

**Purpose:** Dose calculation is one of the core functions in Treatment Planning System (TPS). Finite-Size Pencil Beam(FSPB) method is used in the clinic TPS widely, with the need of calculated time and inverse plan design. Yet the results of the traditional FSPB method may disagree with the practical situation due to lack of practical information of a given medical accelerator such as energy spectra and fluence.

**Methods:** This study mainly focused on the shortage of traditional FSPB method, developing a new photon dose calculation based on the Monte Carlo Finite Size Pencil Beam (MCFSPB) in the Advanced/Accurate Radiotherapy System (ARTS). Based on the MC simulation and the technology of medical accelerator energy spectrum reconstruction, a new pencil beam kernel model was constructed. In the condition of the filter's influence, fluence reconstruction was also a part of MCFSPB model. With the convolution of fluence and MCFSPB kernel, energy deposition of body (or phantom) would be known.

**Results:** Based on the above studies, we designed the MCFSPB method and implemented it with the visual c++ development tool. With several tests including the comparison among the AAPM55 Report sample, the results showed that the average error in the field size was less than 0.5% in the homogeneous phantom and less than 2% in the heterogeneous phantom.

**Conclusions:** This method met the clinical criteria, and would be expected to be used as a fast and accurate dose calculation engine for clinic TPS.

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