A Novel Prior-Knowledge-Based Optimization Algorithm for Automatic Treatment Planning and Adaptive Radiotherapy Re-planning

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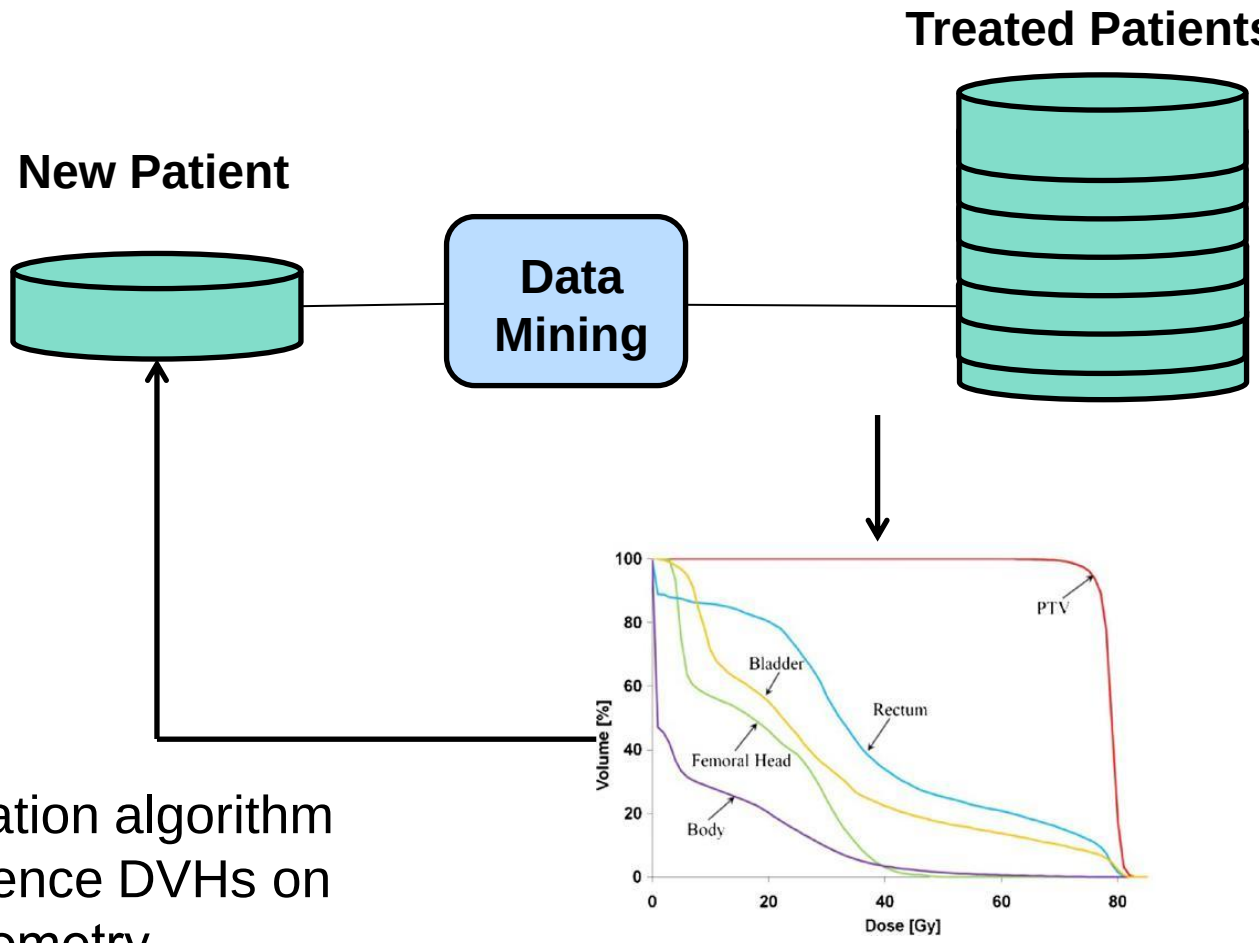
Automatic Treatment Planning



- We need an optimization algorithm to replicate the reference DVHs on the new patient's geometry.

