Assessment tool to quantify and visualize treatment plan robustness regarding patient setup

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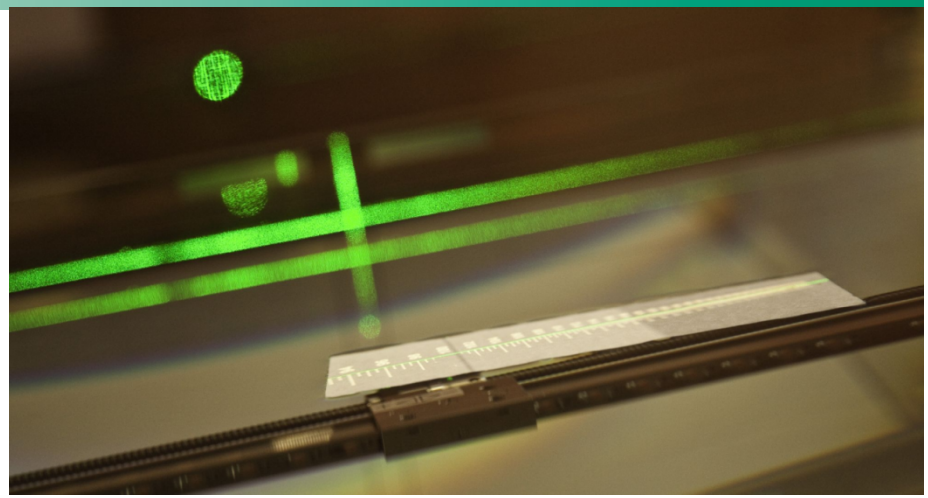

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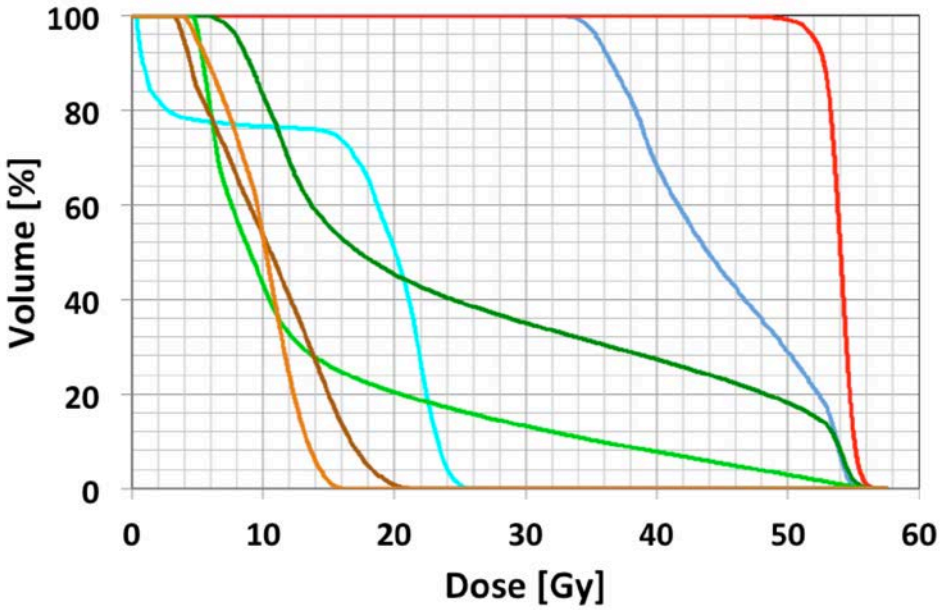
Introduction

- Currently treatment plan evaluation is based on isodose lines and dose volume histogram parameters

