5 Application: Image Deblurring

- **Read:** Chapter 10.1
  Webpage: "Deblurring images" (`http://wiki.helsinki.fi/display/mathstatHenkilokunta/2D+deconvolution`)

- **Exercises:**

1. Create blurred noisy image by running "DB1_data_comp.m". Use "surf" to observe the blurring operator (the point spread function, psf). Show the clean image "X" and the blurred noisy image "mn".
2. Repeat image deblurring with Tikhonov regularization on the webpage, and show the result "recn". Change the value of the regularization parameter "delta". Compare the results visually and quantitively by measuring the 2-norm of difference between the clean image "X" and the restored image "recn", and show this plot versus "delta". Which "delta" give the best result quantitively?
3. Repeat image deblurring with approximate total variation deconvolution on the webpage. Change the value of the regularization parameter "regparam". Compare the results visually and quantitively by measuring the 2-norm of difference between the clean image "orig" and the restored image "final", and show this plot versus "regparam". Which value of "regparam" give the best result quantitively (we call it as optimal choice)? With the optimal "regparam", change the value of the smoothing parameter "beta" into 1 and 10^{-5}, respectively, then how does the restored result change?

   2.2

   Not much
4. Use the Tikhonov regularization and total variation regularization to deblur the same test image and psf. More test images can be found on CampusNet. Please refer to "DB1_data_comp" to create the blurry noisy image and psf in order to avoid inverse crime. Based on numerical test, try to find the regularization parameter for each regularization, which provides best restored image. Compare the restored results. Which regularization provides better result? Why?

   Toatl variation. Because the image contain sharp edge