

INTRODUCTION

- Linac based VMAT technique has been used to generate conformal plans for the treatment of brain metastases in stereotactic radiosurgery (SRS).
- To ensure safe and accurate treatment, pretreatment verification plans are measured and compared with those calculated by the treatment planning system (TPS).
- Sun Nuclear SRS MapCHECK is a high spatial-resolution 2D detector array for SRS QA, but limited to 2D planar dose comparison.
- This study enhanced SRS patient QA by expanding the dose comparisons to: a) more 2D planar doses; and b) 3D dose and 2D slice extraction.

METHOD

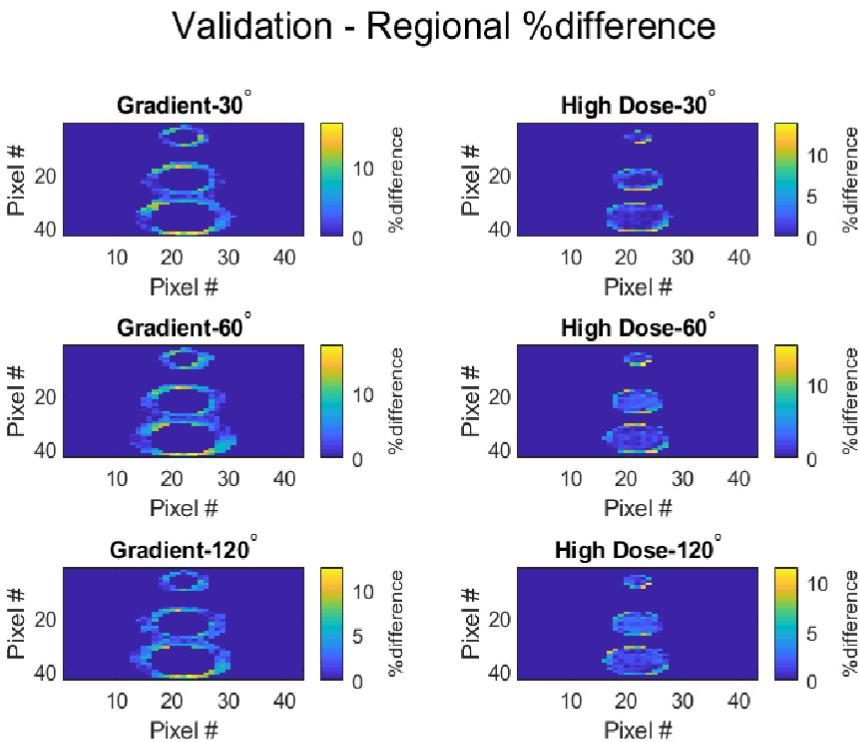
- 2D dose distribution measured from SRS MapCHECK detector (2.47 mm spacing) with StereophAN at 0°, 30°, 45°, 60°, 90° and 120°.
- Bezier interpolation algorithm interpolated all angles between 0°, 45°, 90°, and 135° planes to achieve 2D dose for all angles.
- Validation performed by procuring pixel by pixel percent difference between measured and interpolated 30°, 60°, and 120° planes in the gradient dose (40 – 80% of max dose) and high dose (> 80% of max dose) regions.
- Verification performed by procuring pixel by pixel percent difference between TPS and interpolated 30°, 60°, and 120° planes in the gradient dose (40 – 80% of max dose) and high dose (> 80% of max dose) regions.
- Algorithm applied to patient data: 30°, 60°, 120°, and central axis axial slice generated from interpolation 3D dose vs calculated TPS dose using mean dose and 2D gamma analysis (3%/1mm passing criteria).

