

Application of efficient Monte Carlo photon beam simulations to dose calculations in voxelized human phantoms

Citation for published version (APA):

Walters, B. R. (2017). Application of efficient Monte Carlo photon beam simulations to dose calculations in voxelized human phantoms. [Doctoral Thesis, Maastricht University]. Datawyse / Universitaire Pers Maastricht. <https://doi.org/10.26481/dis.20171214bw>

Document status and date:

Published: 01/01/2017

DOI:

[10.26481/dis.20171214bw](https://doi.org/10.26481/dis.20171214bw)

Document Version:

Publisher's PDF, also known as Version of record

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.umlib.nl/taverne-license

Take down policy

If you believe that this document breaches copyright please contact us at:

repository@maastrichtuniversity.nl

providing details and we will investigate your claim.

Blake Walters

**Application of efficient Monte Carlo photon
beam simulations to dose calculations in
voxellized human phantoms**

Propositions

Be it hereby proposed...

1. With the assistance of Monte Carlo (MC) simulations in nano-scale geometries, the debate over whether dose to medium or dose to water-in-medium is a better specifier of radiobiological effect will end at last, ultimately falling on the side of dose to water-in-medium.
2. Treatment planning systems for kilovoltage beams and brachytherapy units will provide a “sliding scale” to allow the user to visualize how converted dose to water-in-medium varies with the dimensions of the cavity considered.
3. Full linac head simulations or manufacturer-supplied phase space data will be used with MC simulations in clinical treatment planning systems instead of the current parameterized beam models.
4. The steady increase in computing power will mean that routine clinical treatment planning using open source general purpose Monte Carlo algorithms becomes a reality.
5. As patents and licenses on the current fast MC algorithms in commercially available TPSs lapse, smaller companies will emerge providing their own TPS algorithms based on this newly-available software. Many of these will be web-based applications with links to a large database of radiotherapy treatment protocols.
6. Accurate and efficient treatment planning will increase the frequency of multimodality treatment protocols (*e.g.* proton + photon, or “phroton,” therapy).
7. As an alternative to Grays (Gy), radiotherapy dose will be specified in units of RBE (radiobiological effect)—phonetically pronounced “ERB” in honour of F. Herbert Attix—where 1 RBE represents 1 log decrease in the surviving fraction of cells.
8. In Magnetotherapy, electromagnetic redirection of charged particles within the patient will either: a) direct particles to multiple tumour sites during the application of a single treatment beam or b) direct charged particles away from surrounding healthy tissue.
9. Collaborations between medical physicists, radiobiologists and tumour biologists will result in targeted molecules that: a) increase malignant cell sensitivity to ionizing radiation and/or b) result in a DNA-level protection of healthy cells against radiation.
10. The increased frequency of multidisciplinary collaborations will lead to patient-centred holistic approaches to cancer treatment that include not only advanced treatment technology but also optimizing psychosocial factors influencing patient response to therapy.
11. Monte Carlo algorithms will be employed to predict cosmic phenomena, such as asteroid near-misses with Earth.