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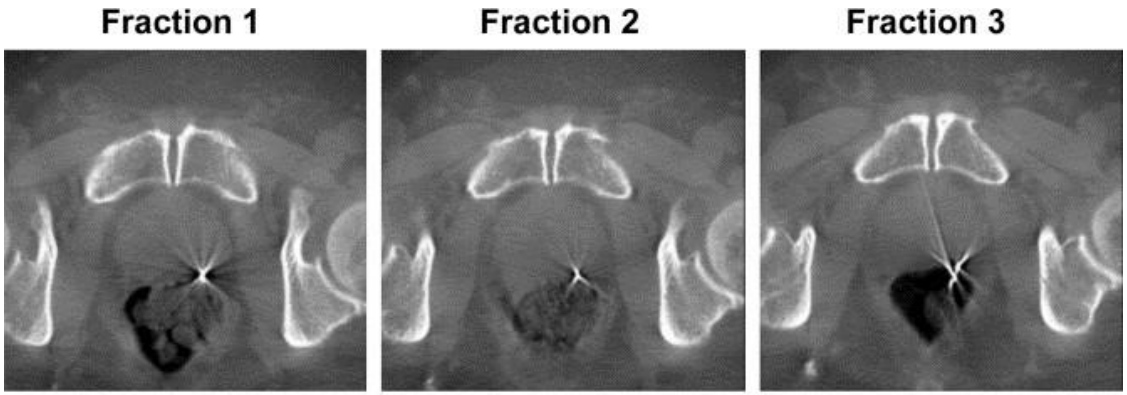
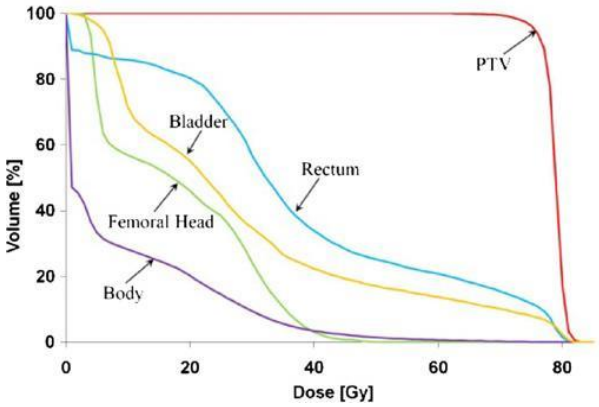
Adaptive Radiotherapy Re-Planning

