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New method for identifying markers in prostate cancer treatment

Results from a study show that manual identification of positioning markers in radiotherapy of the prostate can be replaced by an automatic method, saving resources and avoiding human observer based uncertainties.

Imagine finding a nail on the floor of your room and looking up on the wall to find where the nail fell from. You see many holes and finding the right one will take you a long time. Now imagine if you could have an automatic identification method which could scan all the holes and tell you directly which one is the one matching the size and the shape of the nail you just found.

In radiotherapy treatment of prostate cancer, external radiation is used to kill the cancer. The patient is given parts of an ordinated radiation dose multiple times. Cylindrical nail-shaped positioning markers of gold are inserted into the prostate and used for the positioning of the prostate for each radiation dose. This helps to aim the radiation to the right place.

Before the treatment can be given the treatment must be planned. Some of the imaging modalities used for radiotherapy planning are *computed tomography* (CT) and *magnetic resonance imaging* (MRI). In CT, the tissue contrast depends on the density of the tissue. Positioning markers of gold therefore appear as bright spots and are easy to locate. In MRI, the tissue contrast depends on magnetic properties of the tissue. MRI therefore has superior soft tissue contrast compared to CT and the cancer is easier to delineate in MRI.

The use of multiple image modalities can infer uncertainties in the treatment chain. An *MRI-only workflow* where dose calculation and cancer delineation is based on only MR-images (no CT) has been proven to be feasible.

Positioning markers of gold will appear as signal voids in the MR-images and are harder to locate compared to CT. Like the holes on the wall, the signal void in the MRI images can be due to other objects in the prostate and locating the correct signal void for each positioning marker is a time and resource consuming manual process. To avoid this, new type of MR-images has been introduced in the clinic and an automatic identification method using these images has been developed.

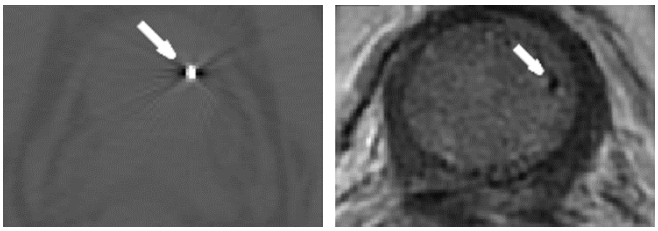

Figure Images of a prostate with a positioning marker. In the CT-image the marker is visible as a bright spot. In the MR-image the marker appears as a signal void.

The purpose of this thesis work was to validate this new type of MR-images. This was performed by asking human observers at the Radiotherapy clinic at Skåne University hospital in Lund to locate the position markers in the new type of MR-images.

The performance results from the human observatory study were superior to the ones used in the automatic method. This showed that the new MR-images were suitable for the task and that there was room for improvements in the automated method. The accuracy of the human observers was superior to the automatic method, however it varied between observers. This was expected as an automated method can eliminate these variations.

In the future, the new MR-images will be chosen as the number one method for locating positioning markers in an MRI only workflow.

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