CCSU

DEPARTMENT OF MATHEMATICAL SCIENCES

VIRTUAL COLLOQUIUM

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https://ccsu.webex.com/meet/gotchev

SCHMIDT REPRESENTATION OF 3-QUBIT STATES WITH REAL AMPLITUDES

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Abstract: The basic unit in quantum information is the qubit. The possible ways to control qubit states using basic quantum gates, even for a quantum computer with just 3 qubits still has some unsolved interesting questions.

The Schmidt representation for 2-qubit states tells us that for every 2-qubit state $[\varphi\rangle = u_{00}[00\rangle + u_{01}[01\rangle + u_{10}[10\rangle + u_{11}[11\rangle$, there exist two unitary 2 by 2 matrices U and V such that

$$U \otimes V[\varphi\rangle = \lambda_1[00\rangle + \lambda_2[11\rangle$$

where λ_1 and λ_2 are real numbers.

In this talk we will be dealing with 3-qubit states. Let us say that a 3-qubit state $u_{000}[000\rangle + u_{001}[001\rangle + u_{010}[010\rangle + u_{011}[011\rangle + u_{100}[100\rangle + u_{101}[101\rangle + u_{110}[110\rangle + u_{111}[111\rangle$ is real if all its amplitudes u_{ijk} are real numbers. We will prove that for every real 3-qubit state $[\varphi\rangle$ there exist three angles θ_1, θ_2 and θ_3 such that

$$U = R_y(\theta_1) \otimes R_y(\theta_2) \otimes R_y(\theta_3)[\varphi\rangle = \lambda_1[000\rangle + \lambda_2[011\rangle + \lambda_3[101\rangle + \lambda_4[110\rangle + \lambda_5[111\rangle.$$

Recall that $R_y(\theta) = \begin{pmatrix} \cos\theta/2 & -\sin\theta/2 \\ \sin\theta/2 & \cos\theta/2 \end{pmatrix}$.

We also proved that for 3-qubit states, the dimension of the *real entanglement space* is 4 and we find four linearly independent degree 4 polynomial invariants.

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