AbstractID: 10701 Title: Use of the adjoint analysis based Greedy Heuristic algorithms in treatment planning for LDR brachytherapy of the prostate and HDR brachytherapy using multicatheter breast implant technique.

Purpose: To demonstrate use of the adjoint analysis based Greedy Heuristic (GH) algorithms in treatment planning for LDR brachytherapy of the prostate using directional sources and multicatheter-HDR breast implant. **Method and Materials:** Two adjoint analysis based GH treatment planning tools are developed; The first, for a directional LDR brachytherapy application and the second, for a HDR-multicatheter brachytherapy application. Both the problems have an extra degree of freedom compared with conventional, binary LDR treatment planning – the seed rotational orientation in directional LDR brachytherapy and the variable dwell-time in HDR brachytherapy. The greedy heuristic treatment planning algorithm uses adjoint-based ROI-sensitivity-fields to search for the best available source type and orientation, or dwell time increment at a source-location in steps to build either a seed-needle-source-orientation distribution or dwell-location-dwell-time distribution solution non-iteratively. The GH treatment planning for LDR technique is based on dose-distribution optimization and that for HDR technique is based on dose-homogeneity optimization. **Results:** The treatment plans generated by the greedy heuristic algorithm using the directional sources resulted in target coverage with V100 >98% and remarkably better OAR-sparing owing to the directional dose properties of the sources, as seen from the DVH analysis and evaluation parameters comparison on 6 prostate cases when compared with conventional LDR-brachytherapy. The multicatheter-HDR brachytherapy dwell-time optimization generated treatment plan with a target coverage V100 >96%, skin-sparing (D85=4.5%), few hot-spots and a dose homogeneity index of 0.82. **Conclusion:** Greedy Heuristic algorithms coupled with greedy criterions based on ROI-sensitivity fields of dose response and dose-homogeneity response are utilized as efficient tools for fast and reproducible treatment planning solutions in LDR and HDR brachytherapy.