MAAS-SFRThelper: Geometry-Based Lattice Positioning for Improved SFRT Planning

Japan K. Patel, Todd A. Wareing, Gregory Gill, Ryan Clark, Anthony Magliari, and Matthew C. Schmidt

2026 JULY 19–22 VANCOUVER, BC
JOINT AAPM | COMP MEETING

GATEWAYSCRIPTS
varian
A Siemens Healthineers Company

INTRODUCTION

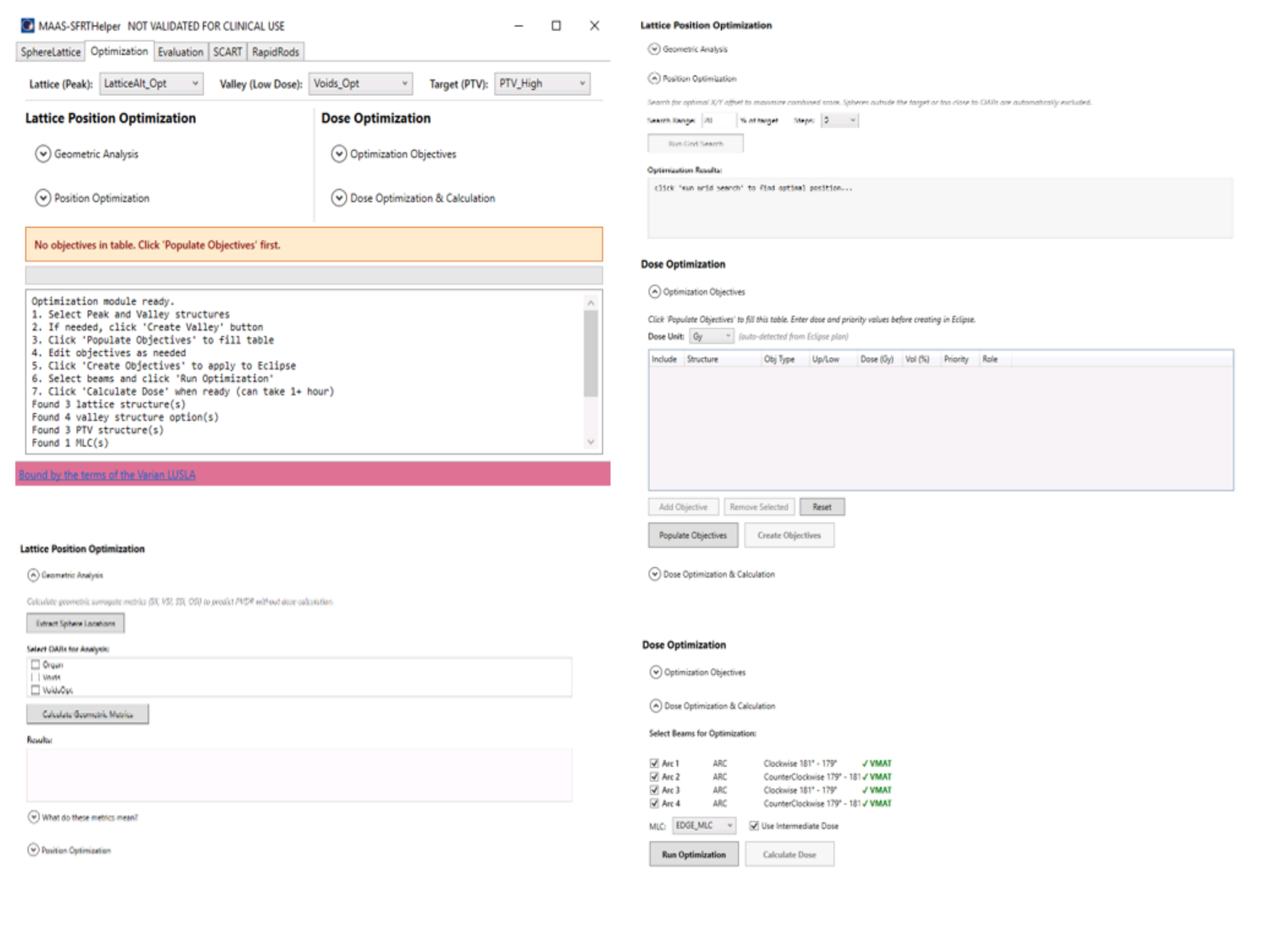
- SFRT delivers a heterogeneous dose with high-dose peaks inside the target separated by low-dose valleys. This dose pattern is quantified by the peak-to-valley dose ratio (PVDR).
- For a fixed target and a fixed lattice, PVDR depends strongly on where the lattice sits in context of the larger geometry. Existing tools largely automate sphere *placement* while position-aware optimization has been demonstrated only in research codes outside a commercial TPS.
- Testing a candidate position by dose calculation takes minutes to hours, so in practice positions are rarely searched, if at all.
- MAAS-SFRThelper is a shared-source ESAPI plugin for SFRT. Its Optimization tab ranks candidate lattice positions using dose-free geometric surrogates, then runs VMAT optimization on the lattice with the best score inside Eclipse.

