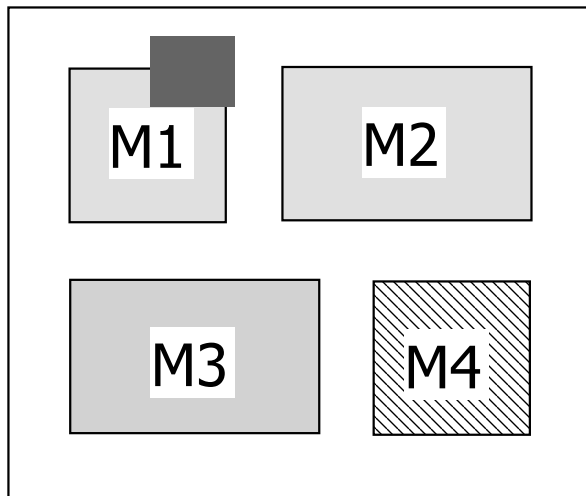# A New Global Routing Algorithm for Custom IC Design

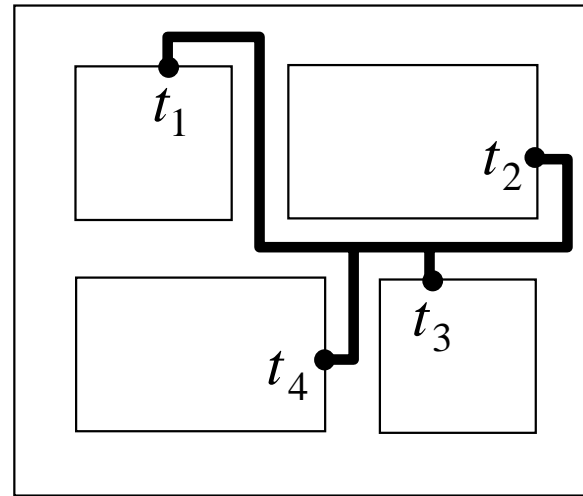**Somchai Prasitjutrakul**

Presentation Outline

- Global routing problem

- Routing graphs

- Shortest path problem

  - Dijkstra's algorithm

  - A*-search algorithm

- Multiterminal signal nets

  - Net length estimation

- Speed-up techniques

- Experimental results

- Summary

Global Routing Problem
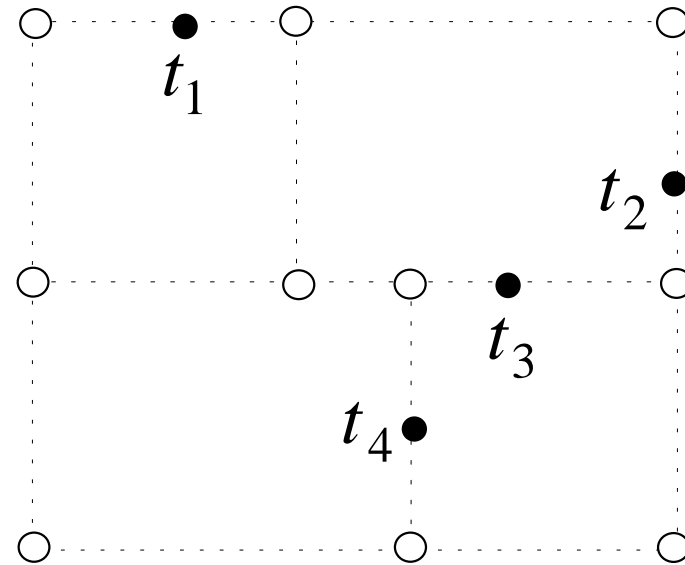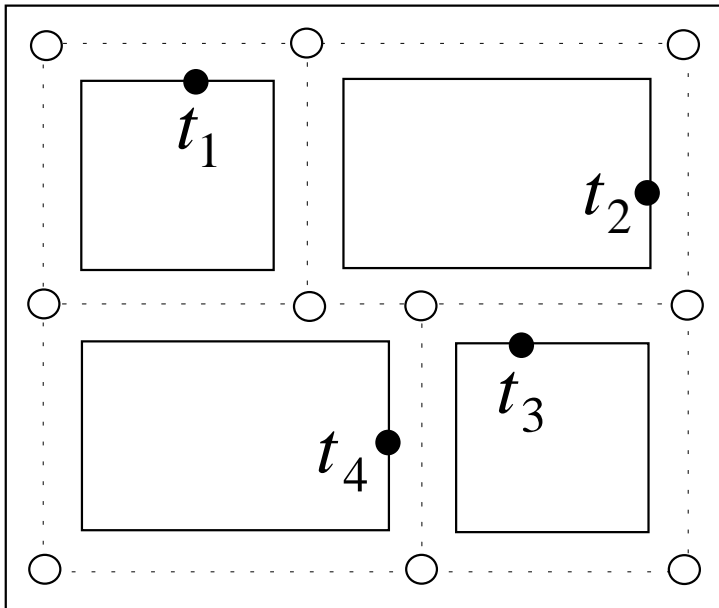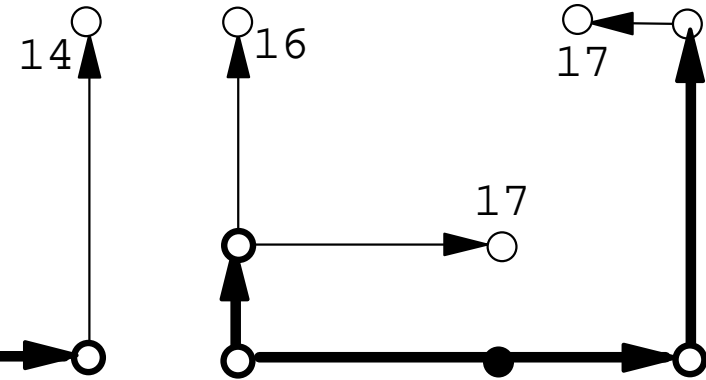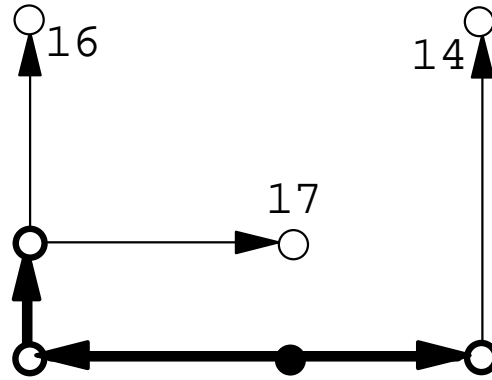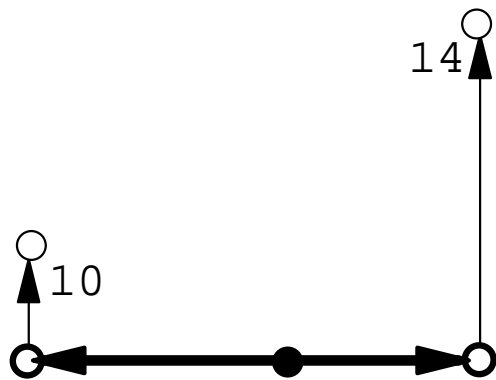

