Generate Digital Elevation Models Using Laser Altimetry (LIDAR) Data

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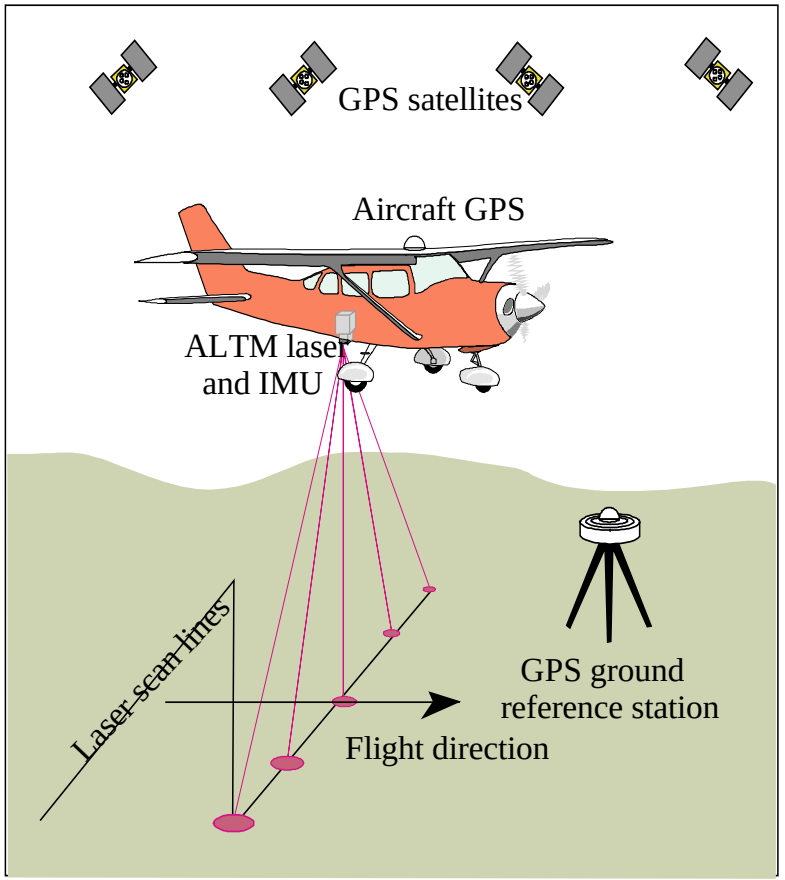
Outline

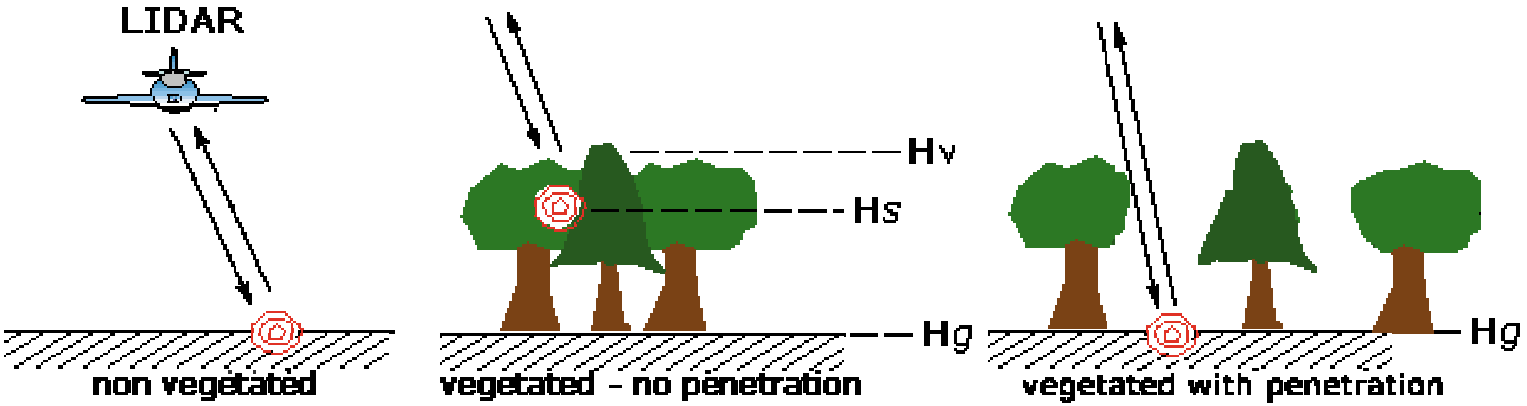
- Introduction
- Data
- Implementation
- Results
- Conclusions