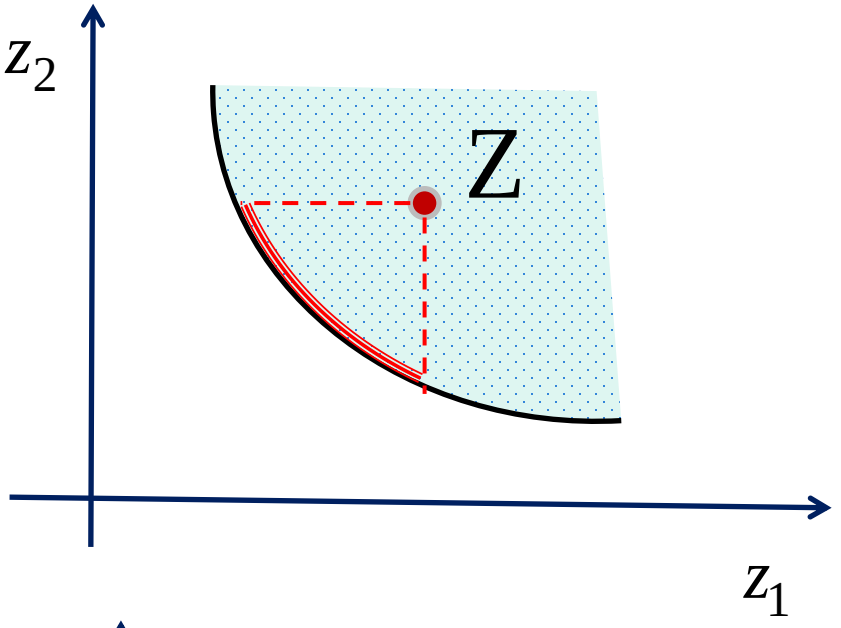




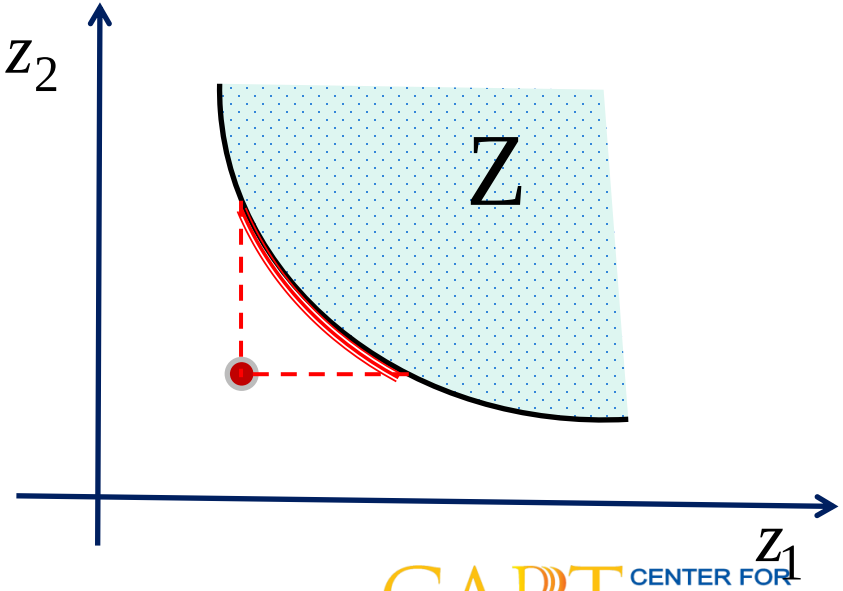
- We need an optimization algorithm to replicate the reference DVHs on the patient's new geometry.

Projection On the Pareto Surface

1- Reference DVHs are easy to be generated on the new geometry.



2- Reference DVHs are difficult to be generated on the new geometry.



Voxel-Based VS Organ-Based Model

Organ-Based Model:

$$\min_{x \geq 0} \sum_{\sigma \in S} w^{\sigma} G^{\sigma}(D^{\sigma} x)$$

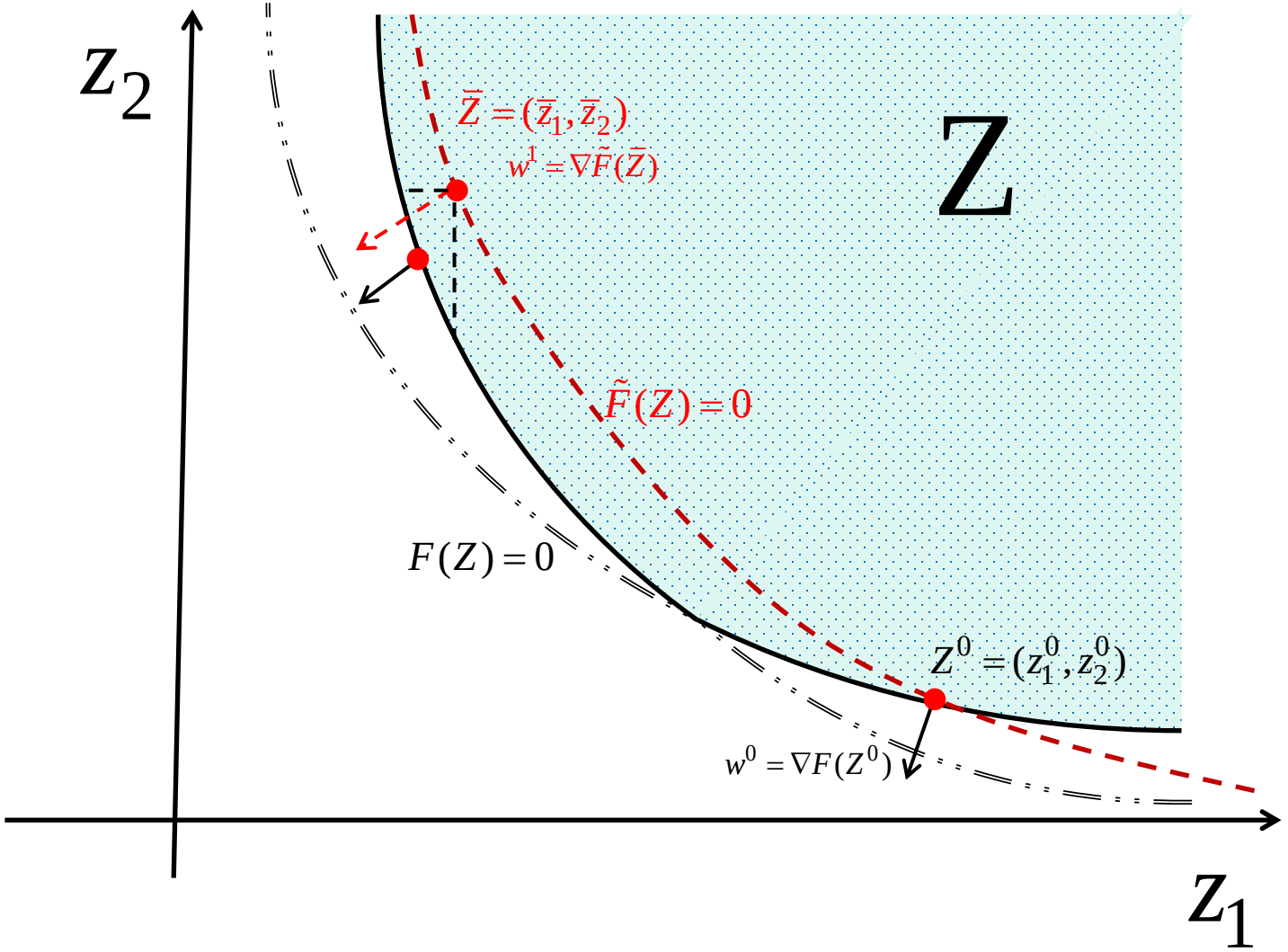
Voxel-Based Model:

$$\min_{x \geq 0} \sum_{\sigma \in S} \sum_{j \in v_{\sigma}} w_j F_j \ (D_j x)$$

- Organ-based model relies on the appropriate choice of the objective function.
- A larger Pareto surface is explored by the voxel-based model, possibly leading to a plan with better trade-offs.
- How to adjust the voxel weights

