Monte Carlo Dose Calculation and Review of AAPM Tg-157 AAPM 2018: SAM Session

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Outline: Lecture 1 (MC basics)

A. Introduction to the Monte Carlo Method as applied to radiation transport:

       - Photon transport and analog physics and explanation of the analog transport approach

       - Electron transport, explanation of the condensed history technique *(SAM question 1)*

B. Brief overview/example of how MC transport of radiation in medical linear accelerators is performed - (AAPM Tg-157, beam/source modeling to be covered by Charlie Ma in second lecture)

Outline: Lecture 1 (MC basics)

C. Review of methods to improve calculation speed:

      - **Efficiency enhancing techniques**

      - **Variance Reduction techniques (VRT's)**

      - **Example showing effects improper use of VRT's**

D. Review of concept of statistical uncertainties:

      - **statistical uncertainties in patient dose and dependencies on no. of histories, simulation volume (*SAM question 2*)**

      - **impact of uncertainties on point vs. volume-based dose prescriptions**

      - **impact of statistical uncertainties on dose distributions for serial and parallel organs**

Outline: Lecture 1 (MC basics)

E. Smoothing/denoising of dose distributions:

- review of the basic approaches

- impact of denoising on dose distributions

- caveats re: improper use of denoising

F. CT number to material conversions:

- review of dose-to-water, Dw and dose-to-medium, Dm and discussion of the tradeoffs

- review methods for converting Dm to Dw (*SAM question 3*)

- examples showing differences between Dm and Dw in clinical dose distributions

Outline: Lecture 2 (AAPM TG-157)

A. Brief description of the AAPM TG-157 objectives

B. Introduction to source models used in MC dose calculation
- Direct simulation *(SAM question 4)*
- Simulation-based models
- Measurement-based models

C. Review of source models in commercial TPS
- Source models for photon dose calculation
- Source models for electron dose calculation

Outline: Lecture 2 (AAPM TG-157)

D. TG-157 guidelines for acceptance testing of MC-based TPS

- Documentation and functionality
- Dosimetry, safety checks & alignment tests *(SAM question 5)*
- Speed benchmarks and statistical tests

E. TG-157 recommendations on methods and practical procedures to commission source models for MC-based TPS

- Recommendations for MC-based TPS users *(SAM question 6)*
- Measurements and tolerances for MC-based TPS
- Guidelines for measurement, calculation and comparison procedures
- Recommendations for MC-based TPS vendors