Introduction

- Laser Data
  - 25,000 pulse/s
  - 5 km swath width
- Data processing
  - GPS location
  - Air plane IMU
  - Laser angle
  - Laser return time
- X, Y, Z points
  - 30 cm x, y accuracy
  - 15 cm z accuracy



Data Points



- Classes
  - Ground
  - Vegetation
  - Man-made objects

Objective

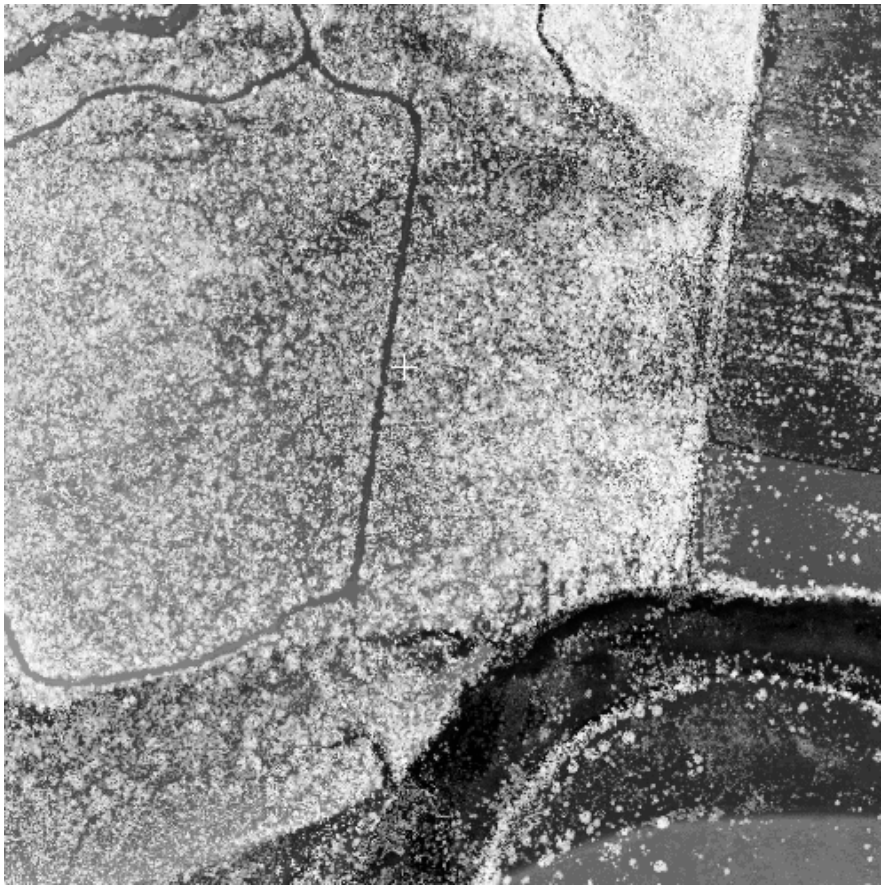
- Generate 1 m digital elevation model of ground surface from LIDAR points

- Should not contain vegetation or man-made objects.

Gridding

- Model each grid cell as a bounded random variable
- Data points are observations of r.v.
- Estimate lower bound with smallest order statistic
- Grid minimum data point