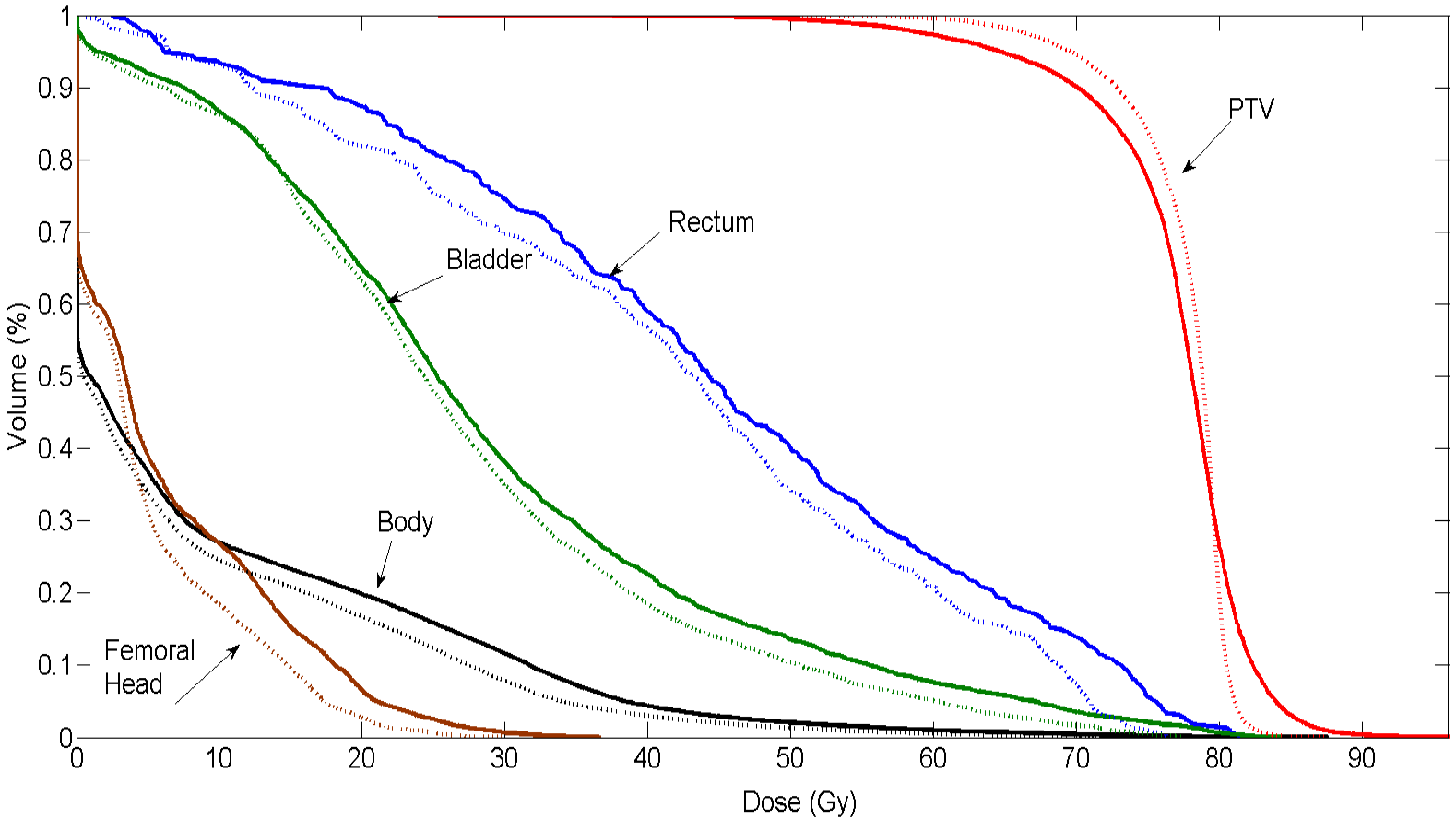
Projection On the Pareto Surface

$$\min_{x \geq 0} \sum_{\sigma \in S} \sum_{j \in \nu_\sigma} w_j (D_j x - p_j)^2$$