chip floorplan /
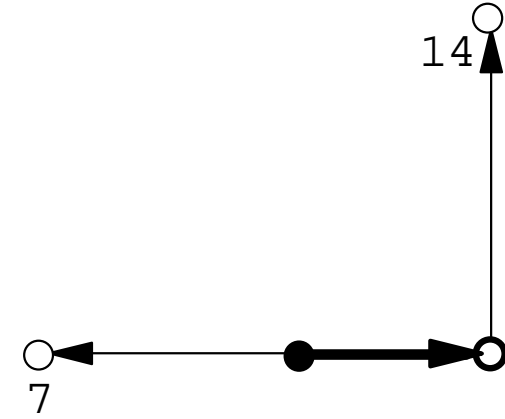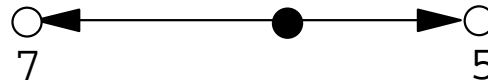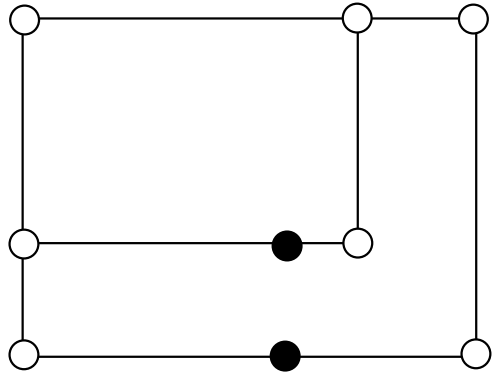module placement

Global routing

Routing constraint :
    signal routes can only pass through
    channels. (channel - space between
    modules)

Routing Graphs

The Dijkstra's Algorithm
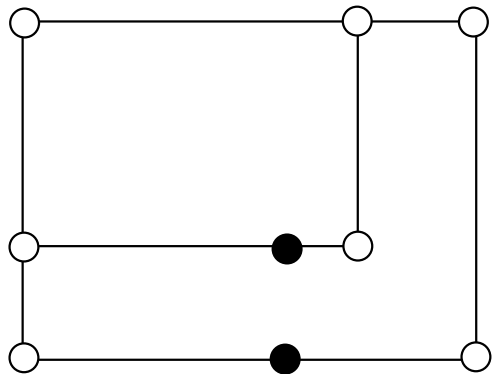
The Dijkstra's Algorithm

