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Field Size Factor test for a Treatment Planning System in Hadrontherapy

Hadrontherapy is a promising approach to tumor treatment which uses ion beams (in particular protons and carbon ions) instead of gamma rays as in standard radiotherapy. The main advantage of this technique is that high energy ions release dose along the longitudinal direction with the tipical Bragg Peak (BP), and this allows to reduce the dose to healty tissues an consequently to concentrate it to the cancer. In this context it is very important to choose the right beam energy, and so the BP position, and direction in order to optimize the rate of dose to tumor over the dose to normal tissues. Treatment Planning Systems (TPS) are softwares that compute the main beam parameters (energy, position, direction, etc.) for optimal dose delivery, taking into account the patient morphology obtained for instance from computed tomography scans. Nowadays commercial TPS used in clinical pratice demand for large computational resources and require significant time for a complete calculation. A faster tool would be important for recalculating the dose delivery plan on the day of the treatment. To solve this problem without compromising the accuracy, a fast Monte Carlo TPS on GPU (Graphics Processing Units) has been developed. To check the numerical implementation of Multiple Coulomb Scattering (MCS) model, and the beam lateral dose profiles, a test called Field Size Factor has been used. The test consists of two different trials, both of them have the same setup: a water phantom with a small cylindrical PTW Markus chamber (0.02 cm^3) placed at variable depths. By studying the current response of the Markus information on the deposited dose can be obtained. By varying the position with respect to the chamber and the number of beams, it is possible to study the lateral dose profile and the contribution due to tails in the MCS distribution.
The experimental tests have been performed at Centro Nazionale di Adroterapia Oncologica (CNAO, Pavia) and then the experimental data have been compared to the simulated dose profiles.
The results of Field Size Factor test for different configurations (beam energy and depth) will be presented.

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