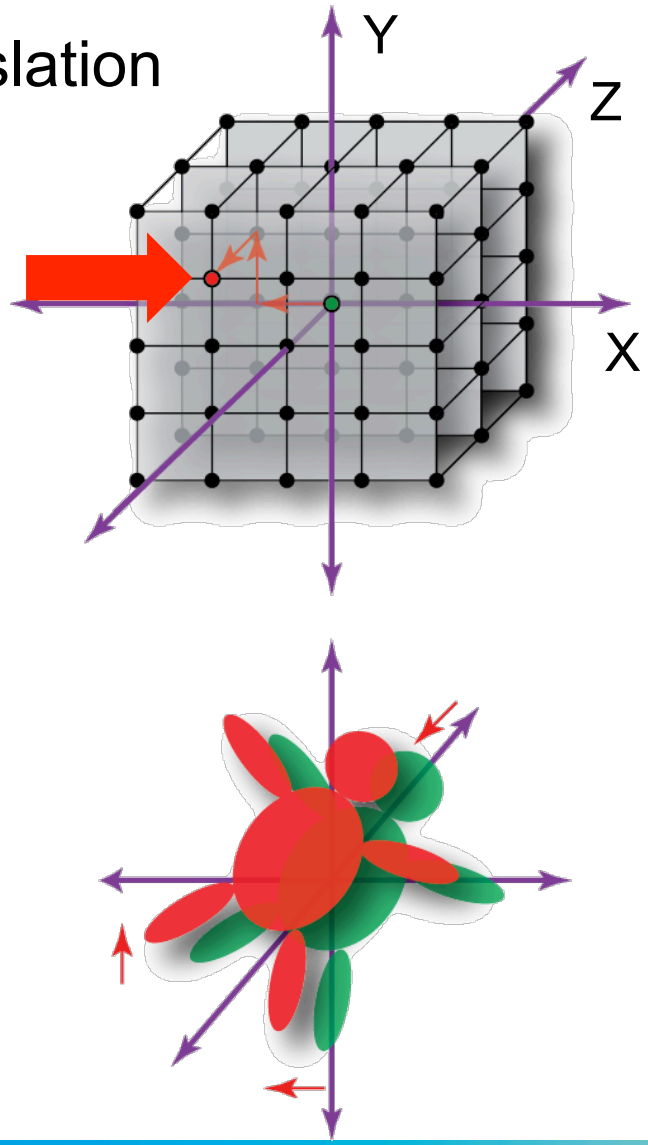


Introduction

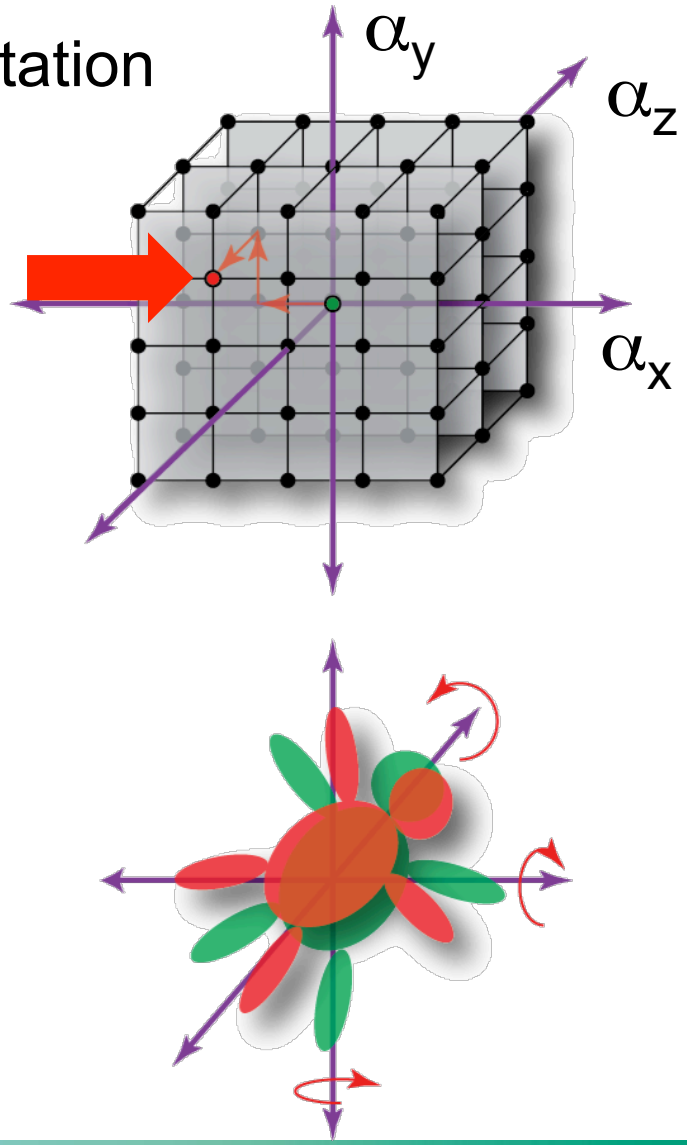
- Currently treatment plan evaluation is based on isodose lines and dose volume histogram parameters
- Generally, robustness is not taken into account in this evaluation process
- This work investigates the treatment plan robustness due to systematic and random setup errors and aims in a tool to quantify and visualize them