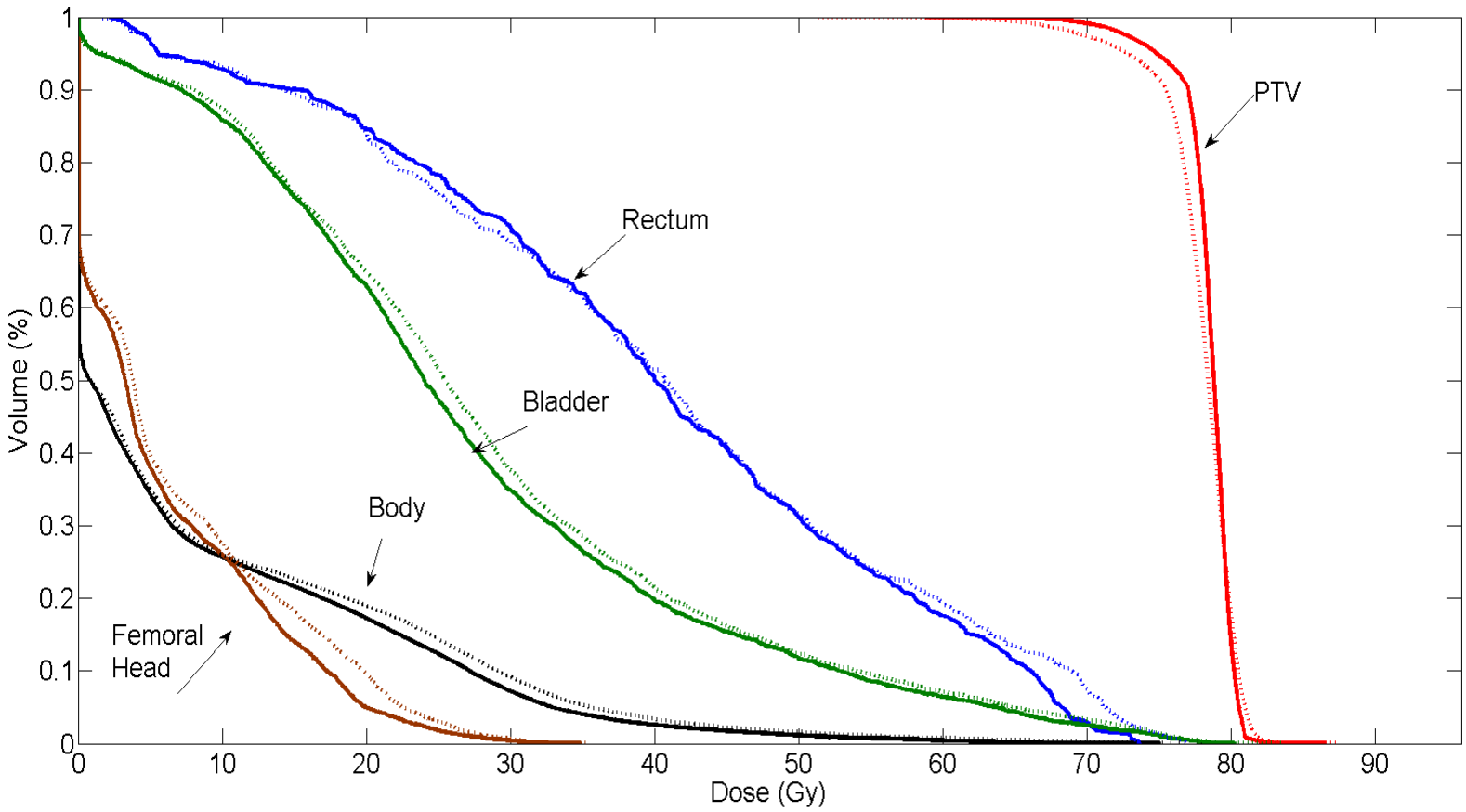
A Prostate Case to Verify the Algorithm

Solid: Reference DVHs (*inside the feasible region*)
Dashed: Our Algorithm's Result