The A*-Search Algorithm

7+10   5+8   7+10

14+11

10+7   14+11   17+0   14+11   17+0   14+11
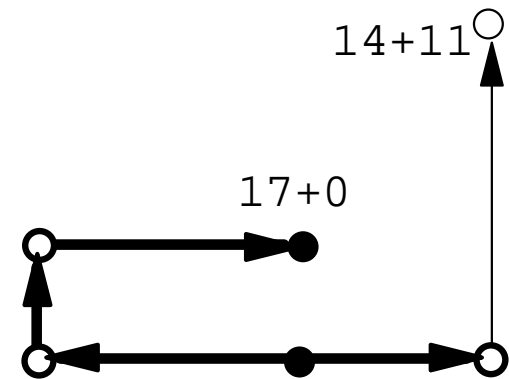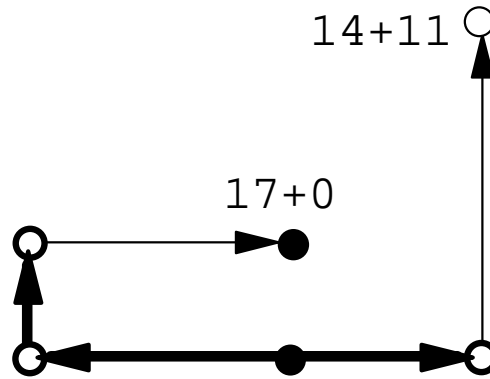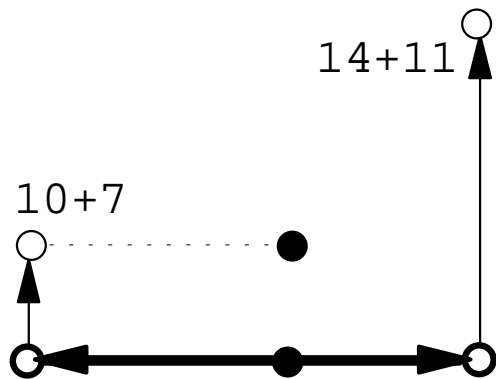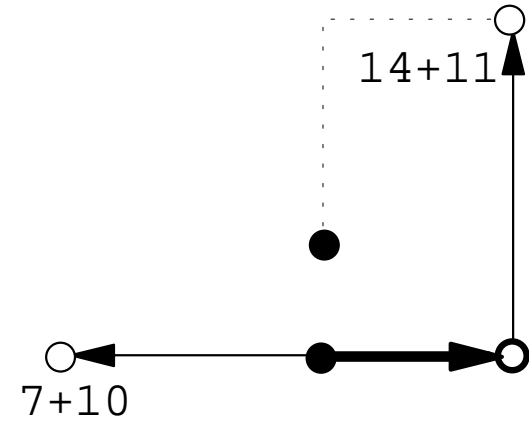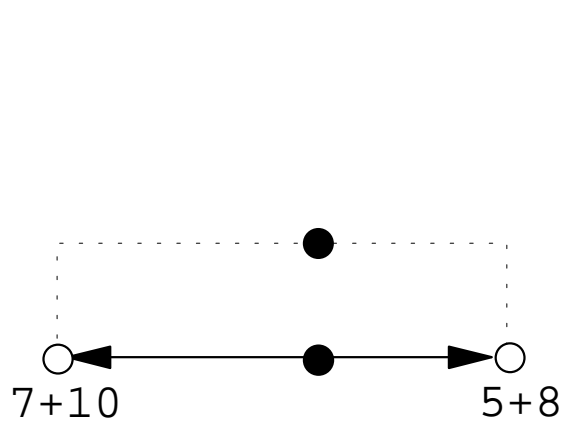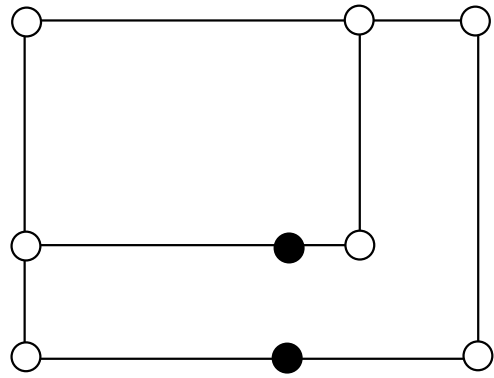
Multi-terminal Nets