Systematic Setup Error

Translation



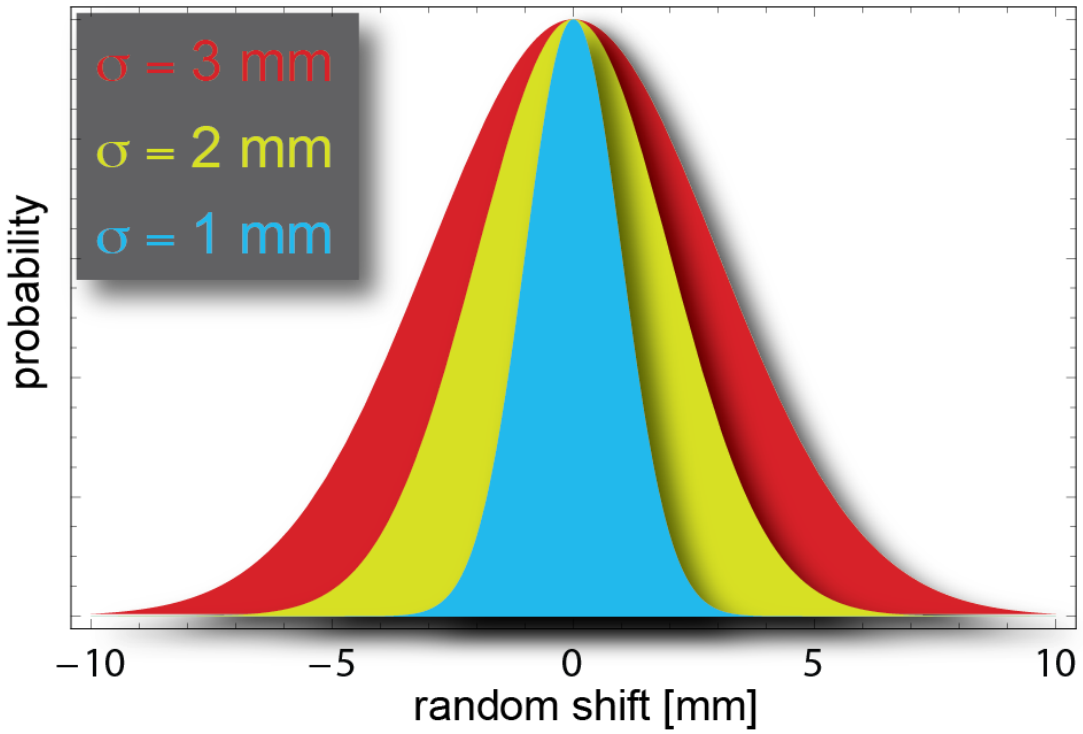
Rotation



Random Setup Error

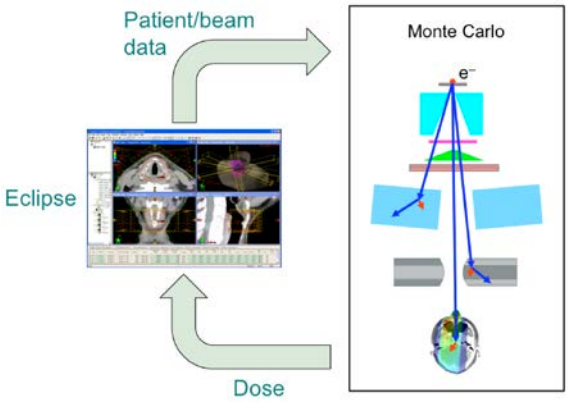
3D Gaussian error distribution

σ_1 = (1 mm, 1 mm, 1 mm)
σ_2 = (2 mm, 2 mm, 2 mm)
σ_3 = (3 mm, 3 mm, 3 mm)



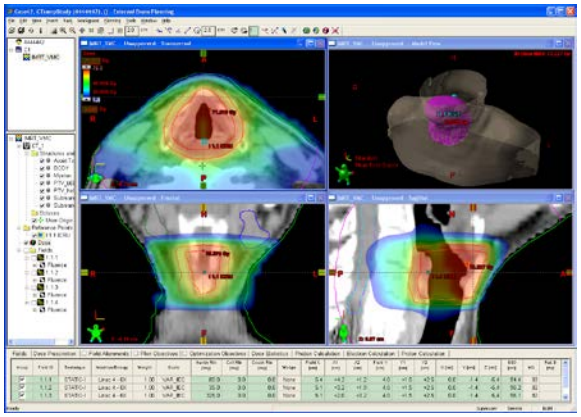
Swiss Monte Carlo Plan (SMCP) Structure

- SMCP is interfaced to a commercial treatment planning system



- No need for cumbersome handling of scripts or processes due to automation and graphical user interface

- Benefits of a commercial TPS are available (contouring, beam arrangement, evaluation, documentation, backup, etc.)

