AbstractID: 4783 Title: Optimized Removal of the Tongue-and-Groove Underdose via Constrained Partial Synchronization and Variable Depth Recursion

Purpose:
IMRT leaf sequencers that remove tongue-and-groove underdosages (TGU) significantly increase the number of segments by using full synchronization (FS). This work aims to minimize the increase in the number of segments by using Constrained Partial Synchronization (CPS) and Variable Depth Recursion (VDR).

Method and Materials:
Adjacent leaves simultaneously expose cells in an intensity map to deliver Vs, determined by cell values V0 and V1 (V0 <= V1). The tongue-and-groove ratio, TGR, is (V1-Vs)/(V0-Vs). In FS, TGR = infinity, while for CPS it is constrained to be greater than the minimum required to remove TGUs. The TGU for various TGRs were measured with film to determine this minimum TGR. The extraction and sweep leaf sequencing processes used in VDR optimization were modified to use CPS. The algorithm was tested on 1400 random maps (3 to 16 levels) and 42 clinical maps.

Results:
For a Siemens MLC, the TGUs are 18%, 4%, and 0, for TGRs of 1, 1.5, and 2, respectively. For the clinical cases, the average increase in the number of segments relative to VDR with no synchronization was 7% for TGR=1.5, and 32% for VDR with FS. A fully synchronized sweeping window produces 170% more segments. For the random maps, an unsynchronized sweeping window produced 1.5 to 2.5 times as many segments as VDR with CPS. Similar results can be obtained for interdigitating MLCs. This has implications for direct aperture optimization (DAO) algorithms that use the sweeping window as a starting point (Pinnacle), for which TGU has been observed. The concept of CPS can be applied to DAO algorithms, by choosing appropriate levels for each segment.

Conclusion:
CPS combined with VDR removes the tongue-and-groove underdose while minimizing the number of segments.