A Centralized Dose Calculation System for Radiation Therapy

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Centralization of treatment planning in a radiation therapy department is a realistic strategy to achieve an integrated and quality-controlled planning system, especially for institutions with numerous affiliations. The rapid evolution of computer hardware and software technology makes this a distinct possibility. However, the procedure of three-dimensional treatment planning involves a number of steps, such as: (1) input of patient computed tomography (CT) images and contour information; (2) interactions with local devices such as a film digitizer; and (3) output of beam information to be integrated with the record and verify the system. A full-fledged realization of the web-based centralized three-dimensional treatment planning system will require an extensive commercial development effort. We have developed and incorporated a web-based Timer/Monitor Unit (MU) program as a first step towards the full implementation of a centralized treatment planning system. The software application was developed in JAVA language. It uses the internet server and client technology. With one server that can handle multiple threads, it is a simple process to access the application anywhere on the network with an internet browser. Both the essential data needed for the calculation and the results are stored on the server, which centralizes the maintenance of the software and the storage of patient information.

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CURRENT ADVANCES in computing software and hardware, especially the rapidly evolving internet technology, offer the opportunity to centralize the planning of radiation therapy treatments. Each individual treatment planning system has its unique requirements for the physical parameters and stores information in different formats. This makes software maintenance and patient information maintenance across all the facilities of the institution a formidable task.

Centralization of treatment planning seems to be the solution to these difficulties and inconveniences. To address these problems, we have developed a web-based Timer/Monitor Unit (MU) calculation program.

MATERIALS AND METHODS

A Timer/MU calculation program is used in radiation therapy departments to calculate the monitor units needed to deliver the prescribed dose to certain geometry with a regular-shaped beam opening. Many different systems and quantities are available for meter-set calculations for photon

Fig 1. Software package flow chart.

beams. The one used here is the standard tissue-air ratio (TAR) method. TAR is defined as:

$$TAR(d,s) = D_w(d,s)/D_A(c),$$

where $D_w(d,s)$ stands for dose measured in water, while $D_A(c)$ is for dose measured in air.

The calculation of the treatment time used the formula¹:

$$D_T = TAR(d,s) \times OF_A(c) \times Const,$$

where $OF_A(c)$ is the head scatter factor measured in air and $Const$ is the constant to account for calibration configuration.

The software package is a web-based application written in JAVA.² It consists of two major components: server and client.

The server component of the software is designed to be multithreading (handle multiple clients simultaneously). The software engine is customized to use the verified data for all beam energies

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PHOTON MU CALCULATION SHEET

PATIENT NAME: Sample
MR NUMBER: 123456
TREATMENT SITE: test

	Field 1	Field 2	Field 3	Field 4
FIELD NAME	AP	PA	LTLAT	RTLAT
PRESCRIPTION DOSE/FIELD (cGy)	100	100	100	100
MACHINE/ENERGY (MV)	6A	6A	6A	6A
FIELD LENGTH (CM)	20	25	30	30
FIELD WIDTH (CM)	20	15	14	16
SSD (CM)	90	95	92	95
DEPTH (CM)	10	15	8	5
TRAY	Yes	Yes	Yes	Yes
OTHER	1.0	1.0	1.0	1.0
MU	116.5	138.5	111.1	100.4

SIGNATURES:

THERAPIST _____ PHYSICIAN _____ PHYSICIST _____

Fig 2. Sample user interface and report.

used for the current treatment planning system. The flow chart of the package is shown in Fig 1.

The client component is actually a multitab JAVA applet user interface. Input information is gathered from user and the server is contacted for the beam data needed for the calculation. The beam data is then transferred to the client side and stored so that no further transfer of data is needed for the same beam/energy. A report containing the calculation result and the patient information is then generated in HTML format. The digital data of the report is stored in a designated directory on the server and a hard copy of which can be made on the printer associated with the computer that the client is running on.

Once the server is installed and ready, the client

software can be used on any computer on the network with an internet browser. There is no need for software maintenance on the client side. The beam data and treatment record are maintained at one central location. The maintenance of the software package, including verification of the dose calculation algorithm, is performed on the server only.

RESULTS AND DISCUSSION

The software package has been tested and released for clinical use. One server is setup to run continuously. A backup server is going to be implemented in case the main server fails. A typical user input page and a printable report are illustrated in Fig 2.

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