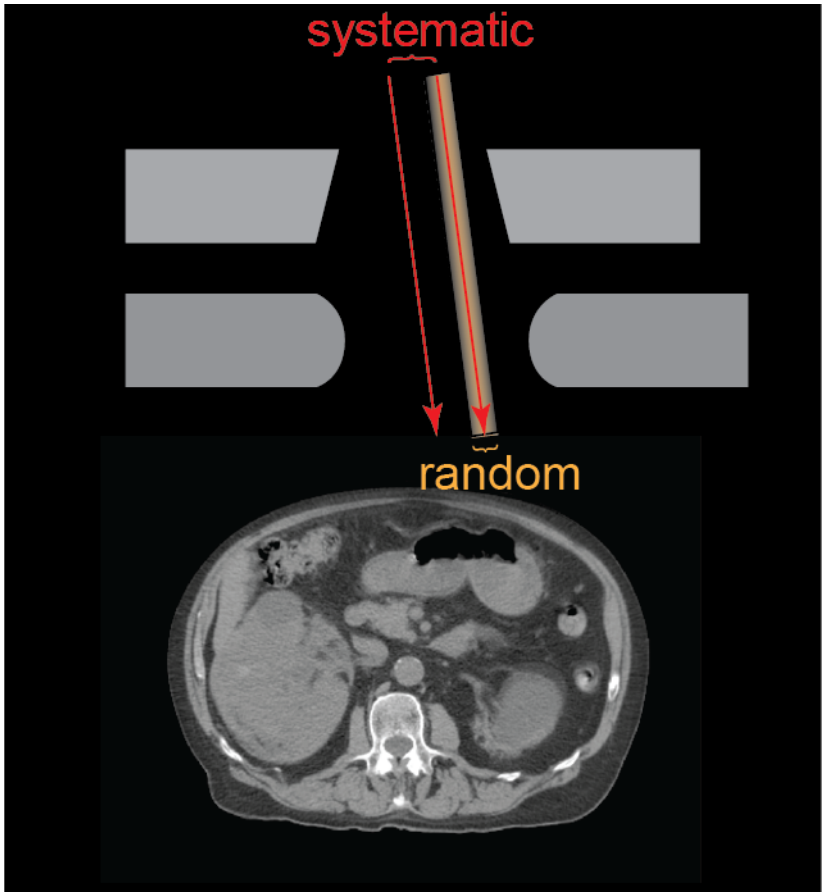


Fix et al., PMB 52 (19) 2007

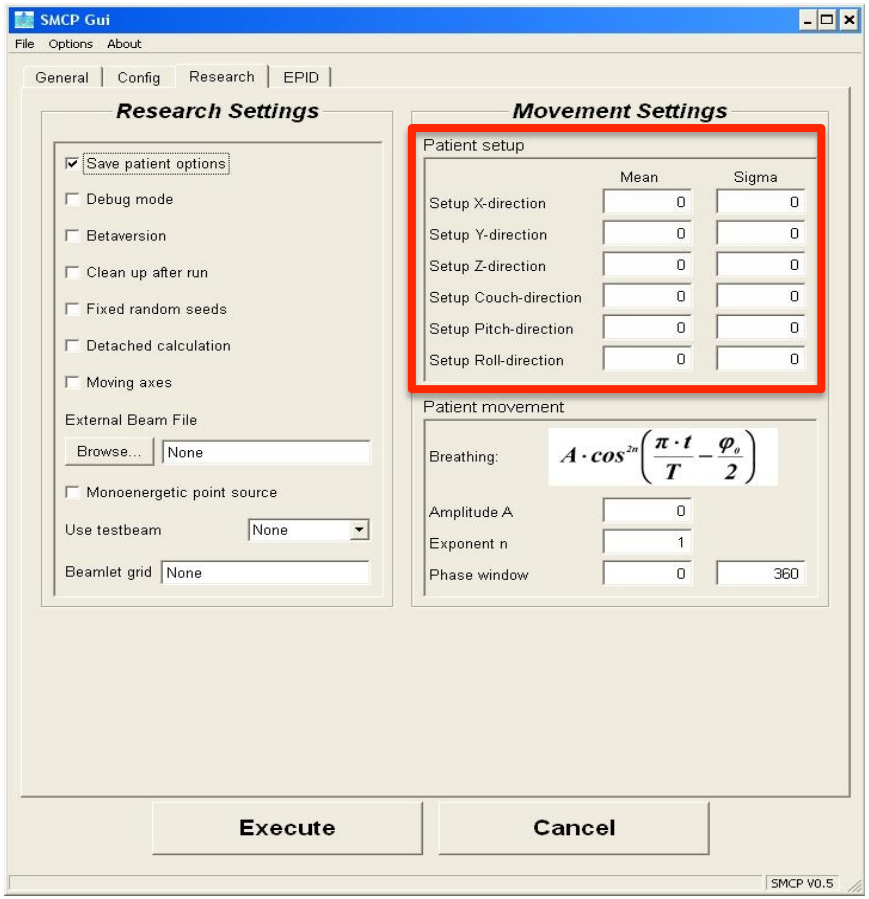
Swiss Monte Carlo Plan Extension

Patient setup errors in SMCP

Particle transformations

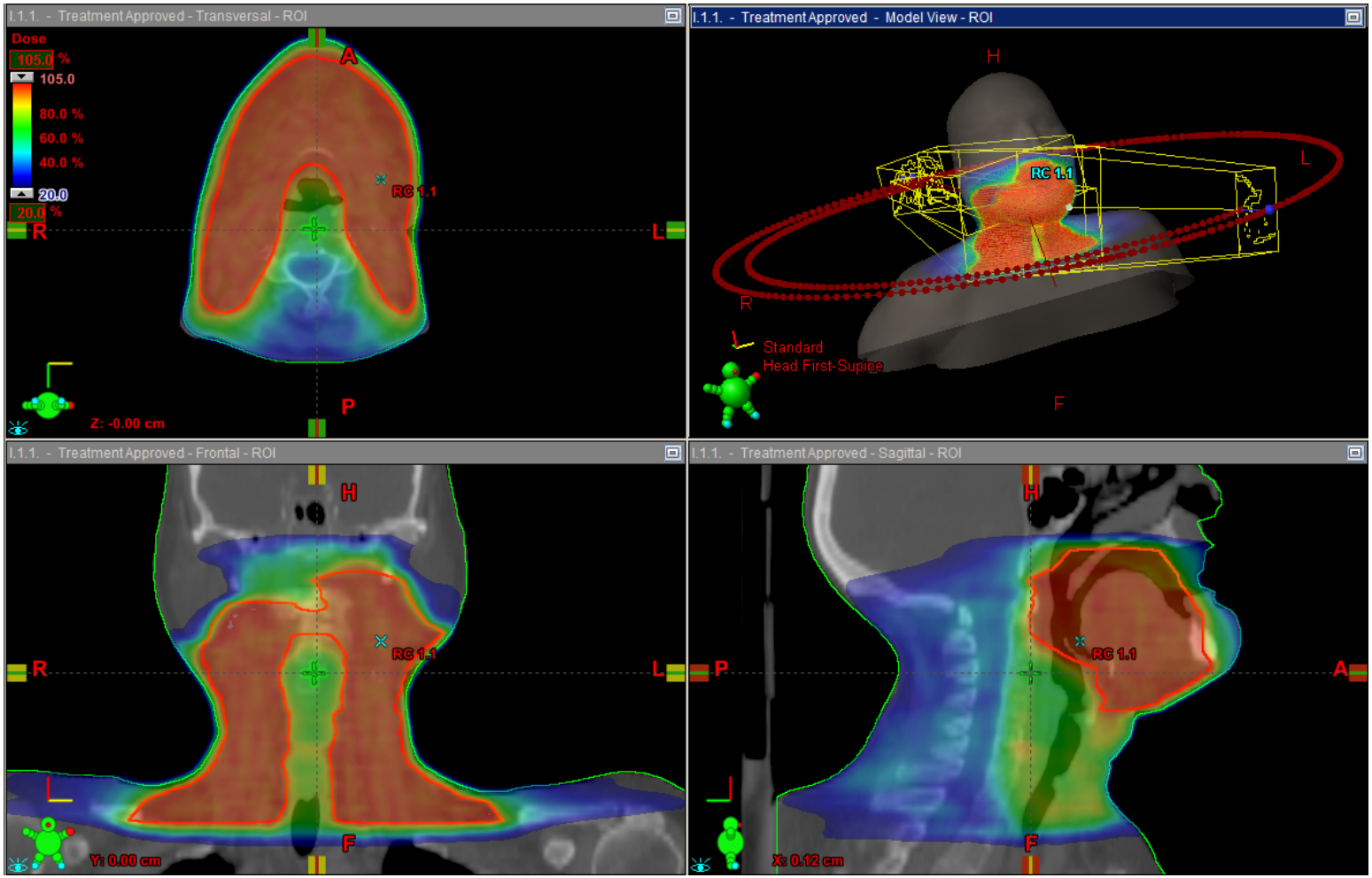


SMCP user interface



