Introduction

An edge can be defined as the boundary between two regions with relatively distinct grey-level properties [1]. It is a local and fundamental property of an individual pixel. And edge detection is the process of detecting and locating these edges.

Edge Detection as a Cost Minimization Problem

- Edge Enhancement using Sobel operator

  ![Edge Enhancement](image1)

  ![Edge Enhancement](image2)

- Cost Function

  There are five cost factors: dissimilarity cost $C_d$, edge pixel cost $C_e$, fragmentation cost $C_f$, thickness cost $C_t$, curvature cost $C_c$. And the total cost of an edge configuration $S$ is the linear sum of weighted cost factors of all pixels.

  $$ F(S) = \sum_{i=1}^{n} w_i C_i(S, I) $$

Genetic Algorithm

Genetic algorithm is a stochastic search and optimization method based on the principles of natural biological evolution.

Pseudo code

Initialize the first generation
Evaluate each individual using the cost function
While not finished, iterate

- Do ranking
- Select parents from this generation
- Reproduce next generation

  - Do crossover
  - Do mutation

- Evaluate this generation

Parallel Scheme

Parallelize the edge detector by dividing the image into small blocks. Each node of the cluster will perform independent edge detection algorithm in those sub regions.

Figures showing the convergence of the edge detector using genetic algorithm

![Convergence Figures](image3)

the speed-up and scalability of the parallel implementation

![Speed-up Chart](image4)