

SSIP 2007
15th Summer School on Image Processing
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SSIP 2007 – Team 7

Binary Tomography

Project 16 – Binary Tomography

TEAM 7

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Problem Description

- Problem 1:
pixel are circles on a grid
→ count object pixels

- Problem 2:
pixel are squares
→ measure length of intersection

Different Approaches 1

Linear Programming Relaxation

LP: $\max \sum_i x_i$
subject to $Ax \leq b$
where $x \geq 0$

Relaxation:
 $x \in \{0,1\}$

Connectivity constraint:
 $\max \sum_i x_i - \sum_i |x_i - x_{i+1}| - \sum_i |x_i - x_{i+m}|$

Different Approaches 2

Simulated Annealing

```

graph TD
    start([start]) --> new_sol([new parent solution])
    new_sol --> temp_cold{Is the system cold enough?}
    temp_cold -- Y --> done([done])
    temp_cold -- N --> limps{> limps}
    limps -- Y --> store_sol([Store as best solution])
    store_sol --> new_sol
    limps -- N --> create_sol([Create new solution])
    create_sol --> energy_low{Is energy lower?}
    energy_low -- Y --> is_better{Is it better?}
    is_better -- Y --> new_sol
    is_better -- N --> rand_exp[-rand < exp(-dE/kT)]
    rand_exp -- Y --> create_sol
    rand_exp -- N --> reduce_temp([Reduce temperature])
    reduce_temp --> temp_cold
    
```

Different Approaches 3

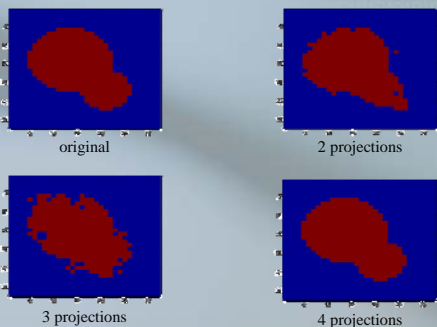
Reduce to maximum flow

1	1	0	2
0	1	0	1
1	0	1	2
2	2	1	

→ not suitable for problems of type 2 because of float values in projections

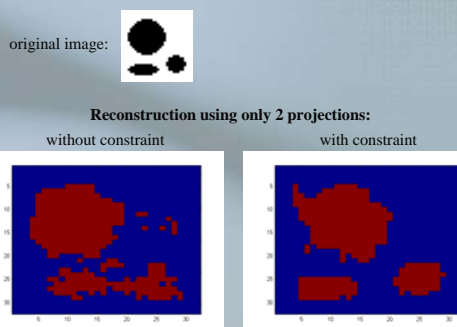
Reconstruction without noise

LP Relaxation



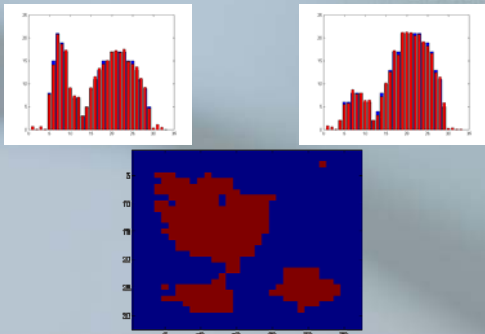
Reconstruction without noise

LP Relaxation with connectivity constraint



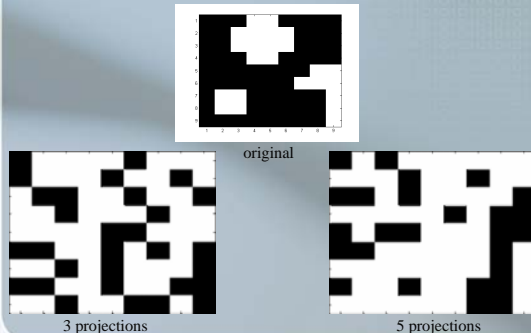
Reconstruction with noise

Added gaussian noise with $\sigma^2 = 0.25$ to the two projections :



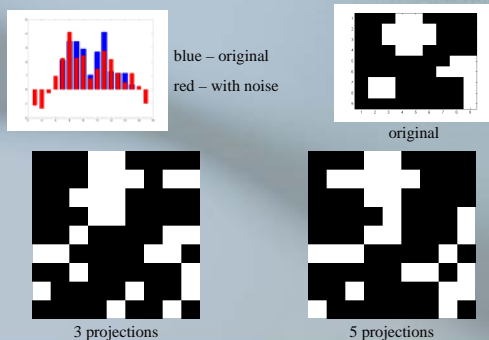
Reconstruction without noise

Simulated Annealing



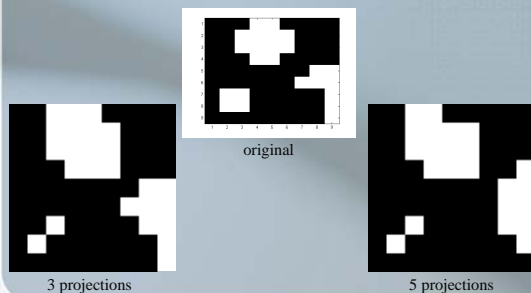
Reconstruction with noise

Added gaussian noise with $\sigma^2 = 1$ to the projection s :



Reconstruction with noise

Added gaussian noise with $\sigma^2 = 1$ to the projection s and used **connectivity constraint** (like in LP)



Thank you for your
attention!

? Questions ?

Perhaps we can answer ☺