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Introducing a Method to Use an Electrometer's Time-Series Data Logger to Measure a Beam Profile Efficiently

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Abstract

Objectives:

This study is to establish a method to measure beam profiles (position series data) efficiently by using an electrometer's time-series data logging function.

A beam profile measuring system executes two functions: position a detector using servo-trails and log charge using an electrometer. The functions can be done using a radiotherapy's patient position system and an electrometer of time-series data logging ability, respectively.

Methods:

The proposed method is illustrated by measuring a z-direction beam profile for the 4mm collimator of Gamma Knife (GK). The setup: a GK Daily QA Tool Plus detector was positioned by the GK table. An electrometer with sampling rate at 0.5 sec was the time-series data logger. The data logger was turned on, then the detector was programed to dwell 6 sec at each of the 37 positions ranging from 91 mm to 109 mm with 0.5 mm each step. A MATLAB algorithm identified the 37 groups of data, averaged each group to be 37 points which corresponds to the 37 positions in space, therefore obtained a beam profile.

Results:

A beam profile of 37 points over 18 mm range was obtained. The profile features of FWHM and 20% -80% penumbra were calculated using a spline interpolation method. The results of 5.01 mm and 2.50 mm were within the tolerance comparing with the reference data.

The method is efficient that the data collection took less than 4 min and the data processing took less than 30 sec on an i7 PC. The instant result is very significant when the time is limited.

Conclusion(s):

We have demonstrated that an relatively inexpensive electrometer of timeseries time-series logging can be used to measure a beam profile efficiently.