FRANCISCO DELGADO, Tecnologico de Monterrey

SU(2) decomposition for complex quantum information hamiltonians generating entanglement

In the gate array version of Quantum Computation, the use of convenient and appropriate gates is essential. But while involved gates adopt convenient forms for the computational algorithms, in the practice, their design depends on specific quantum systems and physical interactions involved. Quantum resources and gates design are restricted to properties and limitations imposed by the physical elements considered in the set up. In addition, predictable and controllable manipulation procedures should be addressed on them. On this scenario, two level quantum systems are the basic elements to connect the binary nature of classical computation with quantum computation. This work presents a general approach to set control procedures by decomposing the dynamics in $SU(2^{2d})$ for $2d$-partite two level spin systems including entangling operations into 2^{2d-1} $SU(2)$ subsystems for the generalized Hamiltonian:

$$\tilde{H} = \sum_{\{i_k\}} h_{\{i_k\}} \bigotimes_{k=1}^{n} \sigma_{i_k} = \sum_{\mathcal{I}=0}^{4^n-1} h_{\mathcal{I}_4^n} \bigotimes_{k=1}^{n} \sigma_{\mathcal{I}_{4,k}^n}$$

by expressing the dynamics on proper basis: the generalized Bell states. Thus, binary operations naturally arise there. Still, alternating the directions of local (or possibly non-local) interaction terms in the Hamiltonian, the procedure states a universal exchange semantics on that basis. Thus, the structure developed can be understood as the splitting of the $2d$ physical systems in 2^{2d-1} pairs of 2 level information channels.