be implemented using only hard pulses and delays. We mainly focused on three-qubit quantum gates such as Toffoli and Fredkin as they are universal for computation and has much application in various algorithms and protocols. The pulse sequence corresponding to the unitary matrices were time optimal and robust to cope up with the errors associated with the NMR quantum information processing. The optimized pulse sequence for the three-qubit unitary matrices was obtained with very high theoretical fidelity. We experimentally implemented these optimized quantum gates on a system of three coupled NMR qubits and computed the final fidelity.