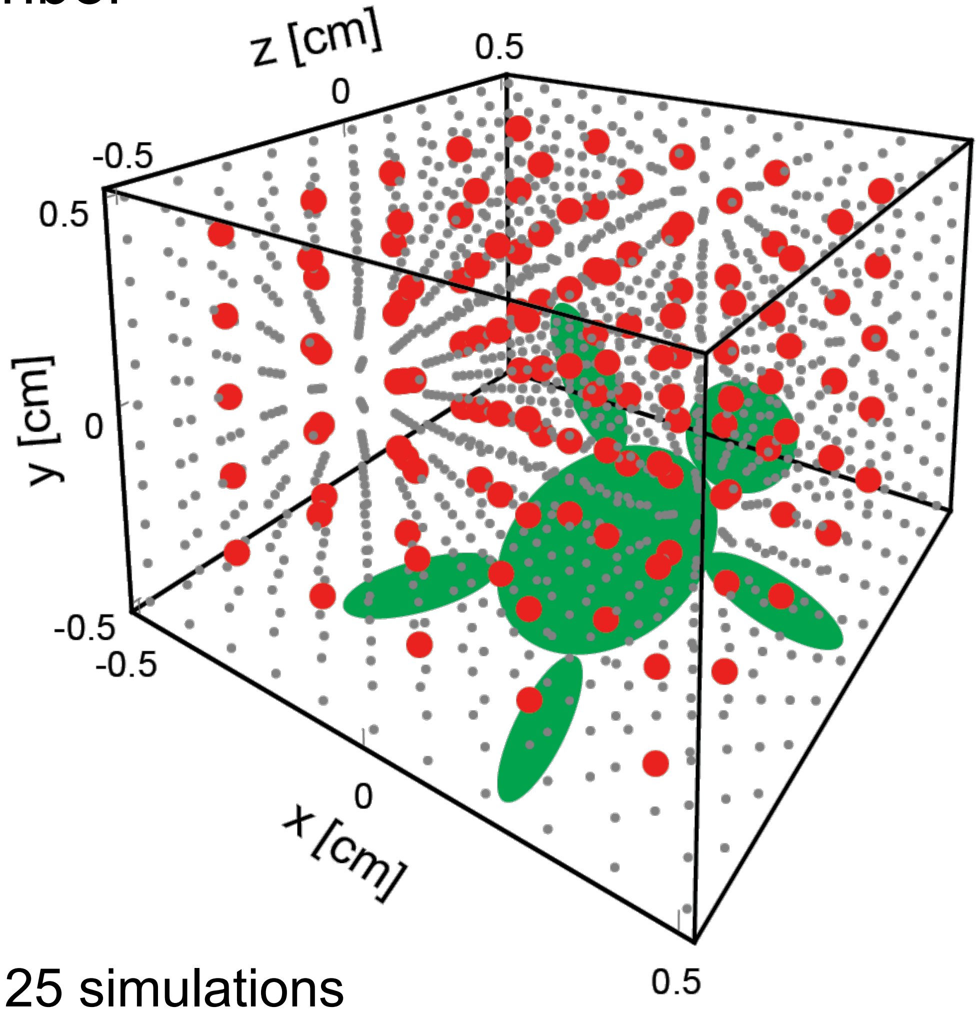
Robustness of Treatment Plans

Head and Neck case (H&N), VMAT 2 and 4 arcs

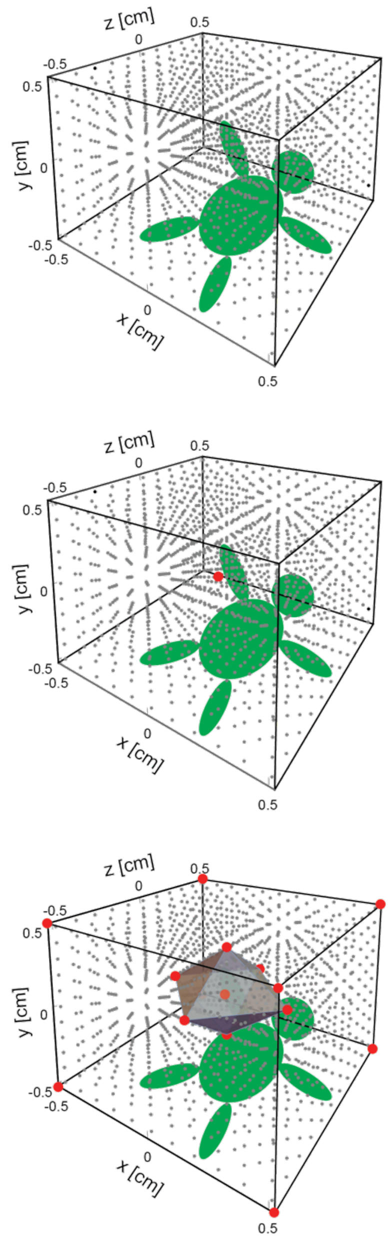


Setup Error Phase Space

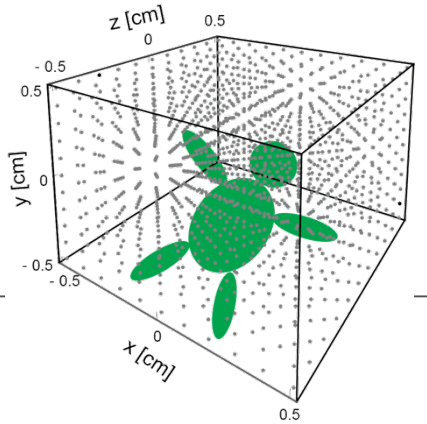
Nearest neighbor

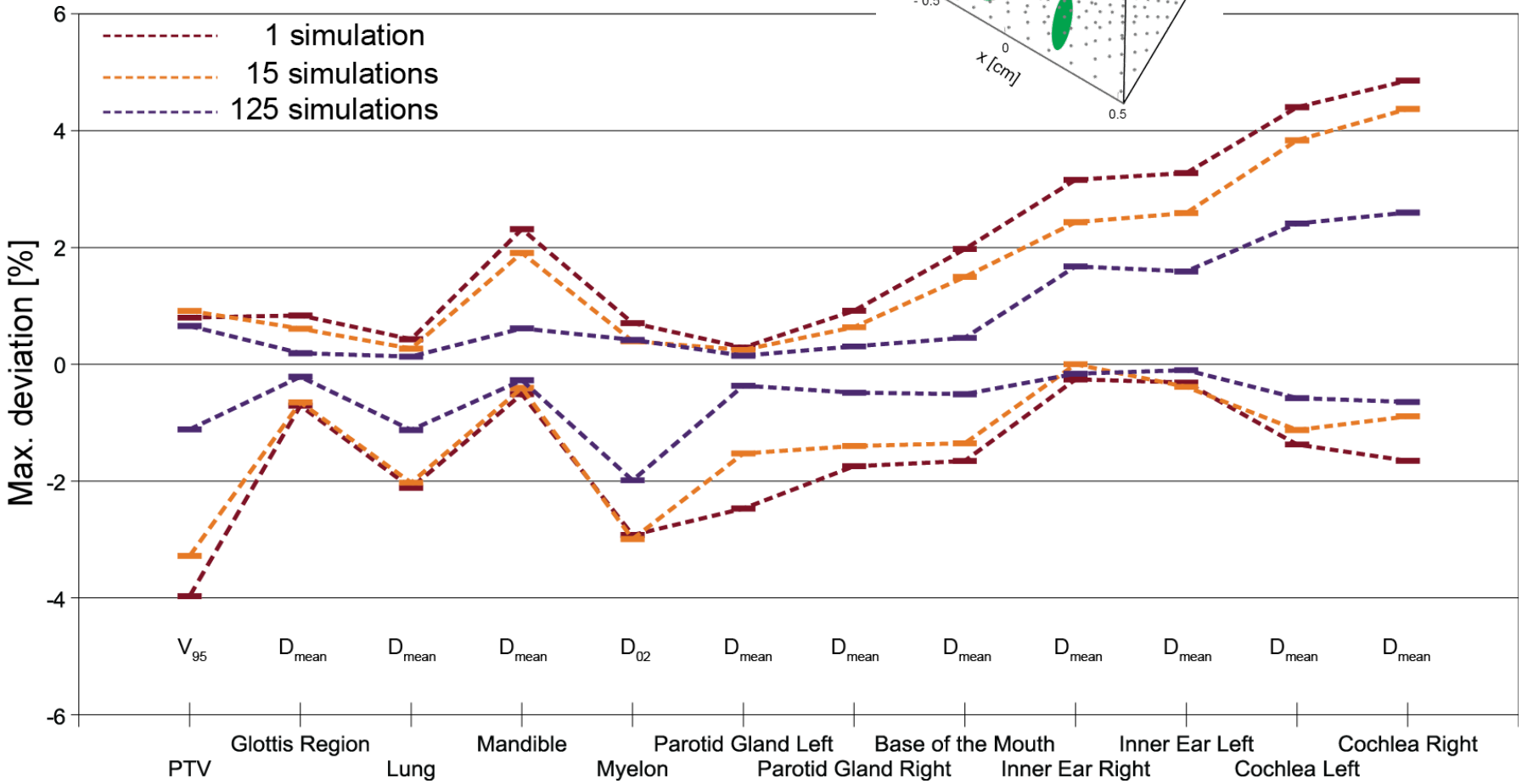


