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Dosimetric evaluation of radiation bundles without flat filter in linear accelerators used in radiotherapy

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The flattening filter is a piece of metal with conical shaped mounted within the treatment head of a linear accelerator, used to produce a flat, uniform beam of X-rays from the forward-peaked distribution exiting the target. They have been used since the introduction of the linac in the 1950's, however, there are still several unresolved issues surrounding their use. The photon scatter and electron contamination introduced by modifying the fluence are difficult to model, as is the variation in energy spectrum caused by differential absorption across the field.

Leakage radiation also causes increased whole body doses to the patient, and the filter itself acts as an amplifier for beam bending and steering issues.

With advances in imaging, dose optimisation and imageguidance it is now possible to locate a tumour accurately in space and to design radiation fields conform to its shape, avoiding adjacent normal and critical tissues. This active production of non-flat fields means that the prerequisite for flat fields no longer exists, and the filter is potentially no longer a necessary component.

This thesis reports on research of two filter-free linear accelerator, from basic operation and optimisation, dosimetric characterisation and beam modelling, through to treatment planning and dose delivery. FFF beams have been shownto produce beams that are more stable, simple to model and with reduced patient leakage (leading to reduced secondary cancers). The increase in dose rate also translates into shorter treatment times for many treatments, aiding patient comfort and reducing problems associated with intra-fraction motion. during a treatment fraction.

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