The Lee's Algorithm
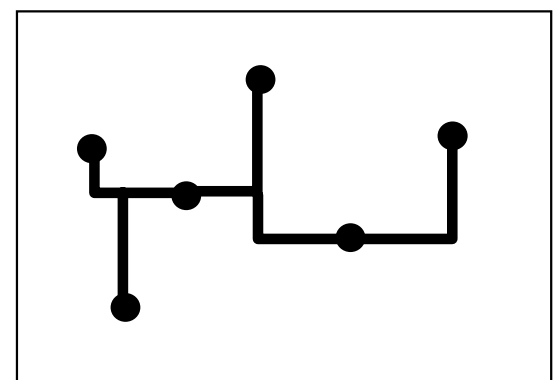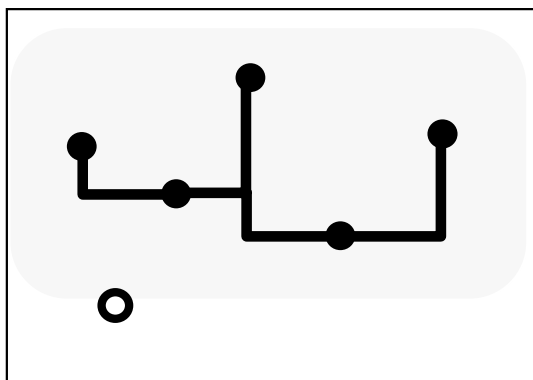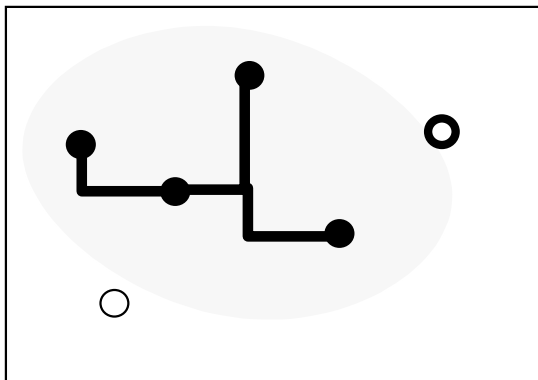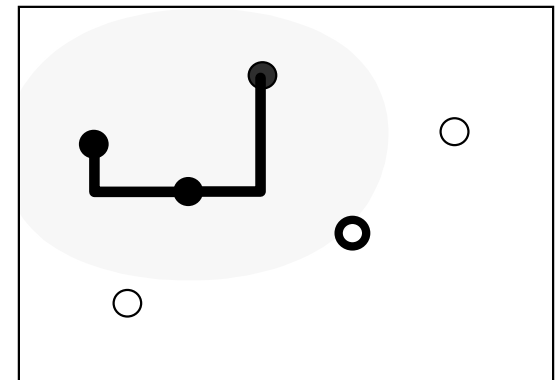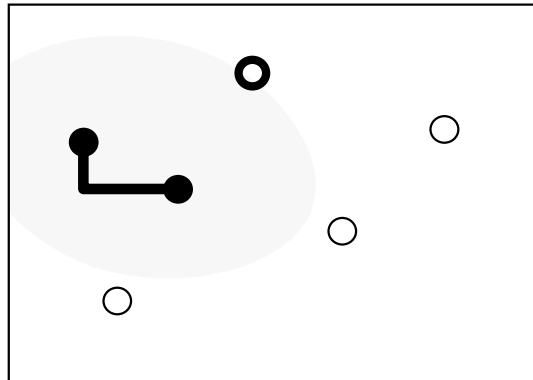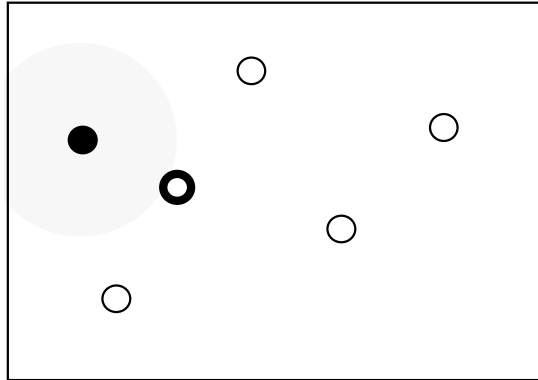
Modified A*-Search Algorithm
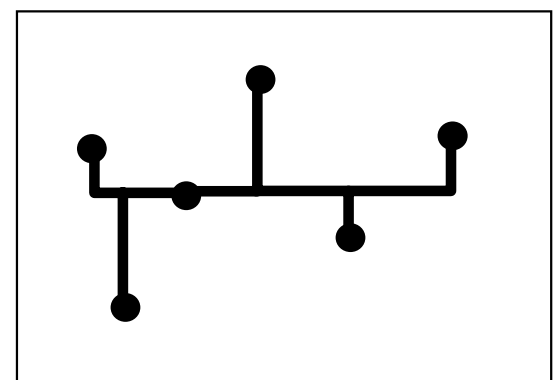