125 simulations



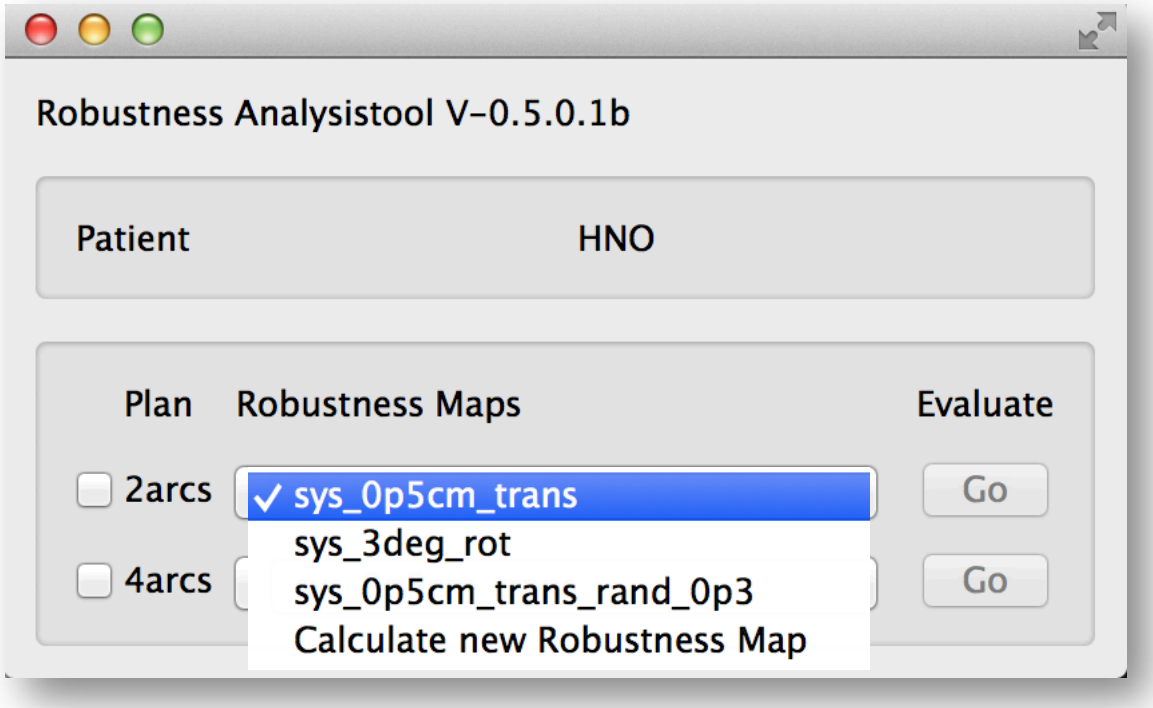
Interpolation vs. Monte Carlo





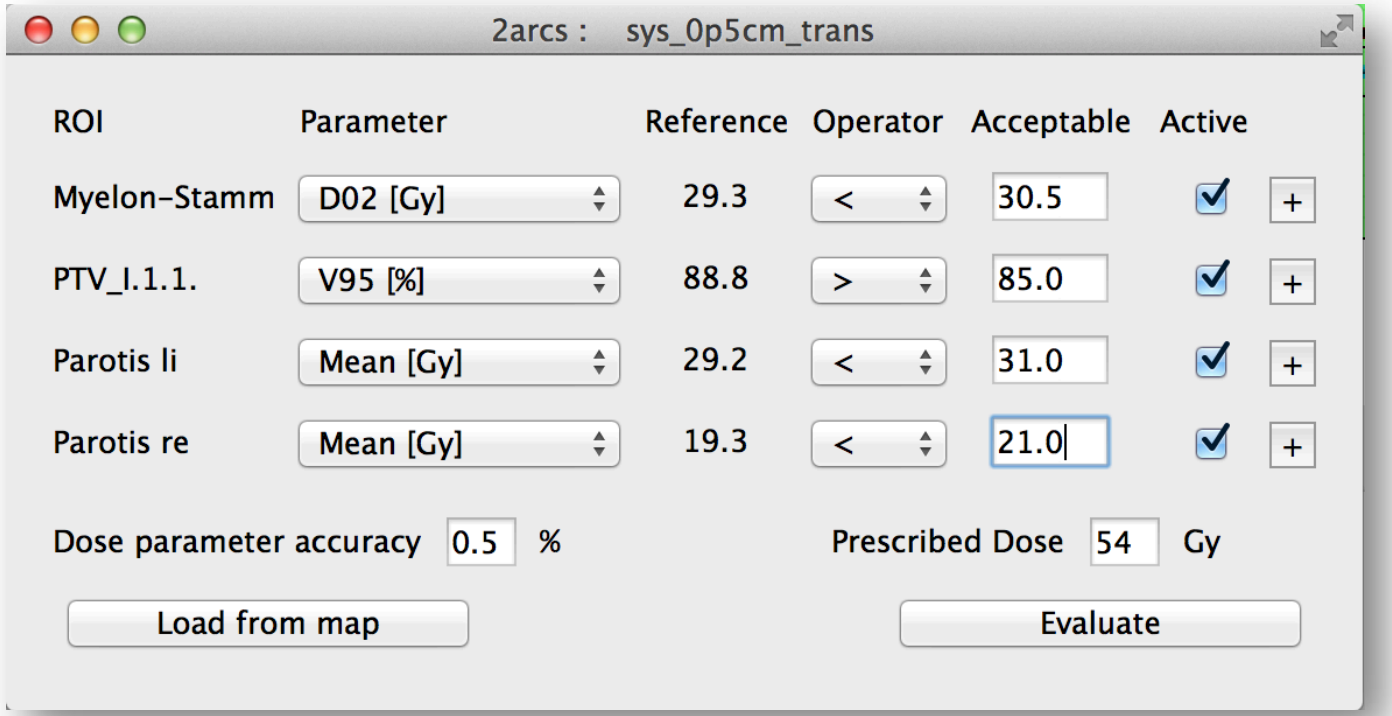
Robustness Assessment and Visualization

rTool



Robustness Assessment and Visualization

rTool

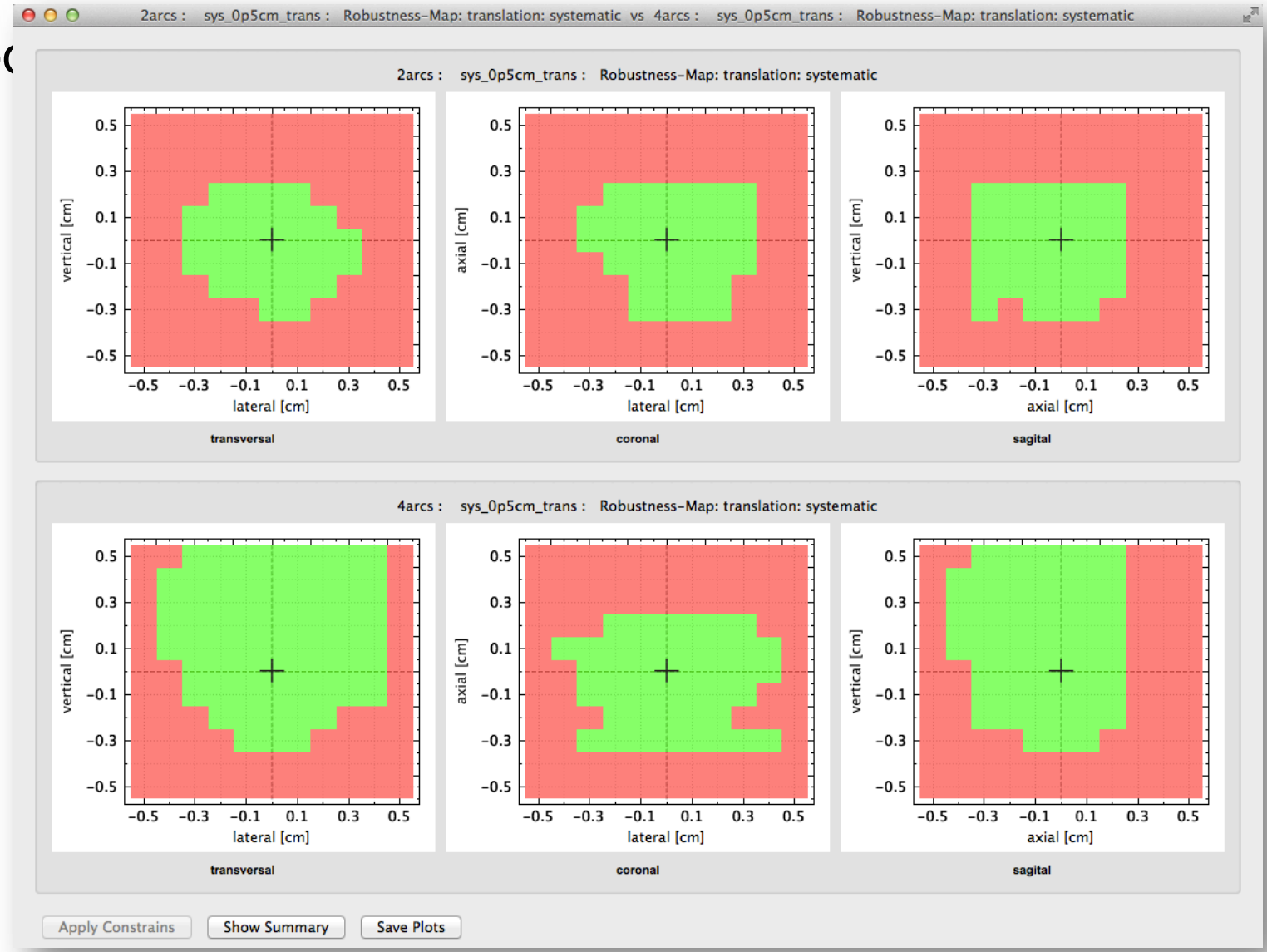


