College of Arts and Sciences
Department of Mathematics
University of South Carolina

Math Colloquium

Recent Developments in Quantum Computing

Professor Robert Calderbank, Duke University
Department of Electrical & Computer Engineering

Friday
March 1st

4:30 PM
LeConte 412

Quantum error-correcting codes can be used to protect qubits involved in quantum computation. This requires that logical operators acting on protected qubits be translated to physical operators (circuits) acting on physical quantum states. I will describe a mathematical framework for synthesizing physical circuits that implements logical Clifford operators for stabilizer codes. Circuit synthesis is enabled by representing the desired physical Clifford operator as a partial $2m \times 2m$ binary symplectic matrix, where $N = 2m$. I will show that for an $[[m, m-k]]$ stabilizer code every logical Clifford operator has $2k(k+1)/2$ symplectic solutions, and I will describe how to obtain the desired physical circuits by decomposing each solution as a product of elementary symplectic matrices, each corresponding to an elementary circuit. Assembling all possible physical realizations enables optimization over the ensemble with respect to any suitable metric.

Explore https://github.com/nrenga/symplectic-arxiv18a for programs implementing these algorithms, including routines to solve for binary symplectic solutions of general linear systems and the overall circuit synthesis algorithm.

This is joint work with Swanand Kadhe, Narayanan Rengaswamy, and Henry Pfister.

UNIVERSITY OF SOUTH CAROLINA