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Deep Learning methods for 3D in-vivo dose reconstruction with EPID detector

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In the past few years, Electronic Portal Imaging Device (EPID) have gained prominence for pre-treatment dose verification and real-time monitoring in radiotherapy. These detectors function by recording the X-ray fluence on a pixel-based surface to produce a two-dimensional digital image. Their rapid image capturing ability, high resolution, good linear dose response, and long-term stability make them advantageous. Nevertheless, utilizing EPIDs necessitates the modeling of their response to estimate the two-dimensional dose distribution, known as Portal Dose (PD). This modeling is crucial to compare the predicted and measured PD and to verify whether an error occurred during treatment. Traditional EPID response modeling is based on physical models and Monte Carlo techniques. However, these methods are complex and time-consuming, involving linac geometry, EPID structure details, and several preprocessing steps like sensitivity matrix adjustment, dose response calibration, and EPID scatter correction, making them impractical for widespread clinical use.
Recently, the evolution of hardware has led to significant advancements in Deep Learning (DL), presenting a potentially useful tool for modeling the EPID response. In this research, we are developing a DL-based methodology, employing a trained U-net architecture, to convert the actual EPID responses (captured as greyscale images) into PD images (in dose Gray values). Our current database is composed of several hundred EPID images collected from irradiation of various phantoms, together with a corresponding set of PD images generated by means of the clinic Treatment Plan System. Finally, comparison techniques are being developed to compare the measured and predicted PD, using metrics like the global gamma-index analyses.
In this presentation we present the goals, status, and preliminary results of the DL model, focusing on recent data acquisitions carried out at the Careggi hospital in Florence.

Collaboration

InTrEPID - ARTEMIS

Role of Submitter

I am the presenter

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