INVERSIO-ONGELMIEN LASKENNALLINEN PERUSKURSSI 2012

MATLAB EXERCISE 5

(1) (a) Construct signals u_i and s_i as in Exercise 4, Problem 1.
 (b) Construct also the convolution kernels (boxcar and Hann window) as in Exercise 4.
 (c) Construct the convolution matrices C_1 and C_2 as in Exercise 4.

(2) Construct noisy measurement data m_n by convolving signals with convolution kernels and by adding gaussian noise

```
m = conv(kernel,signal);
m_n = m + c * randn(size(m));
```

where `c = 0.01 * max(data)`. Calculate the error norm $||\varepsilon|| = ||m - m_n||$.

(3) Try to solve deconvolution problems with noisy data.

(4) Solve the deconvolution problems using truncated singular value decomposition and Morozov discrepancy principle:
 (a) Calculate the SVD of the theory matrix

```
[u,s,v] = svd(matrix);
```

 (b) Calculate the truncated SVD solution $x^{(k)}$ with different values of k, plot the results.
 (c) Try to find the optimal k using the Morozov discrepancy principle.

(5) Try to find optimal solution to the deconvolution problems using L-curve method:
 (a) Start with $k = 1$, and calculate the truncated SVD solution $x^{(k)}$.
 (b) Calculate the discrepancy $||Cx^{(k)} - m_n||$ and the norm of the solution $||x^{(k)}||$.
 (c) Plot the point $(\log ||x^{(k)}||, \log ||Cx^{(k)} - m_n||)$
 (d) Increase k by one, and go to (a)

(6) Study how the measurement error affects to the optimal solution by solving problems with more and less noise.