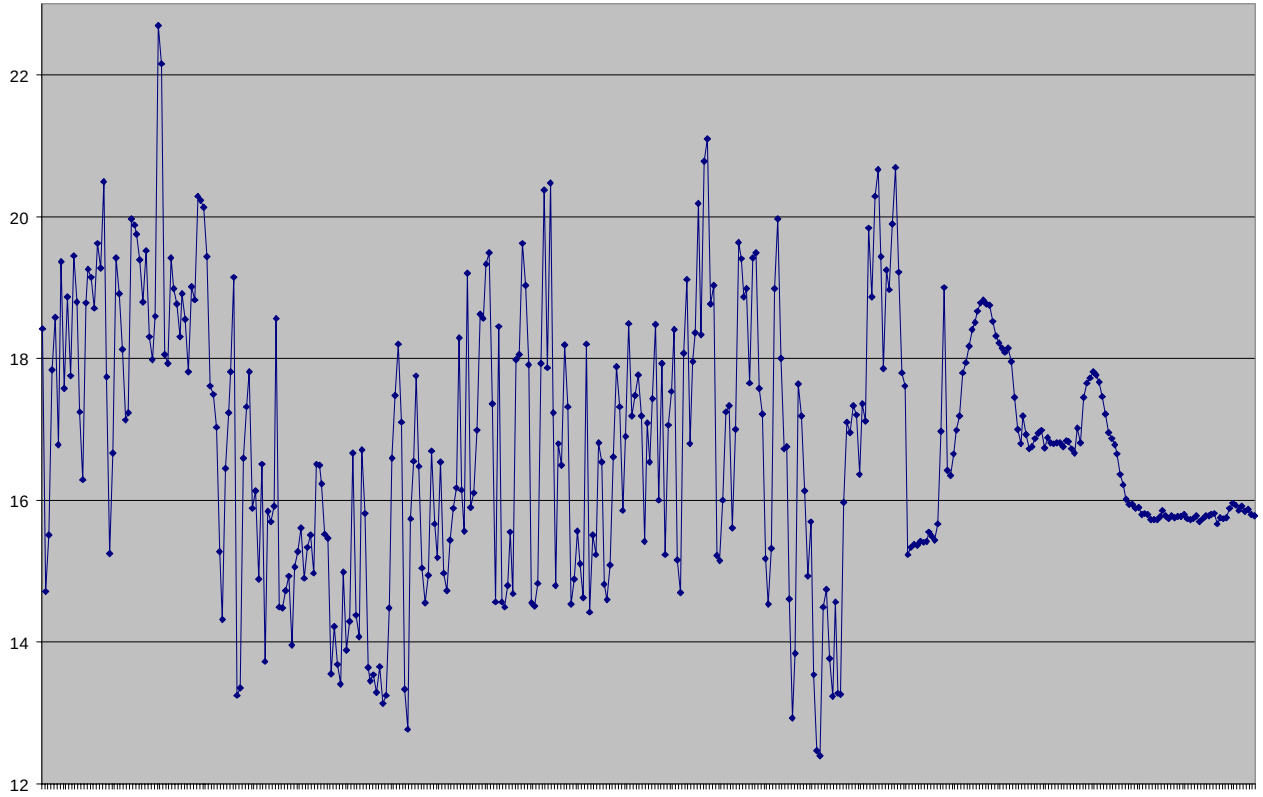
Gridding Results



Inverse Distance Gridding

Minimum Data Gridding

Signal Sample

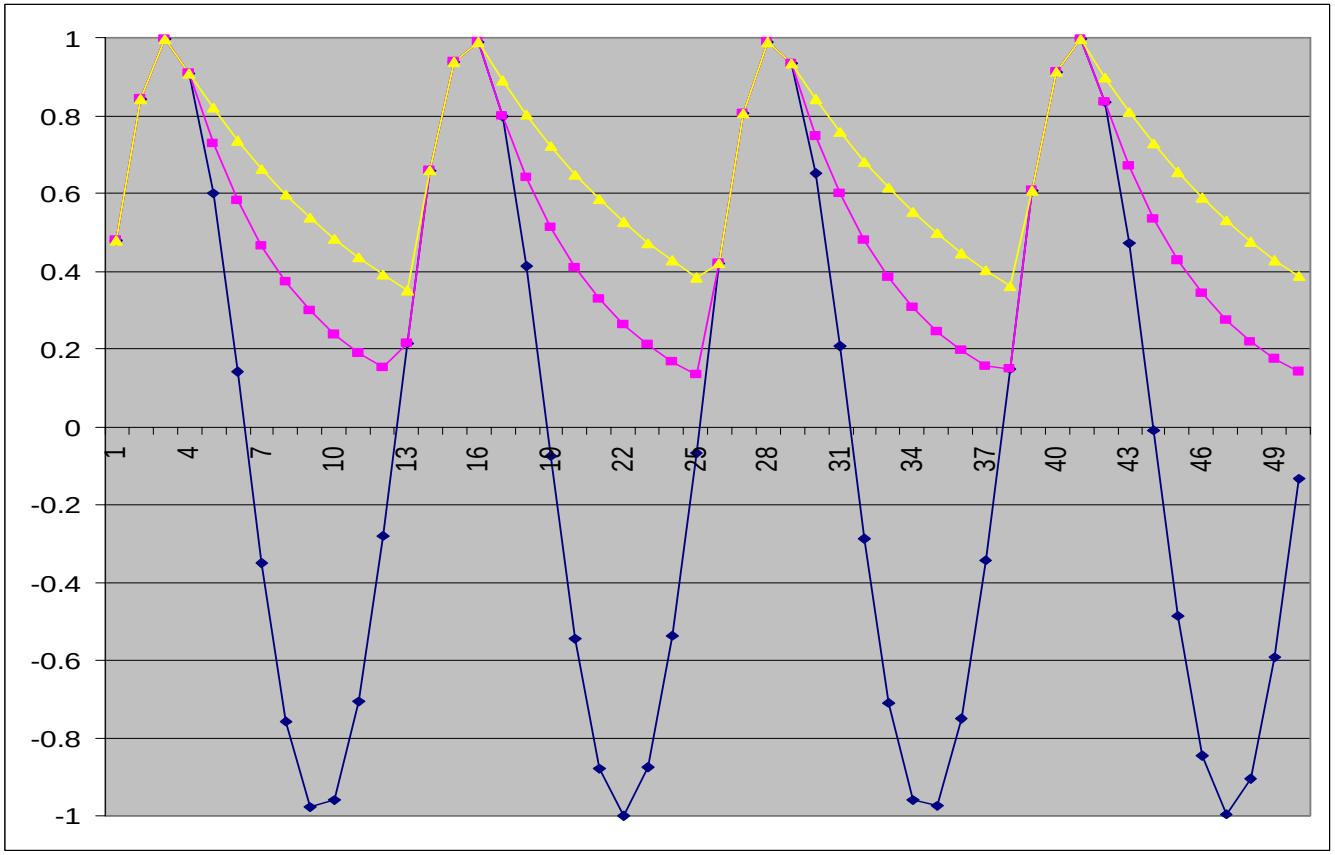


Signal row of elevations

Ground Detection

- Non-stationary Signal Input
- Subtract averaging window value
- Signal symmetric about mean
- Find signal lower envelope
  - Simple amplitude demodulation
  - Keep similar values

