

Features: edge detection

1. Apply the Roberts, Prewitt and Sobel edge detection to *lena.bmp* and threshold the results to obtain binary edge maps. Do not use the `edge` command from Matlab or any other function for edge detection. Analyse the results:

- a) indicate which method you consider to be the best;
- b) motivate your choice for the best method.

2. Canny edge detection

In this exercise you are going to investigate the parameters that are involved in the Canny edge detector. For this purpose, let us consider the image *needle.png* – an X-ray image of a phantom with a biopsy needle inserted. In X-ray imaging it is important to limit the radiation dose that the patient receives when capturing an image. However, this directly affects the image quality and when using a low x-ray dosage, the resulting images will be somewhat noisy.

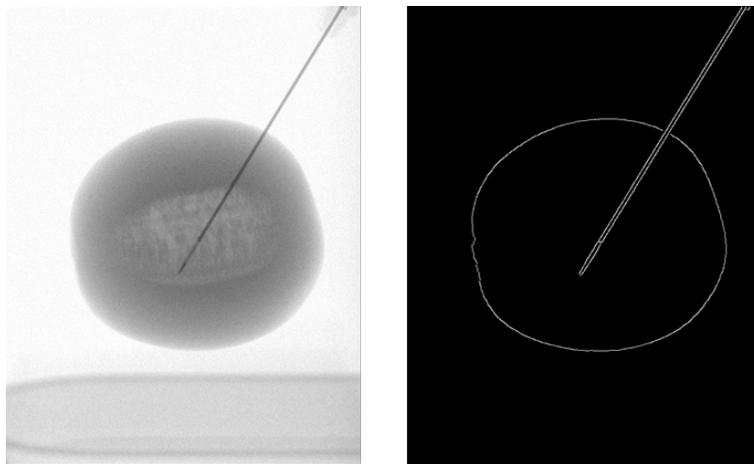


Fig. 1: A noisy X-ray image of a phantom with an inserted needle (left) and the desired edges (right)

In this exercise you are going to use the Canny edge detector to extract the edges from the needle and the phantom. In matlab you can use the command `edge(I, 'Canny', [T1, T2], sigma)` to apply the Canny edge detector to an image `I`, where `T1` represents the lower threshold, `T2` is the higher threshold and `sigma` is the standard deviation of the Gaussian kernel.

- a) The detected edges in the right image of Figure 1 are obtained using carefully tuned values for the Canny parameters, i.e. $T1=0.02$, $T2=0.4$ and $\sigma=2$. Load image `needle.png` and use the canny edge detector to reproduce the result shown in Figure 1.
- b) Change the first threshold $T1$ to 0.38 and show the resulting edges. Describe what has changed with respect to your result at (a) and explain why these changes have occurred.
- c) Next, lower the second threshold $T2$ to 0.05 and show the resulting edges. What is the effect of lowering the second threshold? Explain why this effect occurs.
- d) Now we are going to investigate the effect of parameter σ . Lower this parameter to $\sigma=0.2$, use the canny edge detector again and show the resulting edges. Please describe and explain the differences with the optimal edges, as shown in Figure 1.
- e) Let's say we want the filter to be fast, and therefore we are restricted to a small kernel. How could we obtain better results than obtained in (d), without changing the Canny parameters?
(Hint: what is the reason for the bad result in (d)?)
- f) Finally, increase the size of the filter kernel by setting $\sigma=10$. Describe the resulting edges and explain why increasing σ has the observed effect.