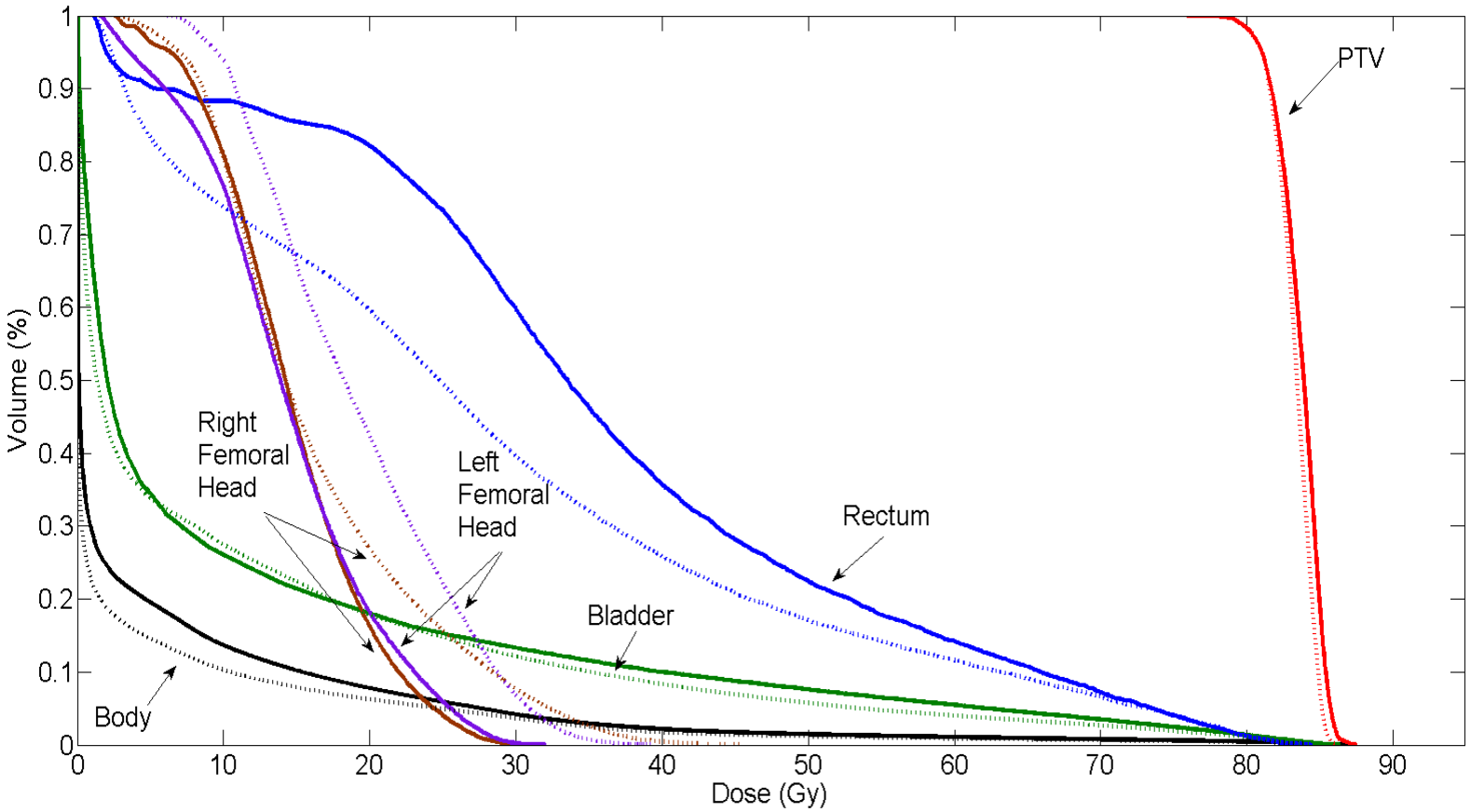
A Prostate Case to Verify the Algorithm

Solid: Reference DVHs (outside *the feasible region*)
Dashed: Our Algorithm's Result