Simple Demodulator

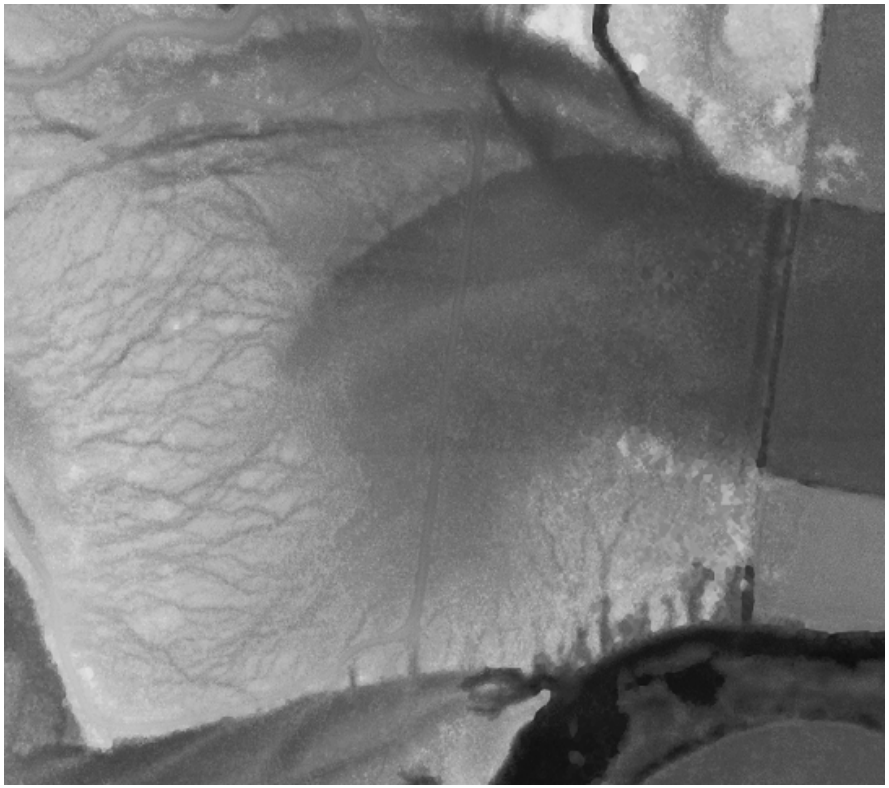


Similar to parallel RC circuit

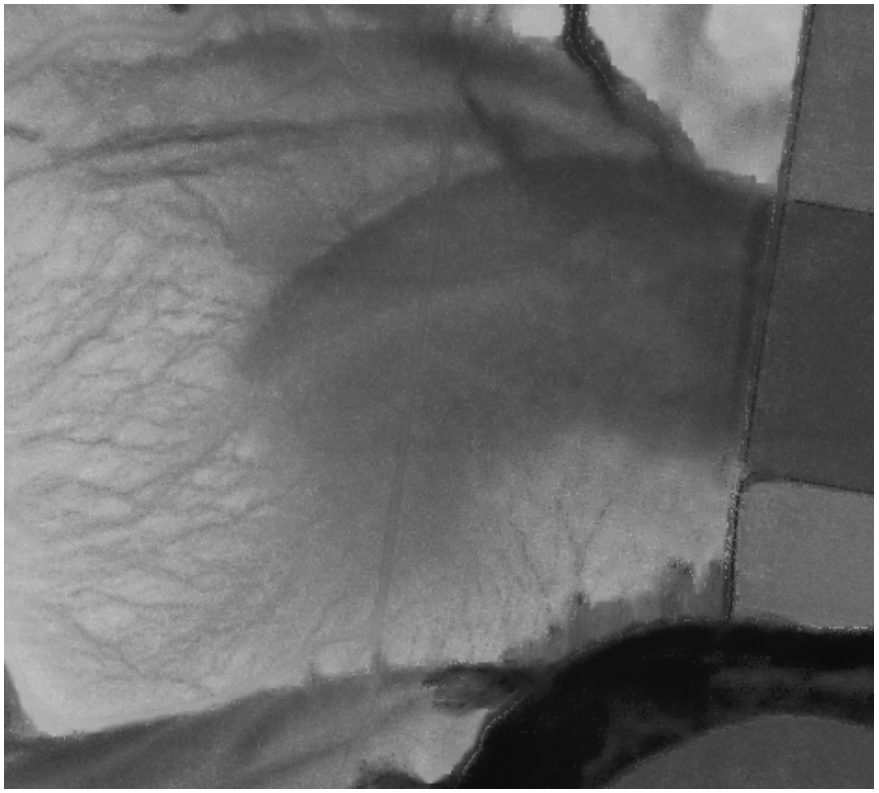
Keep Similar Values

- Modulator removes too many values
  - Removes natural variation
  - Removes natural peaks
- Assume all vegetation gone
- Find locally similar pixels

Results (Flat)

