Fundamentals of Mathematical and Computing Sciences: Applied Mathematical Science

Low rank matrix estimation

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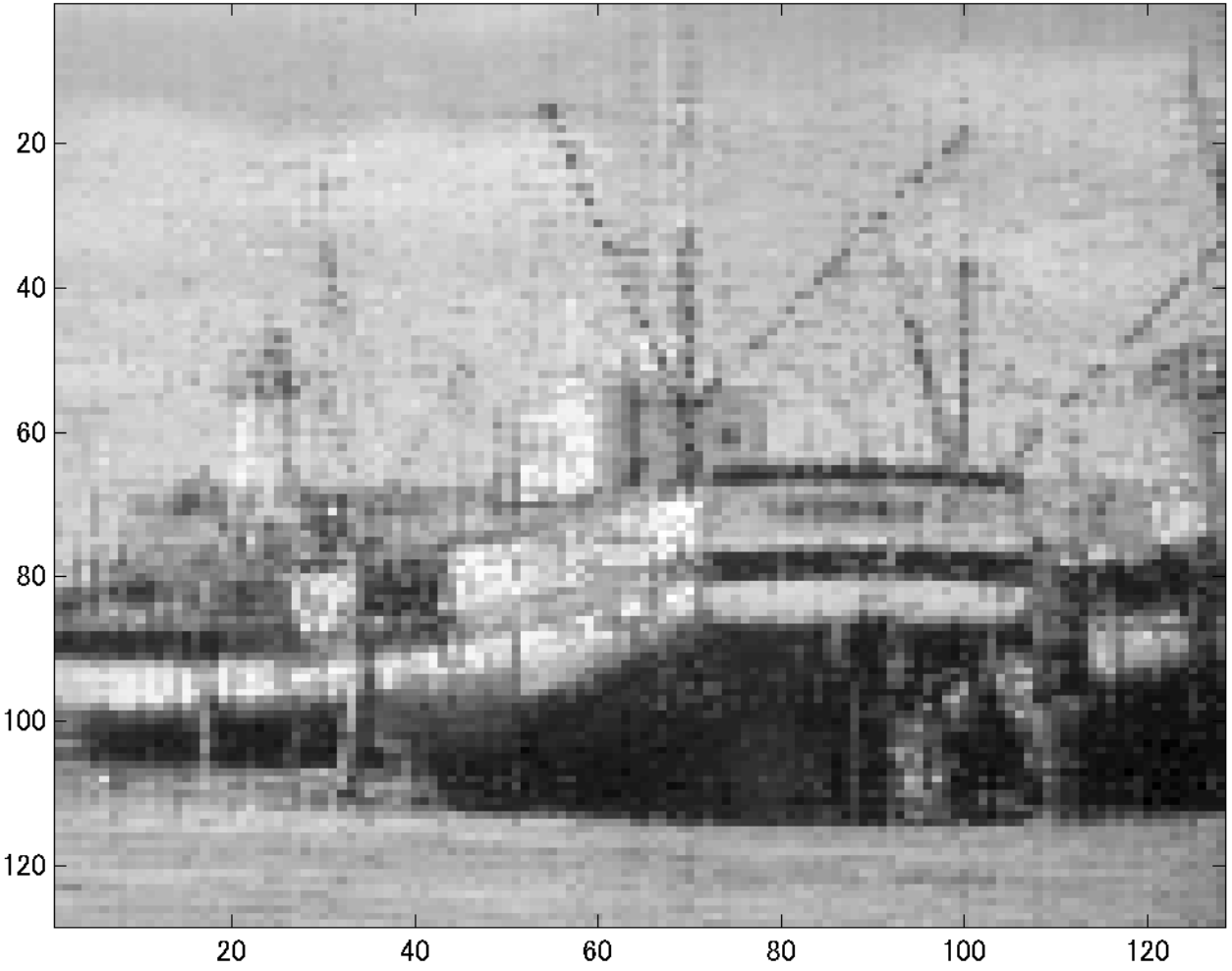
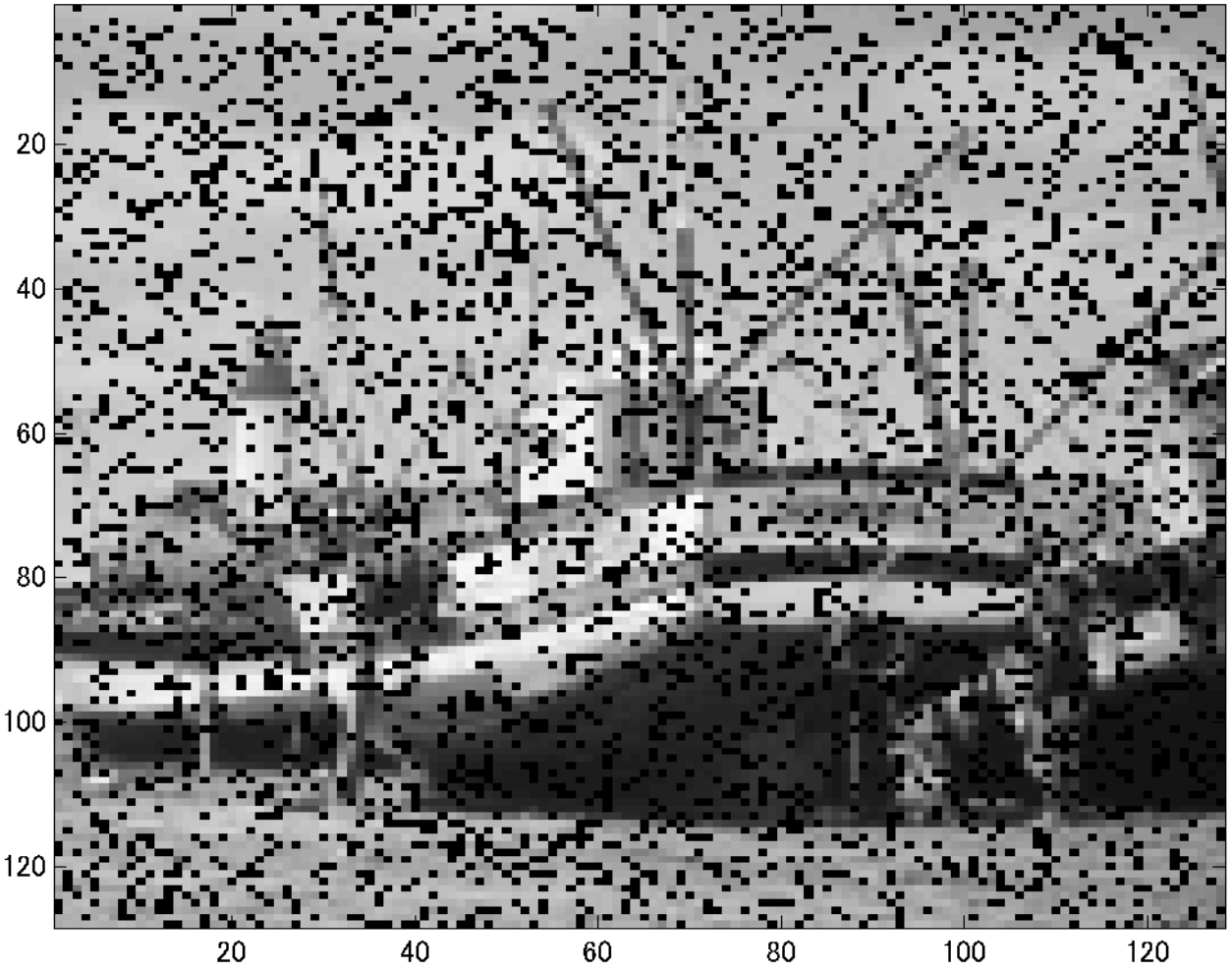
50% observation