Figure 1: SRSMapCHECK detector and StereoPHAN phantom



RESULTS

Figure 2: Interpolated vs TPS Regional Percent Difference



Regional Average Pixel Percent Difference

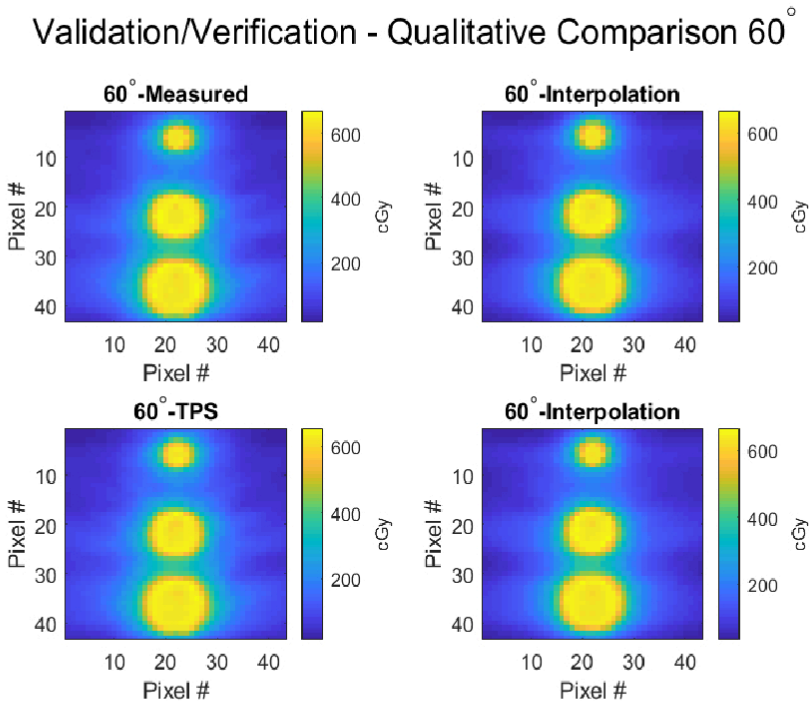
Interpolated vs Measured

| Verification - Mean Percent Difference | | | |
|--|----------|----------|-----------|
| | Low Dose | Gradient | High Dose |
| 30° | 1.63% | 4.14% | 2.13% |
| 60° | 1.75% | 5.64% | 2.54% |
| 120° | 2.40% | 5.63% | 2.42% |