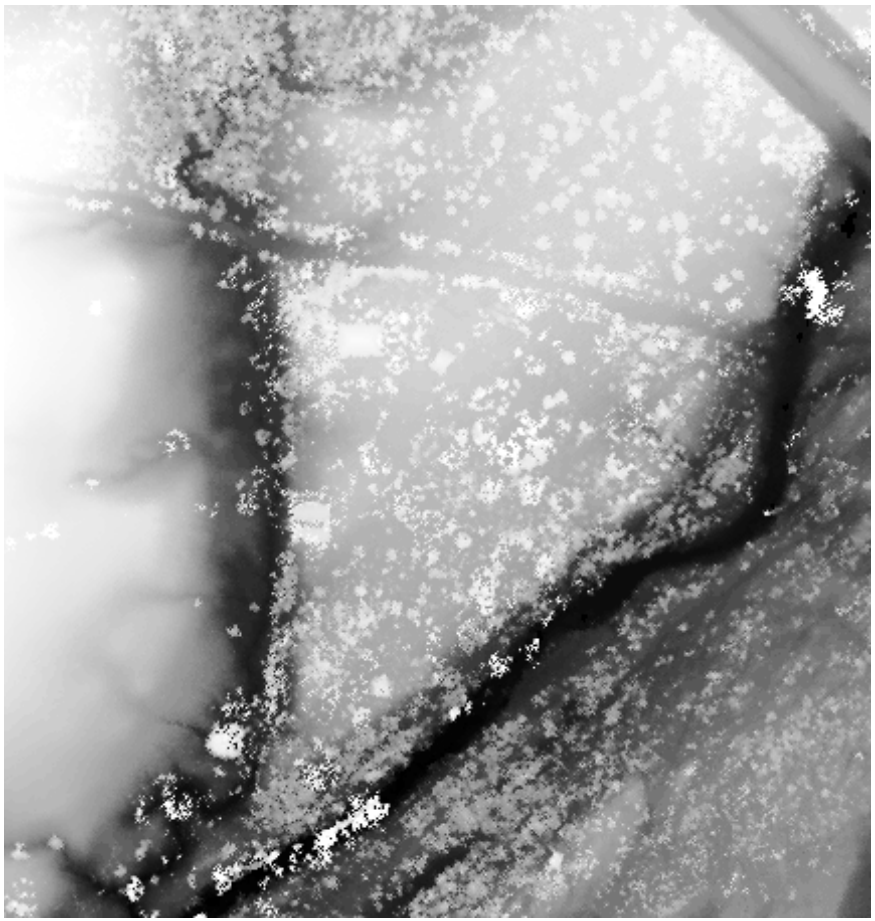


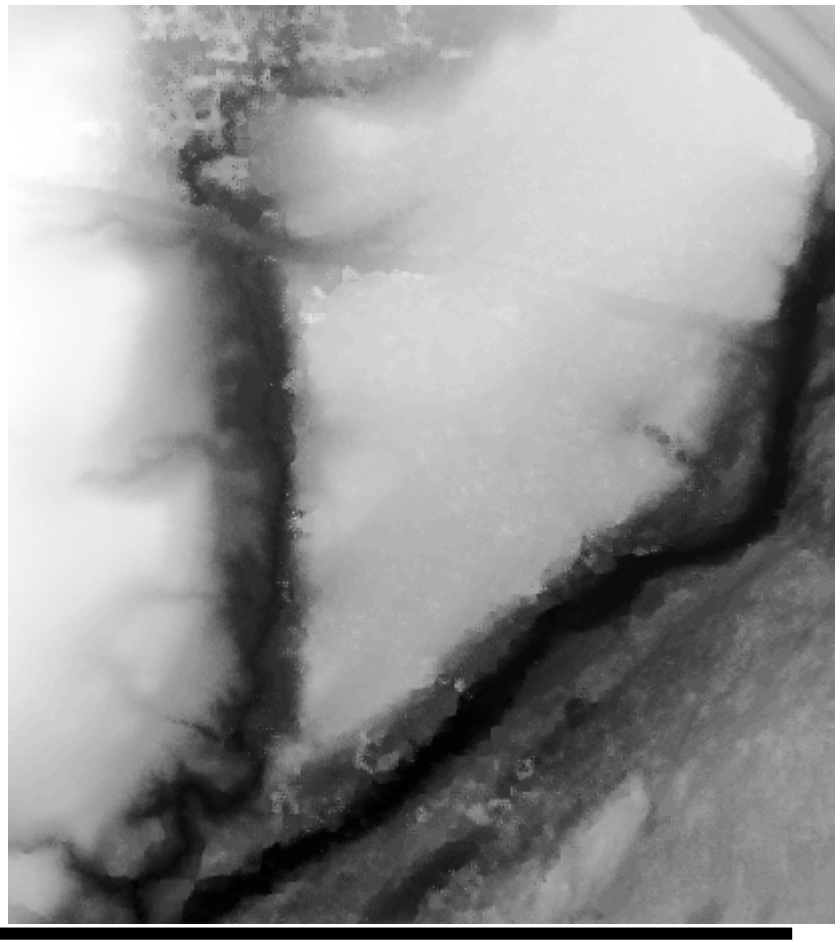
Commercial Package



My Result

Results (Hilly)





Speed

- Commercial Package – 8+ hrs.
  - Produces ground data points
  - Needs to be gridded
- My program - 2 hr.
  - Produces DEM image
  - Can be mapped back onto points

Conclusions

- Faster
- Good result
- Improvements
  - Low penetration regions
  - Adding points