Reconstructed image by low rank matrix estimation



True image

80% observation



Reconstructed image by low rank matrix estimation

Almost perfect reconstruction

True image

Source code (matlab)

```
ytr = (masked image); x = (initial image:m*n);
w=zeros(m*n); u=x;

AAeye = A'*A + rho/2*speye(m*n,m*n);
for ii=1:MAX_ITER
    x = bicgstab(AAeye,A'*ytr - w/2 + u/2);
    u = STfunction(x+w,lambda);
    w = w + (x - u);
end;
```

Implementation of ADMM (Alternating Direction Method of Multipliers)

Subroutine

```
STfunction = @(x,lambda)(reshape(
                softth_matrix(reshape(x,m,n),lambda),m*n,1));
```

```
function vv=softth_matrix(vv,lambda)
   [U S V] = svd(vv);
   vv=U*(sign(S).*max(S-lambda,0))*V';
```

Trace norm regularization

$$\min_{A \in \mathbb{R}^{M \times N}} \quad \|Y - \mathcal{X}(A)\|^2 + C\|A\|_{\mathrm{Tr}}$$

$$\|A\|_{\mathrm{Tr}} = \mathrm{Tr}[(A^\top A)^{\frac{1}{2}}]$$

The code shown in the previous slides solves this optimization problem.