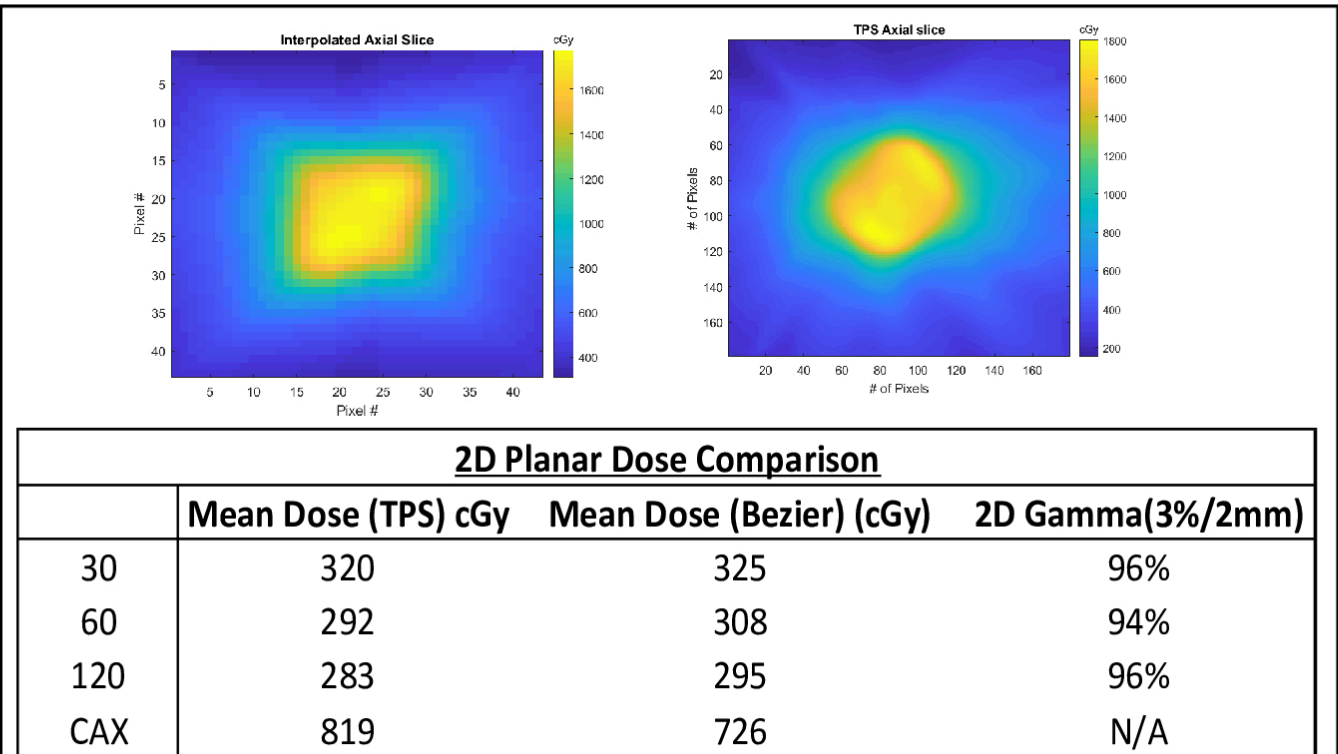
Interpolated vs TPS

| Validation - Mean Percent Difference | | | |
|--------------------------------------|----------|----------|-----------|
| | Low Dose | Gradient | High Dose |
| 30° | 1.36% | 3.55% | 2.60% |
| 60° | 1.44% | 4.94% | 2.71% |
| 120° | 1.94% | 4.93% | 2.55% |

Figure 3: Planar 60° Measured vs Interpolation and TPS vs Interpolation



Patient Application



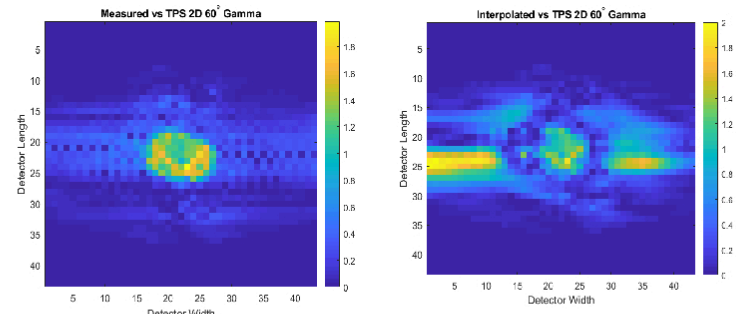
CONCLUSIONS

- Validation and verification mean pixel percent differences and dose distributions demonstrated feasibility of using the Bezier algorithm to obtain 2D planar dose at any angle.
- Extraction of Central Axis Axial slice from 3D interpolated dose reconstruction showed comparable dose distribution; however, the average dose mismatch between the reconstructed and TPS dose exploits inherent discrepancies from 3D reconstruction algorithm.
- The gradient dose region (40 -80% of max dose) was where the algorithm had limitations, as shown by 2D gamma analysis and Regional % difference (see 2D gamma below.)
- 3D gamma analysis had been performed using the same patient with the following criteria: global gamma, 4%/4mm. And 3%/3mm. The pass rates in the high dose region were **92%** and **85%**, respectively.

FUTURE WORK

- We could look at 3D gamma in the high dose region to enhance QA– this is the region where the 3D interpolation is the most accurate and clinically significant; this can provide volumetric QA information.

Figure 4: 2D Gamma 60° : Measured vs TPSand Interpolated vs TPS



- NOTE:** There is a conspicuous discrepancy between the two gamma results in the gradient region
- NOTE:** A pixel passes the gamma test if it is below 1.

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