NTNU-Project proposals 2014

Radiation Therapy Department
St. Olavs Hospital

At the Radiation Therapy Department at St. Olavs Hospital we can offer the following topics for project work for NTNU students in biophysics autumn 2014. Due to limited resources we **can only supervise <u>two</u> of the proposed projects, but there can be up to two students pr. project**.

External radiation therapy

A new linear accelerator is installed at St. Olavs Hospital spring 2014. This accelerator has more photon energies and another type of MLC (Multi Leaf Collimator) than the older accelerators at the department. We wish to evaluate clinical potential and practical consequences related to the new accelerator.

Actual topics for project work:

1.

VMAT (Volumetric Modulated Arc Therapy) with and without use of flattening-filter
The new linac has 3 photon energies with flattening-filter and two photon energies without filter (so called flattening -filter- free (FFF) beams). FFF beams give higher dose rate, and have therefore potential for shorter treatment time. The characteristic dose profile of FFF beams is best suitable for irradiation of smaller volumes, e.g. for lung cancer. The project will be analysis of treatment plans for lung cancer patients with the following focus:

- Conventional treatment planning with radiation of the lung, - possibilities with FFF?
- VMAT with and without flattening filter
    - Clinical judgements:
        - Dose coverage of target volume
        - Dose to organs at risk
    - Practical aspects:
        - Beam-on- time (FFF actual with breath-hold techniques?)
        - Monitor Units
        - Consistency between planned and delivered dose.

Supervisor: Sigrun Saur Almberg

2.

VMAT and effects of MLC

The new linac has smaller collimator leaves than the other accelerators at the department, and they can move faster.

- Clinical influence? Analysis of treatment plans:
  - Dose coverage of target volume
  - Dose to organs at risk
  - Studies of different diagnosis / treatment plans with different complexity
- Practical aspects:
  - Beam-on- time
  - Consistency between planned and delivered dose.

Supervisor: Sigrun Saur Almberg

3.

VMAT and IMRT: Dosimetric sensitivity to mechanical calibration errors of the linac.

For advanced treatment techniques as VMAT and IMRT minor errors in the calibration of MLC and collimators may result in relatively large errors in the delivered dose. Due to this, regular checks and adjustments are performed on the geometric and dosimetric status of the linac. Presently, all treatment plans are subjected to dosimetric controls in a phantom before patient treatment as we still don't know how critical different calibration errors can be in terms of dosimetric output. This project will try to establish the necessary level of precision in linac calibration. The parameters which will be tested are:

- MLC gain and offset
- Collimator position: gain and offset
- Collimator rotation: gain and offset

Each type of error will be introduced to a set of patient plans of different complexity together with some artificially designed plans and run on a Delta4 phantom. This phantom has a set of dose detectors inserted and dosimetric errors can be determined in two orthogonal planes in the phantom with a resolution of 1cm between points.

Supervisor: Jomar Frengen

Brachyterapy

4.

In brachytherapy of cervical cancer a ring applicator can be used to conduct the source to predefined positions in the patient. The source is fastened at the tip end of a wire which is guided into the hollow lumen of the ring. Because of the curvature of the ring and the stiffness of the wire the source positions will not follow exactly the centre of the lumen. It is shown that placement of the source can differ relatively much compared to a predefined position in the centre of the lumen.

The project will study the actual placement of each source position for 3 ring applicators with different diameters. Each accurate position is defined by blackening of film. Comparing of the obtained source positions with different types of similar published values should be done. Evaluation of effects of dose to target volumes and organs at risk due to shift in placement of the source from the defined mid lumen position in adequate treatment plans with ring applicators should be done. A goal is to define more accurate source positions for the ring applicators present at St. Olavs Hospital to be incorporated in the treatment planning system for future more precise dose delivery.

Supervisors: Anne Beate Langeland Marthinsen and Francisca Correas Vidaurre

Physicists connected to the Department of Radiation Therapy at the Cancer Clinic, St. Olavs Hospital:

Jomar Frengen	Jomar.Frengen@stolav.no
Sigrun Saur Almberg	Sigrun.Saur.Almberg@stolav.no
Anne Beate Langeland Marthinsen	Anne.Marthinsen@stolav.no
Francisca Correas Vidaurre	Francisca.Correas.Vidaurre@stolav.no
Signe Danielsen	Signe.Danielsen@stolav.no Head Department of Research and Education
Anne Dybdahl Wanderås	Anne.Dybdahl.Wanderas@stolav.no Head Department of Radiation Therapy