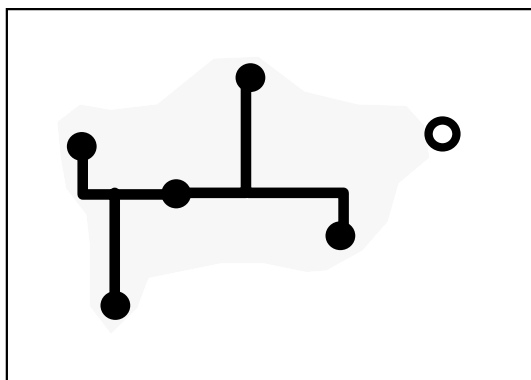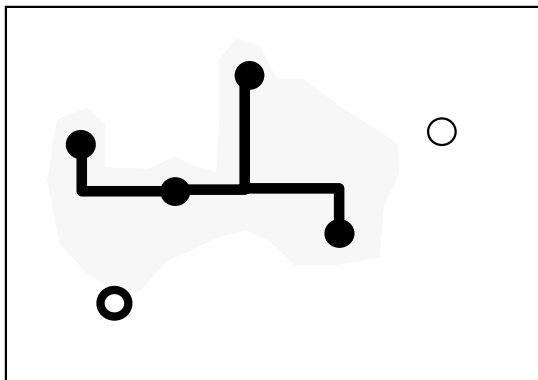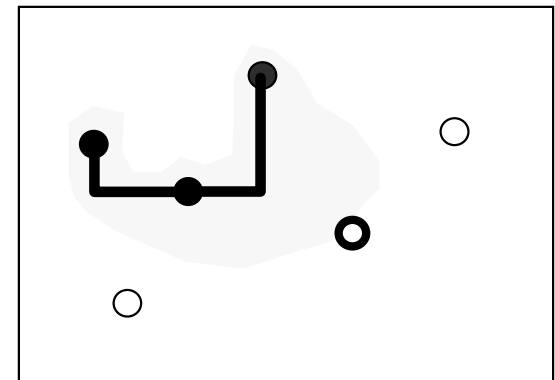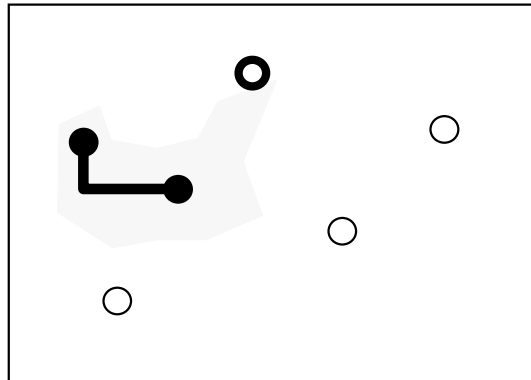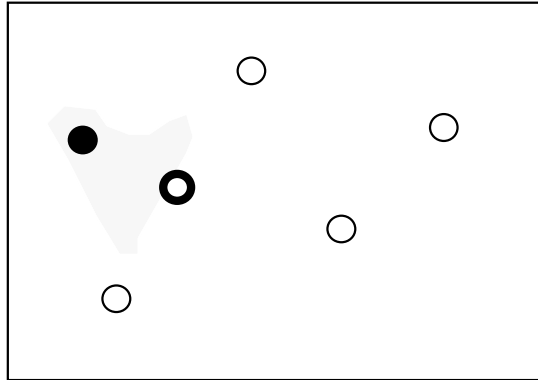
Total Net Length Estimation
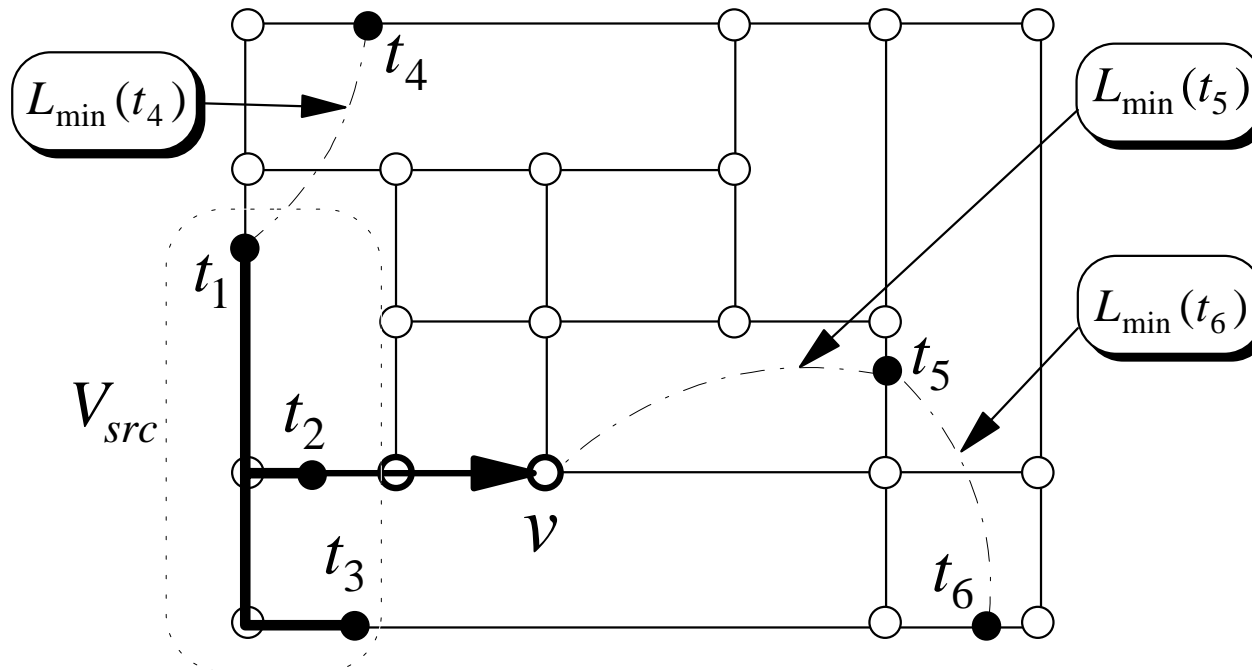
$$L^{*}(v) \;=\; L_{p}(v) + \frac{2}{3} \sum_{\forall t_i, t_i \in T_u} L_{\min}(t_i)$$

