Open book examination in TBMT02 Medical Images

The exam is available for download not earlier than 08.00 o’clock the 5th of June from the course web page (‘course documents’) in LISAM or course web page at IMT. Return no later than 08.00 o’clock the 12th of June by submission via LISAM.

The exam consists of three (3) cases. They are similar to those you have practiced at the tutorial sessions. Sometimes they are a little bit more specific. Remember to use the experience and workflow from the tutorial session when you are solving these three tasks.

You are allowed to use all material you collected throughout the course.
If you are discussing or brainstorming together with another student, write down his/her personnel identification on the home exam. It is allowed to do the brainstorming in a tutorial group but thereafter should all learning goals and analysis be made individually.

Reports are written individually.

Plagiarism is presenting someone else’s ideas or words as your own.
Do not copy; instead use the sampled information to create your own knowledge.
If you are to make quotations, do not forget to put it within brackets and only short quotations. Paraphrasing without giving credit, or changing only a few words (i.e. paraphrasing too closely) even if you give credit are also examples of plagiarism. All ideas and facts that are obtained from other sources must be properly cited, unless they qualify as common knowledge. (If in doubt about whether something is common knowledge, provide a citation.) All exams will be automatically submitted to Urkund from LISAM to check for plagiarism.

The submission is blind, that is the examiner cannot see which student the exam belongs to until the grade has been set. (Please make sure all meta-information is removed in the document submitted.)

The exam consists of 3 cases. To every case you are expected to formulate 3 questions. If the questions are relevant to the case and the learning outcomes of the course you will gain 1 p. The three questions should be answered as good as possible and will be evaluated according to the SOLO taxonomy consisting of 5 levels. (See http://www.uq.edu.au/teach/assessment/docs/biggs-SOLO.pdf and http://www.cuhk.edu.hk/policy/assessment/SOLO-description.pdf) The lowest level will give 0 p and levels 2-5 will generate increasing number of points. For every case, you will get a maximum of 10 p. A minima of 4 p for each case is required in order to pass the exam.

Grading: <12 UK F (not passed)
12-17 3 C
18-23 4 B
>23 5 A

Results are available 14 working days after the exam.

Good luck!!!
Göran Salerud
28 67 55
For each of the situations below identify different aspects of the problems and define 3-4 different questions (learning outcomes) in accordance to both the description of the situation and the aims of the course (course learning outcomes). It is welcomed that these questions are answered including a background, analysis, applicability and a validation. You will be assessed both on basis of the delivered answers but also on basis of the questions chosen. Do not forget to motivate your answers. Maximum number of pages for the exam is limited to 15.

1) A new multi-slice-spiral-CT for rapid examinations of trauma patients is recently installed. Scientific journalists, politicians from the County Council, surgeons and nurses from the emergency department are present in the conference, where you are asked to talk about all advantages of the new equipment.

How are you going to present this to such a multi-professional group of journalist’s politicians, and medical staff? You decide to take an example showing images that are ordered from the dental surgeons when a hockey player had completely destroyed his face? You start showing 3D images of the skeleton, then a reconstruction with muscles and soft tissue and finally also with the skin. During the presentation questions arise about advantages of the new CT with multi-slice compared to the older ones. “Are you sure that the images are telling the truth and nothing but the truth after such a rapid scan?” One of the journalists is suspicious and wonder if the radiation from modern CT is unnecessary and dangerous. All the time they question “and what compared using older CT equipment”.

You have to explain how a multi-slice CT works and how the radiation doses for different examinations are measured and also about techniques for minimizing the radiation dose. Another question is about different types of artefacts; which are the most common ones for CT and are there special types when using the spiral technique.

2) Local as well as international scientific journalists were coming to the magnificent opening of the Medical Image Science and Visualization centre at the university Hospital. In the next Sunday newspaper issue they are supposed to write an extensive report for their readers. Unfortunately, many of the scientific reporters did not manage to explain how MRI equipment works, its pros and cons and therefore during the week they are coming back with new questions to you. Therefore, you decide to give an extra press conference the coming Friday morning. Before starting, incoming questions are handed over to you. They could look like this:

a) How does one explain what is happening when an electromagnetic wave (RF-pulse) is transmitted and what is occurring when it is turned off in an MRI equipment?

b) T1 and T2, how are these connected to the contrast?

c) What parameters affect the grey scale – that is the contrast in every voxel in the slice?

d) What set the limits for the resolution in MR and how can it be modified?

e) How is it possible to find out the location in the object, from whom the signal arises?
f) What is causing artefacts in the MR images?

g) Why are there errors in the image when there is flowing blood? Could this be used for visualisation of blood vessels?

Prepare for the new conference where most of these questions will be answered and how are you going to answer them.

3) For one year, the radiotherapy department at the university hospital has been using 3D ultrasound equipment’s. In the specification of requirements, it was written that the equipment should have a broad field of applications from heart valve investigations to high-resolution flow profiles in small vessels. The staff is not comfortable with the equipment since they claim not having been trained nor educated in using 3D ultrasound. They became really irritated last week when they had to perform an investigation on Olof, a 6-year-old boy with diffuse hip pains. He had been complaining about pain in his right leg after crashing with his bicycle a week ago. At the end of the week he still has pain and he and his mother decide to visit the primary health care centre. After examination of the leg it is obvious that there is a need for a more thorough investigation and Olof is urgently referred to the university hospital.

At the hospital, they decide to take images of both the skeleton and tissue surrounding the hip area, the place of the diffuse pain. The initial x-ray images have only given limited information saying that there is no bone fracture or any other severe disease at the right hip area but not all questions have been answered and therefore they decide to make supplementary ultrasound investigations.

The 3D ultrasound investigation does not show any remarkably findings in the hip region except for a small swelling of the capsule. Olof’s parents think it would have been sufficiently to use only ultrasound but the staff is of another opinion, rather sceptical to the method in terms of delivering quality and reliability in making correct diagnosis based on the 3D images from the equipment.

What type of experience and knowledge about ultrasound, especially in this setup, make the staff sceptical but the parents more confident about the technique? Is there something with the promised functionality that is not clear and not compatible with the specification of requirements?

The board at the clinic decide to do something about these misinterpretations and ask you, a biomedical engineer specialized in ultrasound, to arrange some lectures where both the staff and the parents could have their questions answered. Immediately you foresee the need for both basic knowledge about ultrasound, its interaction with biological tissue and medical interpretation. A lot of rumours are buzzing about the use and understanding of ultrasound and tomorrow is the lecture. Do not waste the time start preparing for the lecture.