Development of a QA Software Tool for Automatic Verification of Plan Data Transfer and Delivery

Using Microsoft Visual C++, together with open database connectivity (ODBC) and structured query language (SQL), we developed a quality assurance (QA) software tool capable of automatically verifying (1) the treatment data transfer from treatment planning system (TPS) to the record and verification system (R&V), (2) the monitor units (MU) with an independent MU calculation program prior to the treatment delivery, and (3) the accuracy of treatment delivery.

The QA tool extracts the treatment data such as gantry angle, collimator angle and couch positions, multi-leaf-collimator (MLC) leaf positions, and MU numbers etc, from the TPS and the R&V system via a certain manner. From the TPS, the QA tool can read treatment plan parameters from RTP and/or DICOM files that are exported from the TPS (Xio, CMS/Elekta, or RealART, Prowess). Based on the exported DICOM plan file, an independent MU calculation is performed utilizing the modified Clarkson integration (MCI) algorithm. The calculated MU for each individual beam is then compared with that from the TPS. On the other hand, from the R&V (Mosaic, Elekta) system database, the QA tool retrieves those treatment parameters, for both imported from the TPS and recorded from the treatment machine, via ODBC connection and SQL queries. The data from aforementioned two systems were then compared to verify the consistency between the TPS and the R&V system. The data from the R&V system itself was also used to check the accuracy of the treatment delivery.

The QA tool was tested to be fully functional with 3D and IMRT plans from regular treatments. The main graphic user interface (GUI) for the tool is shown in Figure 1A. Illustrations of independent MU calculation, treatment parameter transfer consistency verification and treatment delivery accuracy check are shown in Figure 1B, C and D, respectively. Twenty patients were QA’ed with this software. Reported plan data inconsistencies and large MU discrepancies were traced before treatments were delivered. With quite a lot within-tolerance discrepancies being identified, no significant treatment delivery deviation from plan was found, consistent with our weekly chart check for these patients. The pre-treatment and the weekly chart check QA procedures each takes less than one minute. The utilization of the QA software saves a lot of time as compared to visual inspection and some necessary manual modifications.

The tool is essential for online adaptive planning, and also can speed up the plan data transfer verification and chart check process for regular treatments. Furthermore, the tool eliminates human error inevitable during a visual inspection of tremendous data, and therefore, improves patient safety in radiation oncology.

Figure 1. A. The main GUI of the QA software. B. Illustration of independent MU calculation. C. Verification of treatment parameter transfer. D. Verification of treatment delivery accuracy.