Passive vs. active quantum steering

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The challenge of preparing a system in a designated state spans diverse facets of quantum mechanics. To complete this task of steering quantum states, one can employ quantum control through a sequence of generalized measurements which direct the system towards the target state. In an active version of this protocol, the obtained measurement readouts are used to adjust the protocol on-the-go, with a possibility for accelerated performance or fidelity increase. We have considered such active measurement-driven steering as applied to the challenging case of many-body quantum systems. The target states of highest interest would be those with multipartite entanglement. Such state preparation in a measurement-based protocol is limited by the natural constraints for system-detector couplings. We developed a framework for finding such physically feasible couplings, based on parent Hamiltonian construction. For helpful decision-making strategies, we offer Hilbert-space-orientation techniques, comparable to those used in navigation. The first one is to tie the active-decision protocol to the fastest accumulation of the cost function, such as the target state fidelity. We have shown the potential of 9.5-fold speedup, employing this approach for generating the ground state of the Affleck-Lieb-Kennedy-Tasaki spin chain. The second path-finding technique is to map out the available measurement actions onto a Quantum State Machine. A decision-making protocol can be based on such a representation, using semiclassical heuristics. This approach has advantages and limitations complementary to the cost function-based method. We give an example of a W-state preparation which is accelerated with this method by a factor of 12.5.