Rectilinear Steiner Trees
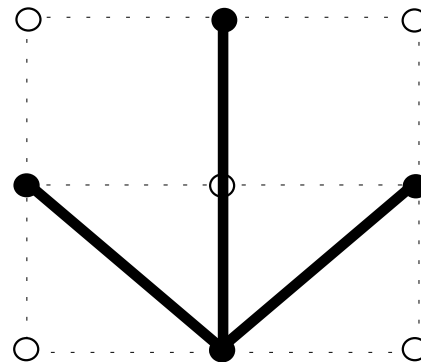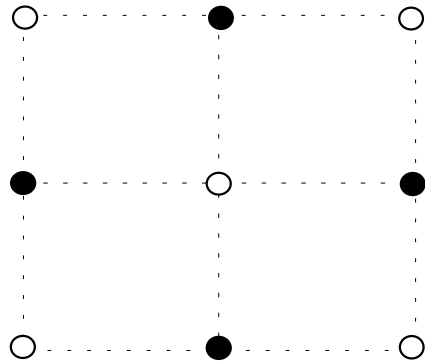
Minimum Spanning Tree
(MST)
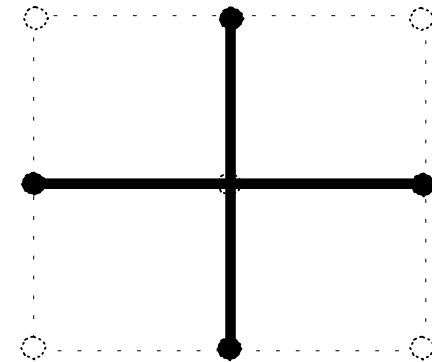
Rectilinear Steiner Tree
(RST)

$$\frac{\text{Rectilinear MST}}{\text{Optimal RST}} \leq \frac{3}{2}$$

Hwang F.K., "On Steiner Minimal Trees with Rectilinear
Distance", SIAM Journal of Applied Math., 1976

