Adaptive Inverse Planning with Consideration of MLC Field Size Constraint

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Inverse planning starts with a treatment objective and obtains the solution by optimizing an objective function. The MLC hardware limitations are usually not considered in the optimization process. One of these limitations is the maximum MLC field size without cartridge movement. Currently, this is limited to 14.5cm for Varian accelerators. Other vendors have similar constraints. To treat a large tumor using IMRT, it is required to divide the field into two or more sub-fields and deliver them separately. To overcome this problem, an adaptive optimization algorithm which incorporates the MLC hardware constraint is developed. Although it is impossible to have a set of completely independent beamlets over the entire field, it is feasible to separate the field into two or three regions. One of them has a filed width ~14.5cm, in which the beamlet weights are completely independent. The intensity of the remaining sub-field(s) is modulated in a monotonic fashion toward the field edge(s). The overall intensity profile becomes deliverable without cartridge movement. An iterative algorithm is used to generate the intensity profile. The profile is converted to the leaf sequences with a "step-and-shoot" approach. The plans are compared to that without considering the MLC field size limitation. In many cases, the results are comparable or only slightly worse depending on the number of beams, indicating that the approach may have some clinical impact.