AbstractID: 6925 Title: A high MU efficiency dynamic MLC leaf sequencing algorithm

Purpose: MU efficiency is a major figure of merit for dMLC leaf sequencing. However, leaf sequencing is often generated with focus on other constraints and the MU efficiency is taken as a byproduct. This work is to develop a new dMLC leaf sequencing algorithm (MinMU) that explicitly minimize the total MU.

Method & Materials:
At a constant dose rate, the maximum MU efficiency is achieved by minimizing, through optimization, an objective function which is essentially the total beam on time. The constraints considered are: maximum leaf speed, maximum separation between leaves and under dosing caused by tongue-and-groove effect. These mixed integer constraints are converted to linear ones by enumerating and eliminating redundant scenarios, for a given intensity map. These steps also help eliminating the infeasible solutions. The optimization was implemented for the Varian Millenium 120-leaf MLC and was solved with the CPLEX software. Its performance was tested against published algorithms using phantom and real patient treatment fluence maps.

Results:
The fluence maps in the phantom study were generated with various grid sizes. The MU increases at a much slower rate for the MinMU algorithm than for the published algorithms with finer grid size. The MU efficiency advantage of the MinMU is more pronounced for more complex and larger fluences.

Among the 18 fluence maps that were taken from two real head-and-neck cancer treatment plans, the MinMU algoithm uses more MU for 2 fluence maps, same MU for 2, and less MU for the rest 14 fluence maps than the commercial treatment planning software. Overall, the MinMU used 10% and 7% less MU for the two plans, respectively. Also, the MinMU reproduced the original optimal fluence with minimal difference.

Conclusion: A new dMLC leaf sequencing algorithm is developed. Its high MU efficiency potential is demonstrated.