CLAIMS

1. A method of determining a quantum operation control layout for a quantum computation on a quantum system, wherein the quantum computation is to be carried out on constituents of the quantum system arranged in accordance with a mesh, wherein vertices of the mesh represent possible sites for the constituents of the quantum system and each cell of the mesh indicates that quantum interactions between constituents of the quantum system arranged in that cell are possible during the quantum computation, the method comprising:

providing a data set including data representing hyperedges of a hypergraph;

determining a set of generalized cycles, the generalized cycles containing hyperedges of the hypergraph or containing hyperedges of an enlarged hypergraph, the enlarged hypergraph at least including the hyperedges of the hypergraph and an additional hyperedge, wherein a maximal length of generalized cycles of the set of generalized cycles is not greater than a maximal vertex number of the cells of the mesh;

determining a mesh mapping that maps data representing the hyperedges of the hypergraph or of the enlarged hypergraph to the vertices of the mesh, wherein each generalized cycle of a constraining subset of the set of generalized cycles consists of hyperedges mapped to a cell of the mesh; and

generating the quantum operation control layout, the quantum operation control layout including data indicating layout vertices of the mesh, wherein each layout vertex corresponds to a hyperedge mapped according to the mesh mapping, and including data indicating layout vertex sets, each layout vertex set consisting of layout vertices within a cell of the mesh that correspond to a generalized cycle of the constraining subset of generalized cycles.

2. The method of claim 1, wherein the mesh is two-dimensional.

3. The method of any of the preceding claims, wherein the lengths of the generalized cycles of the set of generalized cycles are in the range from three to the maximal vertex number of the cells of the mesh, or are equal to the maximal vertex number of the cells of the mesh.

4. The method of any of the preceding claims, wherein the number of nodes of the hypergraph is N, the number of hyperedges of the hypergraph is K, and the cardinality of the constraining subset is at least K-N.

5. The method of any of the preceding claims, wherein the number of nodes of the hypergraph is N, the number of hyperedges of the hypergraph is K, and wherein K is smaller than $N(N-1)/2$.

6. The method of any of the preceding claims, wherein the hyperedges of the hypergraph are associated with weights, and the quantum operation control layout includes data associating the layout vertices with the weights of the hyperedges of the hypergraph or of the enlarged hypergraph that are mapped to the layout vertices by the mesh mapping, wherein additional hyperedges of the enlarged hypergraph not contained in the hypergraph are assigned a weight of zero.

7. The method of any of the preceding claims, wherein the quantum operation control layout is a transparent quantum operation control layout which includes at least one of: data representing the mesh mapping and data representing the generalized cycles of the constraining subset of generalized cycles.

8. The method of any of the preceding claims, wherein the union of generalized cycles of the constraining subset of generalized cycles contains all hyperedges of the hypergraph or of the enlarged hypergraph and/or wherein the generalized cycles of the constraining subset of generalized cycles connect all hyperedges of the hypergraph or of the enlarged hypergraph.

9. The method of any of the preceding claims, wherein the cardinality of at least one hyperedge of the hypergraph is odd and/or wherein the cardinality of at least one hyperedge of the hypergraph is at least three.

10. The method of any of the preceding claims, wherein the constraining subset includes at least one of: a regular generalized cycle and an irregular generalized cycle.

11. The method of any of the preceding claims, wherein the mesh mapping is constructed by mapping the hyperedges of a first generalized cycle of the set of generalized cycles on vertices of a cell of the mesh, mapping the hyperedges of a second generalized cycle of the set of generalized cycles on the vertices of a neighboring cell of the mesh, wherein the first generalized cycle and the second generalized cycle have at least one hyperedge in common and the at least one hyperedge is mapped on a corresponding at least one vertex of the mesh, and repeating this process of mapping hyperedges of generalized cycles of the set of generalized cycles until the mapped generalized cycles form the constraining subset.

12. The method of any of the preceding claims, comprising at least one of:

(a) providing mesh data that represents the mesh or includes at least one information element about the mesh, and deriving the mesh from the mesh data, where default values are used where information about the mesh is lacking; and

(b) providing information about the type of the quantum computation to be performed, wherein generating the quantum operation control layout includes adapting the format and/or content of the quantum operation control layout in dependence of the information about the type of the quantum computation to be performed.

13. A quantum operation control layout for controlling a quantum computation on a quantum system, wherein the quantum computation is to be carried out on constituents of the quantum system arranged in accordance with a mesh, wherein vertices of the mesh represent possible sites for the constituents of the quantum system and each cell of the mesh indicates that quantum interactions between constituents of the quantum system arranged in that cell are possible during the quantum computation, the quantum operation control layout comprising:

data indicating layout vertices of the mesh, and

data indicating layout vertex sets, wherein each layout vertex set consists of layout vertices within a cell of the mesh.

14. The quantum operation control layout according to claim 13, wherein at least one of the following applies:

the quantum operation control layout comprises data representing weights associated with the layout vertices;

the layout vertices correspond to hyperedges of a hypergraph or of an enlarged hypergraph mapped to the layout vertices according to a mesh mapping, wherein layout vertices of each layout vertex set correspond to hyperedges forming a generalized cycle of the hypergraph or of the enlarged hypergraph; and

the weights associated with the layout vertices correspond to weights of the hyperedges of the hypergraph or of the enlarged hypergraph mapped to the layout vertices by the mesh mapping.

15. A method of performing a quantum computation on a quantum system, wherein the quantum computation is carried out on constituents of the quantum system, the method comprising:

providing a quantum operation control layout according to any of claims 13-14;

providing the constituents of the quantum system in a spatial arrangement such that there is a constituent for every layout vertex of the mesh and, for each layout vertex set, quantum interactions are possible between constituents corresponding to layout vertices of that layout vertex set;

for each layout vertex associated with a non-zero weight, applying a local field to the constituent corresponding to that layout vertex;

for each layout vertex set, performing quantum interactions between constituents corresponding to the layout vertices of that layout vertex set; and

measuring some or all of the constituents of the quantum system.