3-dimensional routing in VLSI design on a cube

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Two Special cases of the 3-dimensional routing have been studied: if either all the terminals are on a single face (SALRP - Single Active Layer Routing Problem) [1] or they are on two opposite faces of a cube (3DCRP - 3-dimensional Channel Routing Problem) [2].

Special situations cause difficulties if the terminals are on two adjacent faces of the cube. We present a polynomial algorithm for this problem.

Routing in the design of VLSI (Very Large Scale Integrated) circuits is an important area of modern applied mathematics, in particular combinatorial optimization.

In the detailed routing phase we have to connect the nodes (terminals) of electrical instruments with wires. These terminals are grouped into some given subsets (nets). Wires belonging to different nets may never get closer to each other than a specific distance. Hence cubic grids are often applied in this design. If the grid had only one layer then most problems would be unsolvable. Hence we use more layers parallel to the circuit board. Wires can switch from one layer to another in any gridpoint with the wires.

In a graph theoretical view detailed routing problem is searching for vertex-disjoint Steiner-trees (trees with given sets containing specific terminals) on a 3-dimensional cubic grid.

Our main result is in the 3-dimensional Γ Routing Problem ($3D\Gamma RP$). In general this problem is also unsolvable. But if we try to solve it on a cube the problem becomes solvable. A polynomial algorithm will be given to solve the problem on a small area. Minimizing is clearly very important in electronics.

References

[1] A. Recski, D. Szeszlér, 3-dimensional single active layer routing, Discrete Comput. Geom., LNCS 2098 (2001), 318–329.

[2] A. Reiss, D. Szeszlér, 3-dimensional channel routing, Proc. 4th Japan.-Hungar. Symp. on Discrete Math. and Its Appl. (2005), 409–415.