Purpose: Target tracking using DMLC is a promising approach for intrafraction motion management in radiation therapy. The purpose of this work is to develop a DMLC tracking algorithm capable of delivering VMAT to the targets that experience 2D rigid motion in the beam's eye view.

Methods: The problem of VMAT delivery to moving targets is formulated as a control problem with constraints. The relationships between gantry speed, gantry acceleration, MLC leaf-velocity, dose rate, and target motion are derived. An iterative search algorithm is developed to find solutions for efficient delivery of a specific VMAT plan to the moving target using. The delivery of five VMAT lung plans is simulated. The planned and delivered fluence maps are calculated and compared.

Results: The simulation demonstrates that the 2D tracking algorithm is capable of delivering the VMAT plan to a moving target fast and accurately without violating the machine constraints and the plan integrity. The average delivery time is only 30 seconds longer than that of no-tracking delivery, 95.6 s versus 66 s. The fluence maps are normalized to 200 MU and the average RMS error between the desired and the delivered fluence is 2.1 MU, compared to 14.8 MU for no-tracking and 3.6 MU for 1D tracking.

Conclusions: An optimal MLC tracking algorithm for VMAT delivery is proposed aiming at shortest delivery time while maintaining treatment plan invariant. The inconsequential increase of treatment time due to DMLC tracking is clinically desirable, which makes VMAT with DMLC tracking attractive in treating moving tumors.