Total Net Length Estimation
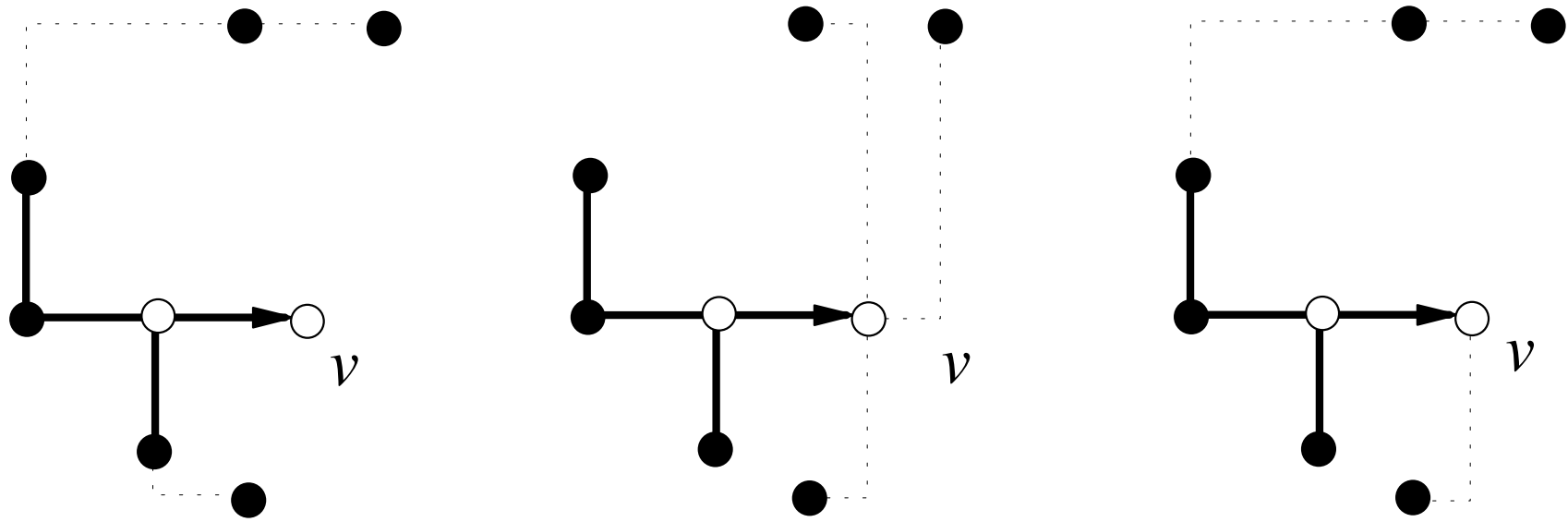
One-Step Look Ahead
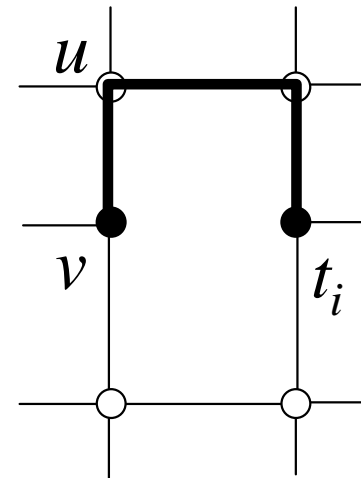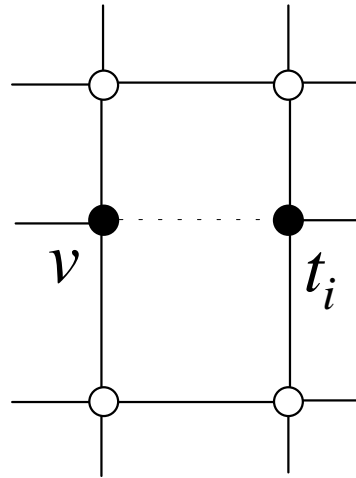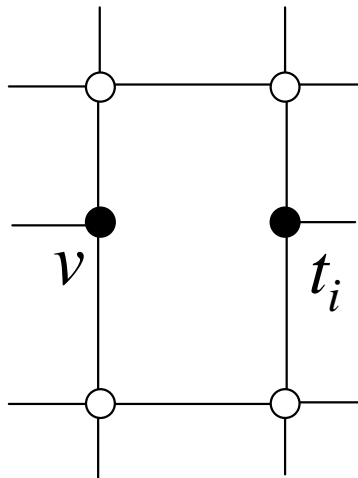
$$\text{RectDist1}(v, t_i) = \underset{\substack{\forall u,\ u \text{ is an adjacent} \\ \text{vertex of } v}}{\text{Minimum}} \left[\text{RectDist}(v, u) + \text{RectDist}(u, t_i) \right]$$