AIM

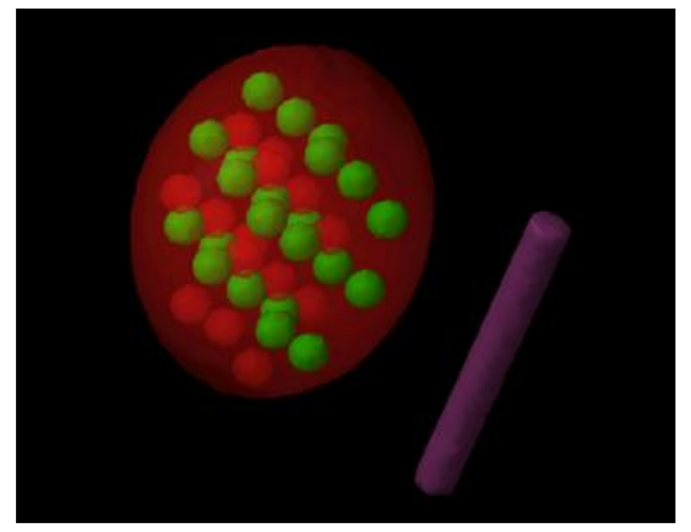
- To demonstrate how the SFRThelper interface is set up and how to use it.
- To investigate lattice optimization for sphere placement in SFRThelper using in-house surrogates.

RESULTS

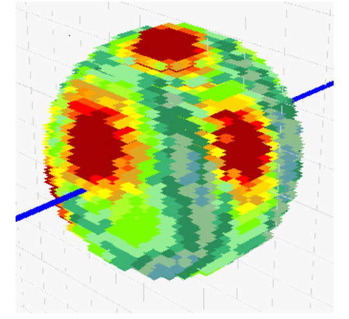
< 1 mm	81 positions	+30% PVDR
sphere-center extraction accuracy	scored in under one second	2.13 → 2.77



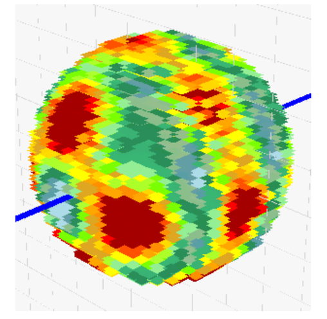
Optimization tab



Baseline (green) vs. repositioned (red)



3D dose (baseline)



3D dose (repositioned)

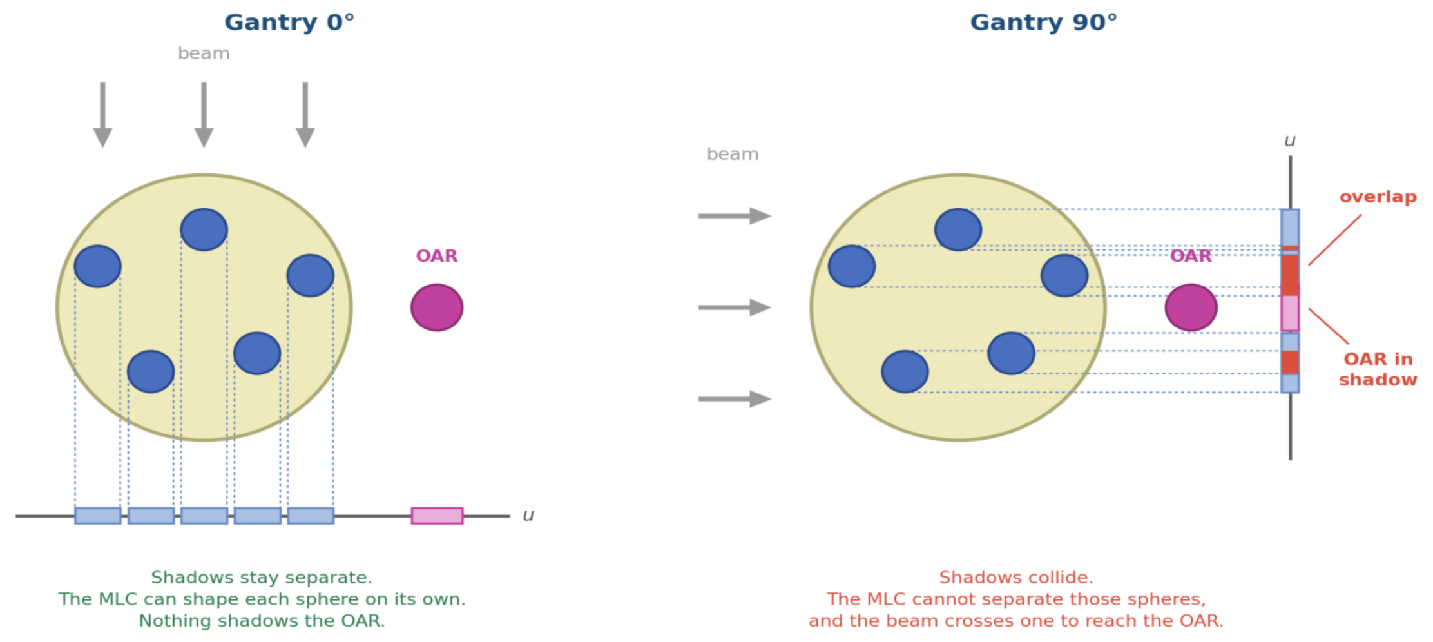
Metric	Change [%]
Spheres	-36
Geometric Score	3
PVDR	30
Peak Mean Dose	8
Valley Mean Dose	-17
OAR Mean Dose	-22
OAR Max dose	-26

