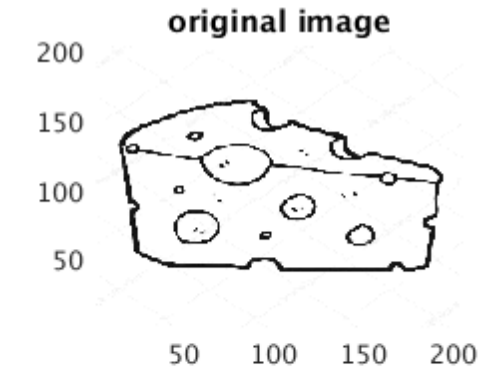
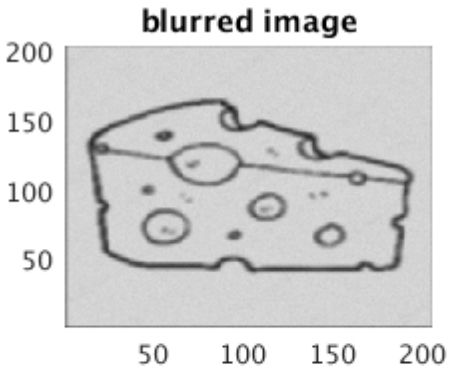
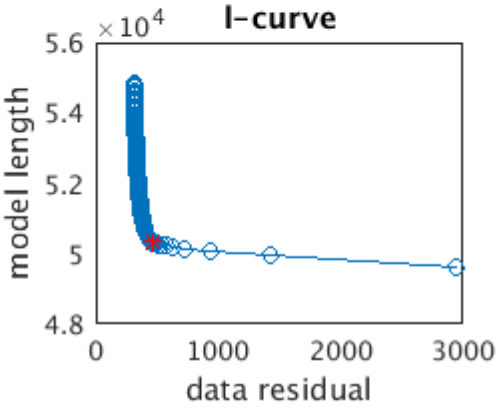
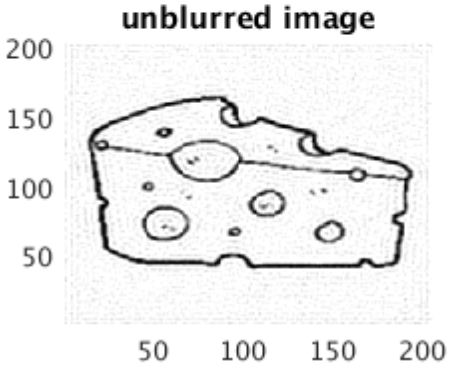
```
% load image and sample
close all
pics = imread('cheese.jpg');
pics2 = flipud(double(pics(:,:,3)));
pics2 = pics2(1:5:end,1:5:end);
[n,m] = size(pics2);
npts = n*m;
idim = n;


% plot original image
subplot(2,2,1); pcolor(pics2); shading flat; box on; colormap gray; caxis([0 255]);
title('original image');



% blur image and add noise
sig = 1.5;
wid = 3;
scale = 0.01.*(max(max(pics2)));
a = [exp(-([0:wid-1].^2)./(2*sig.^2)), zeros(1,idim-wid)];
g = toeplitz(a);
g = sparse(g);
g = (1/(2.*pi.*sig.^2)).*kron(g,g);
gs = sparse(g);
d = gs*reshape(pics2,npts,1)+(scale.*randn(npts,1));
di = reshape(d, n,m);

% plot blurred image
subplot(2,2,2); pcolor(di); shading flat; colormap gray; box on; caxis([0 255]);
title('blurred image');

% set initial parameters
m0 = zeros(npts,1);
s0 = d-(gs*m0);
r0 = gs'*s0;
p0 = r0;
q0 = gs*p0;
nints = 100;
mk_all = [];
m_all = [];
d_all = [];

% iterate
for k=1:nints
    % set initial conditions on first iteration
    if k == 1
        rk = r0;
        qk = q0;
        mk = m0;
        pk = p0;
        sk = s0;
    end

    % find next model
    ak1 = (rk'*rk)./(qk'*qk);
    mk1 = mk+(ak1*pk);
    sk1 = sk-(ak1*qk);
    rk1 = (gs'*sk1);
```

```
    bk1 = (rk1'*rk1)./(rk'*rk);
    pk1 = rk1+(bk1'*pk);
    qk1 = (gs*pk1);

    % set new model
    rk = rk1;
    qk = qk1;
    mk = mk1;
    pk = pk1;
    qk = qk1;
    sk = sk1;

    % model length
    m_all = [m_all; sqrt(sum(mk'*mk))];
    % data residual
    gm = gs*mk;
    d_all = [d_all; sqrt(sum((gm-d)'*(gm-d)))];
    % all models
    mk_all = [mk_all mk];

end

% plot l-curve
subplot(2,2,3); hold on; box on;
plot(d_all, m_all, 'o-');
title('l-curve');
xlabel('data residual');
ylabel('model length');

% choose best value according to l-curve
idx = 14;
plot(d_all(idx), m_all(idx), 'r*');
mkp = mk_all(:,idx);

% plot un-blurred image with early termination
subplot(2,2,4); pcolor(reshape(mkp,n,m)); shading flat; box on; colormap gray; caxis([0 255]);
title('unblurred image');
```









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