Experimental Results

21918 μm
[Clow 1984]

21203 μm
[Hsu 1987]

20493 μm

Experimental Results

20809 μm
[Clow 1984]

19988 μm
[Hsu 1987]

19300 μm

Experimental Results

Distribution of the differences in net length of 1000 routes obtained from our algorithm and obtained from [Hsu, 1984]
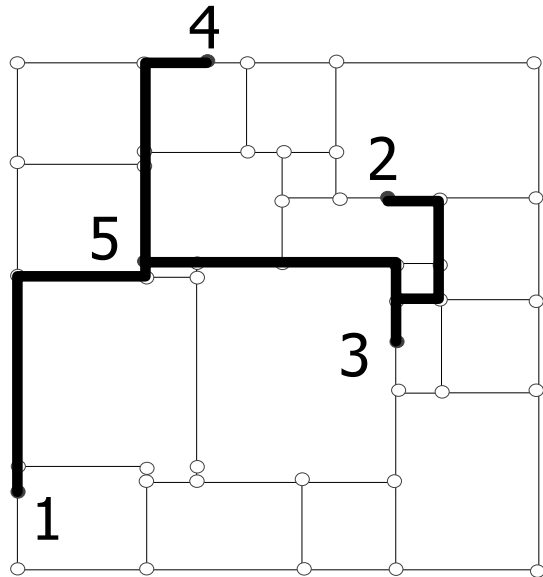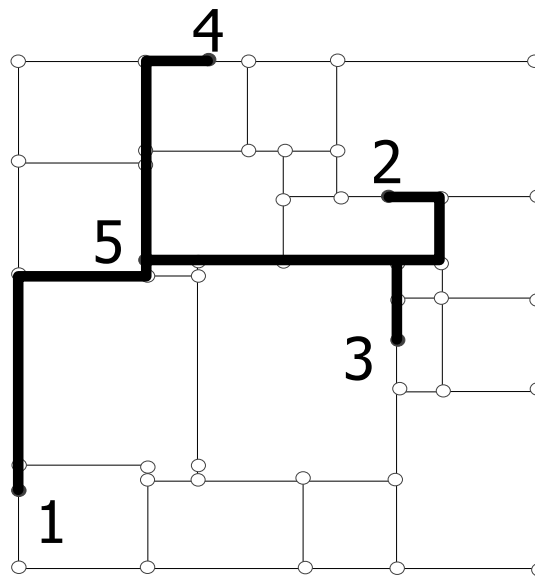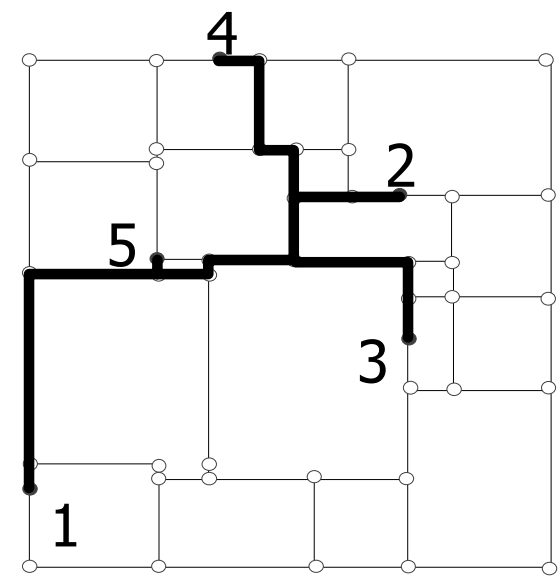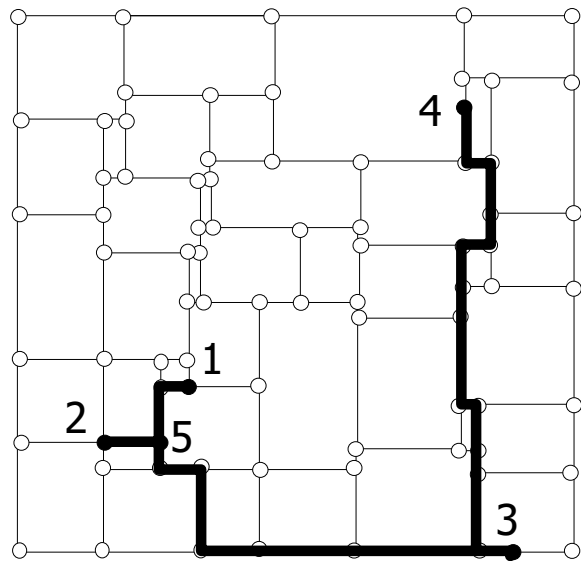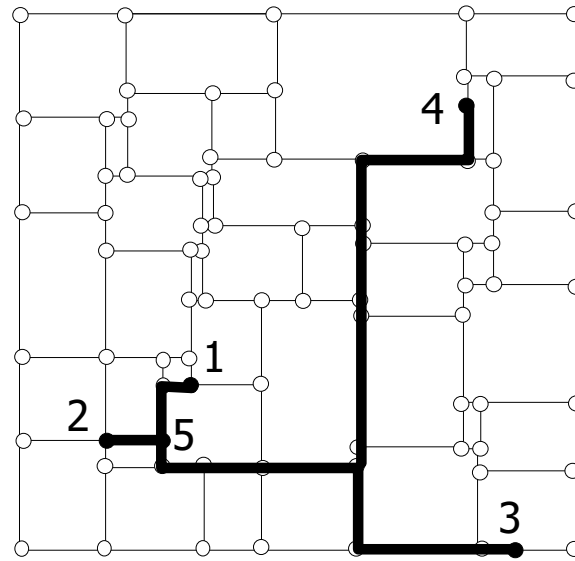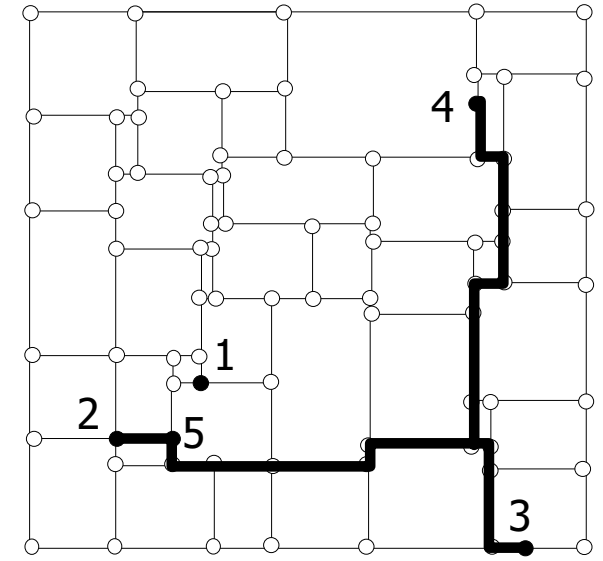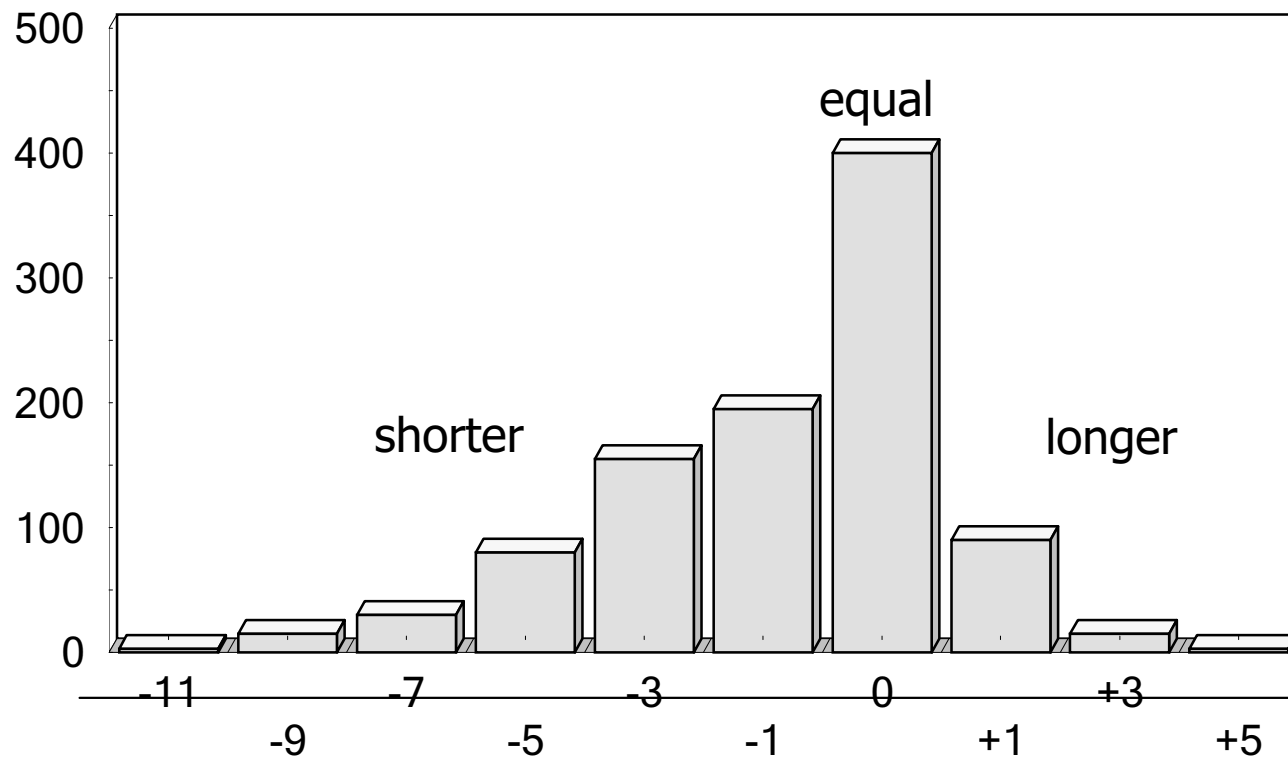
Summary

- An algorithm for the global routing of multiterminal net.

- Based on the A*-search algorithm.

- Consider *all* the unconnected terminals *simultaneously*

- Use lower bound of minimum rectilinear Steiner tree for guiding the search process.

- A large number of Shorter global routes is obtained compared with the previous approaches.