Higher PVDR and better OAR sparing — with 36% fewer spheres. Lattice position may matter as much as sphere count.
Note: We are showing a sample case. Metric improvements are highly problem dependent.

METHODS

In one sentence: score *where* the lattice sits using geometry alone — search different positions for lattice placement using geometry — then plan the best-scoring position.

- **Find the spheres**
  - Optimization tab reads the lattice structure already in Eclipse and automatically recovers every sphere's center and radius.
  - This is accurate within 1 mm and usually does not require human intervention.



Sphere shadows on the beam's-eye view.

- **Look from the beam's eye view and score the geometry**
  - Every sphere casts a shadow on the beam's-eye view. Four numbers score those shadows — each runs 0 to 1, higher is better:

Metric	What it asks
SII — Sphere Isolation	Do spheres block each other?
VSI — Valley Space	How much target is left open as valley?
OSI — OAR Sparing	Do spheres shadow the OAR?
SSI — Sphere Spread	Are enough spheres kept, and is the lattice centered?

$$S = 0.25\,(SII + VSI + OSI + SSI)$$

Why SSI? The other three all improve if you simply *delete* spheres. SSI drops when spheres are lost or the lattice drifts off-center — so the search cannot cheat by thinning the lattice.

- **Search positions**
  - Slide the whole lattice in the x–y plane: ±20% of the target radius → 81 candidate positions. Spheres that fall outside the target are dropped, survivors are scored, and positions are ranked by S.
  - No dose calculation is involved. All evaluations performed in under a second.
- **Optimize**
  - The best-scoring lattice is written back into Eclipse. The objectives table fills in by structure name, then VMAT optimization and dose calculation run through ESAPI.
- **Validate setup**
  - Digital phantom: ellipsoidal target of 62.5 mm radius in a cylindrical body, and a cylindrical OAR outside it. Cubic lattice, 8 mm sphere radius → 22 spheres at baseline.
  - Baseline and repositioned lattices were planned with identical beams and objectives.

CONCLUSIONS

- Geometric surrogates, computed without any dose calculation, identified a lattice position that yielded a ~30% higher PVDR after VMAT optimization on a digital phantom.
- The optimized configuration achieved higher PVDR with fewer spheres — lattice *position* may matter as much as sphere *count* for SFRT plan quality.
- Scoring 81 positions in under a second makes position search practical at the console, where a dose-calculated search would not be.
- **Limitations:** single digital phantom, single lattice pattern; search ranges and metric weights not yet established and will vary by site and protocol; surrogates do not model collimator angle or MLC leaf travel.
- **Next:** validation across retrospective patient cases. Shared-source under the Varian LUSLA: github.com/Varian-MedicalAffairsAppliedSolutions/MAAS-SFRThelper

REFERENCES

1. Prezado Y, et al. *Phys Med Biol.* 2024;69:10TR02.
2. Li H, Mayr NA, Griffin RJ, et al. *Int J Radiat Oncol Biol Phys.* 2024;119:737.
3. Wu X, Perez NC, Zheng Y, Li H. *Radiat Res.* 2020;194:737.
4. Zhang H, Lin L, Wang W, et al. *Med Phys.* 2023;50:7269.
5. Deufel C, Dodoo C, Kavanaugh J, et al. *Phys Med Biol.* 2024;69:075010.
6. Patel JK, Sachpazidis I, Raman C, et al. MAAS-SFRThelper: A Shared Source Code Sphere Generation Engine for SFRT. *AAPM Spring Clinical Meeting*; 2025.

ACKNOWLEDGEMENTS

We would like to acknowledge the SFRT community for helping us improve the codebase with continuous feedback..

CONTACT INFORMATION

Japan Patel: jpatel@gatewayscripts.com
Matthew Schmidt: mattew.schmidt@wustl.edu
Anthony Magliari: anthony.magliari@varian.com