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Example Questions for
Introduction to Image Acquisition Methods

Answers and opportunity for discussion in lecture on February 12

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1. In photography, assume we have a lighting situation in which the sensor of our camera is correctly exposed by 1/60 second exposure at aperture 16.

a) Which aperture has to be chosen if the exposure time is reduced to 1/500 second?

b) Which of the two settings is better for imaging fast moving objects?

c) For which kind of scene is the other setting preferable?

d) What could be changed to avoid the disadvantages of both settings?

(2+2+2+2 p.)

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2. Assume there are two light sources. Assume further that the light of each of them appears neutral white for the human visual system. For instance, a white sheet of paper whose reflectivity is constant across the visual spectrum, appears white in both illuminations.

Can there exist objects which appear of equal colour under one of these light sources, but are visibly different in colour under the other one? Explain.

(8 p.)

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3. In imaging methods based on different kinds of radiation, spatial resolution can be achieved in two ways: on the illumination side and on the detector side.

a) For each of these possibilities, name two example techniques.

b) Give an example how spatial resolution on *both* sides can be combined to extract additional information.

(4+2 p.)

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4. Name two imaging techniques in which piezoelectric effects are used in the measurement system. Describe for one of these methods how they are used.

(4 p.)

5. A magnetic resonance imaging system has three gradient systems, one for each of x, y, and z directions. The radio frequency is adjusted to the measurement of hydrogen nuclei.

Assume the x and y gradient systems are switched on simultaneously at equal strength while the radio-frequency pulse is transmitted into the measurement volume, and the z gradient is switched on during readout (x and y gradient switched off). No additional fields are applied between the two steps, and for simplicity only one signal frequency is measured during readout.

What is measured by this sequence (exactly one of a–e is correct)?

a) the density of hydrogen nuclei in a plane parallel to the x-y plane

b) the density of hydrogen nuclei along some straight line parallel to the x-y plane

c) the diffusion in z direction of hydrogen nuclei located in a plane parallel to the x-z plane

d) the density of hydrogen nuclei in one specific voxel

e) the density of hydrogen nuclei along a line parallel to the x-z plane

Give a short reasoning for your answer.

(7 p.)

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6. Check which of the following statements A–F are true, and which are false.

(2 p. for each correct "true" or "false" answer, −2 p. for each incorrect "true" or "false" answer, 0 p. for each unanswered statement. Negative total numbers of points are adjusted to 0*.)*

A: The illuminance on a surface remains constant when the surface is moved to a different distance from the single point light source.

B: By combining two radio telescopes at 10 km distance by radio interferometry one achieves the same sensitivity as with a single radio telescope of 10 km diametre.

C: The scanner geometry of a first generation CT scanner leads to lower noise in the image than that of later scanner generations.

D: Diffusion tensor imaging is a technique that measures the movement of water molecules due to blood flow.

E: In an ultrasound C-scan, attenuation compensation is not necessary to achieve comparable image contrast at different image locations.

F: The possible health damage caused by injecting a higher dose of radionuclides into the patient's body prevents refining the spatial resolution of positron emission tomography into the submillimetre range.