

## **Introduction to biomedical engineering**

### Homework on medical imaging (fall 2006)

1. A freshly prepared sample of a certain radioactive isotope has an activity of 10 mCi. After 4 h, the activity is 8 mCi.
  - a) Find the decay constant and half-life of the isotope.
  - b) How many atoms of the isotope were contained in the freshly prepared sample?
  - c) What is the sample's activity 30 h after it is prepared?
2. An apparatus for screening osteoporosis looks like this: It uses two beams of X-ray sources which have different energies. By projecting on the (lumbar) spine it gives an estimate of bone mineral density without being interfered by the surrounding soft tissues. Try some literature search and write a short essay in less than one double-spaced A4 page about its principles.
3. A contrast agent for ultrasonic imaging is the "microbubbles". By injecting microbubbles into the blood stream, the reflective ultrasound signal gets strongly enhanced. In less than half a double-spaced A4 page, detail its major operating principles.
4. Do some survey on MRI to answer how a higher magnetic field strength could help to get better images in terms of: (1) signal-to-noise ratio, and (2) sensitivity on blood oxygenation contrast. Write down your answer in less than one double-spaced A4 page.
5. Given the example image file (Note: This is an abdominal CT image. Although JPEG is not the proper format to store medical images, we used it here just to save memory space), please test any two 7x7 spatial filters by using mathematics software programs such as Matlab. State clearly how you did it and append your program codes. Compare the performance. For those of you who use Matlab, the following is a list of useful commands: help, imread, imwrite, colormap, imshow. Also note that for "imshow", you need to pay attention to the data format. "uint8" (unsigned integer with 8 bits) is completely different from "int" (integer) and certainly different from "double" (double precision).