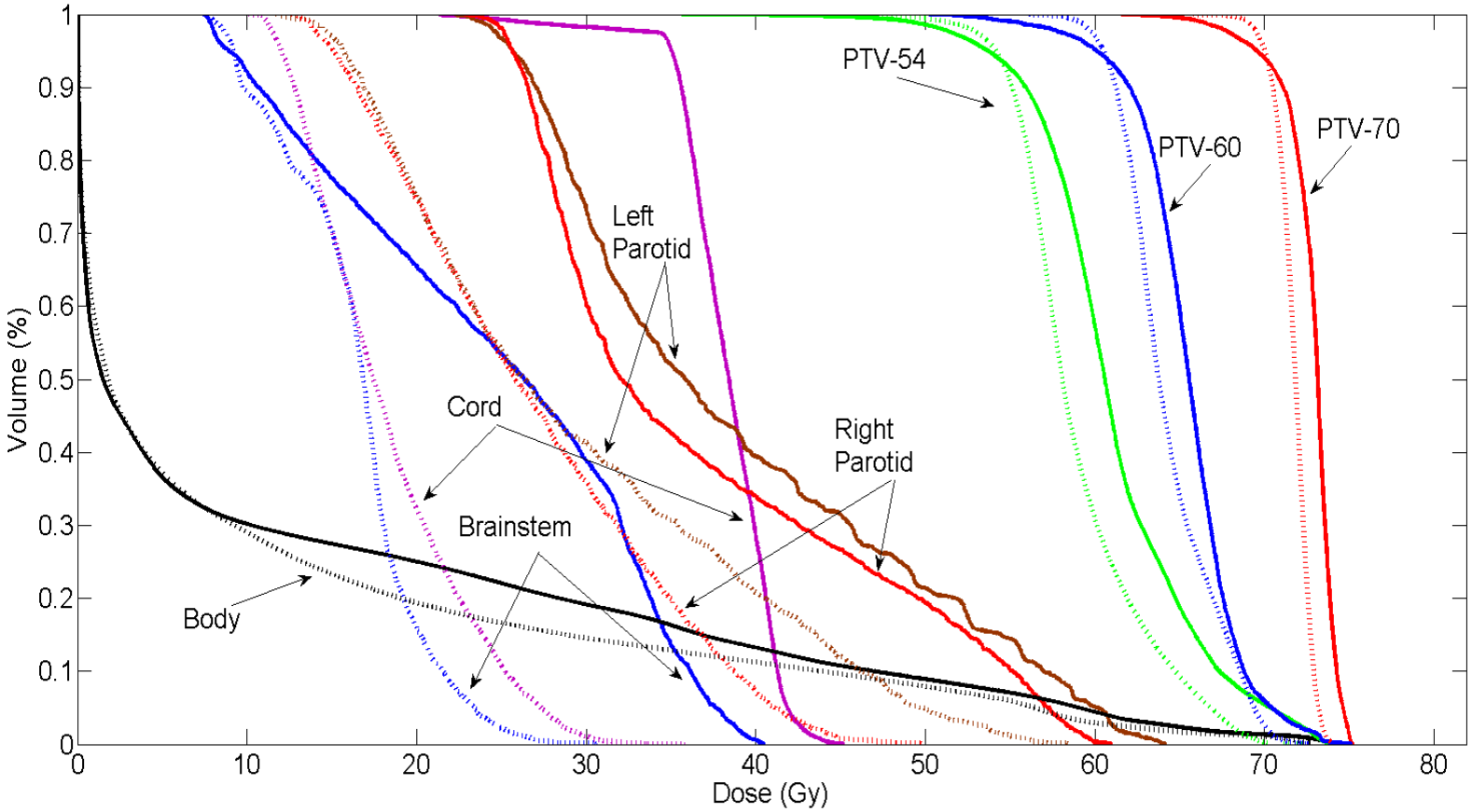
Automatic Treatment Planning

Solid: Plan that patient has been treated with
Dashed: Our Algorithm's Result



Adaptive Radiotherapy Re-Planning

Solid: Original plan on the patient's new geometry
Dashed: Our Algorithm's Result



Conclusions

1- Automatic voxel weight adjustment.

2- Automatic treatment planning and adaptive radiotherapy re-planning.

3- If the automated plan is not satisfactory, we can do interactive treatment planning process.

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4- Clinical studies on GYN, pancreas, prostate and head and neck patients using the proposed algorithm.

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Ting Song, SU-E-T-718 Sunday

Nan Li, SU-E-T-652 Sunday

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