Robustness Assessment and Visualization

rTool

Robustness Assessment and Visualization

rTo



Robustness Assessment and Visualization

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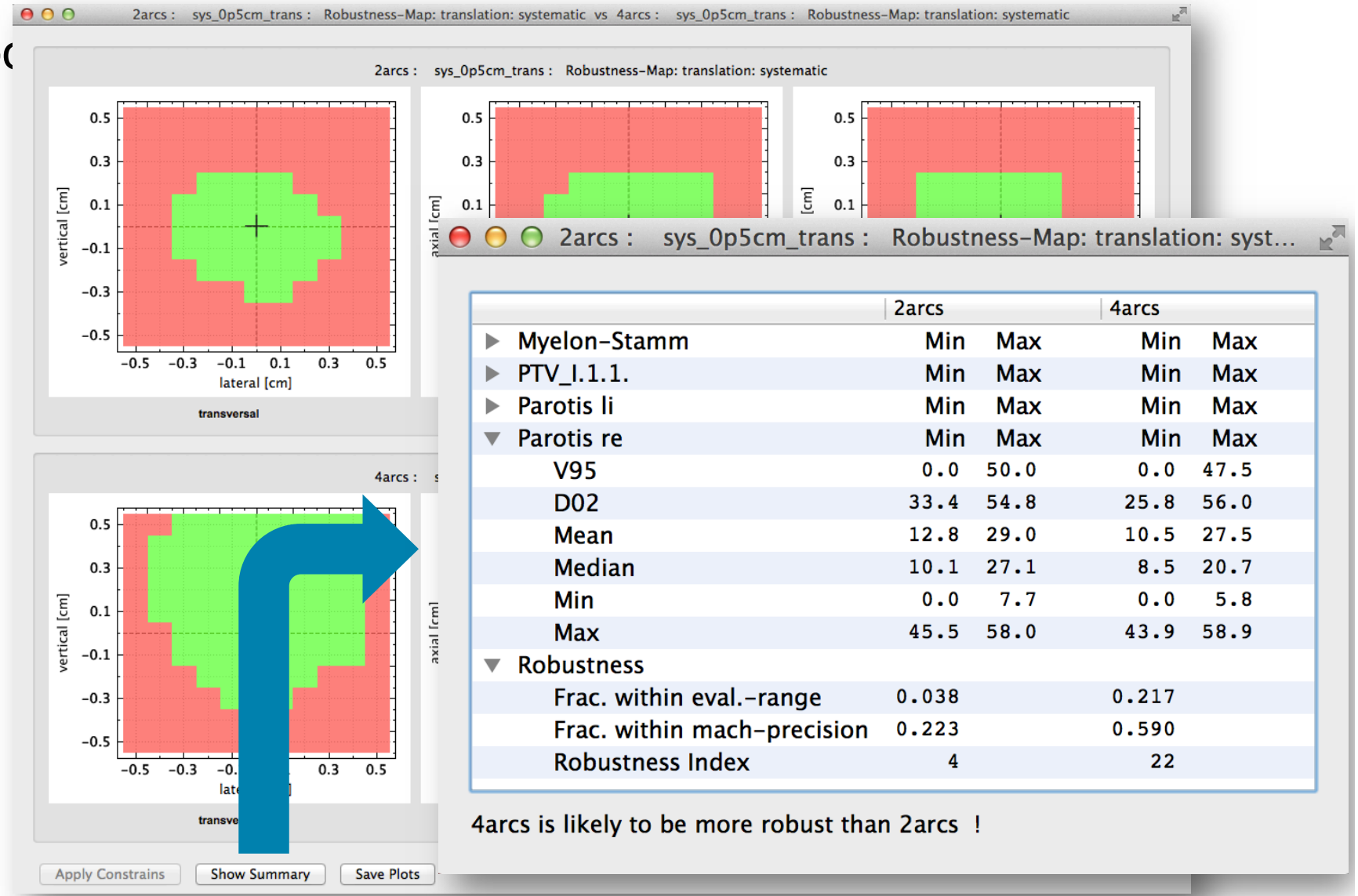

Summary and Conclusion

- Implementation of different approaches to assess treatment plan robustness with respect to systematic and random setup errors
- Tool to quantify and visualize treatment plan robustness for different setup errors
- Support comparisons of the robustness for different treatment plans