WHEN BNCT MEETS ARTIFICIAL INTELLIGENCE

Smarter Segmentation, Accurate Positioning, Stronger Treatment

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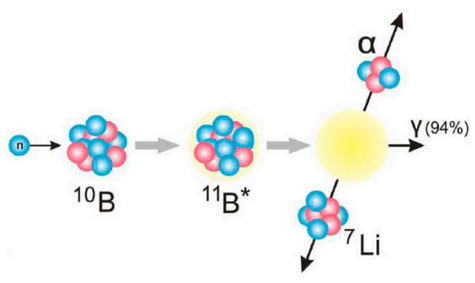
Introduction



- High LET Radiations
- High Selectivity
- Mixed Radiation Field
- Neutron Transport (MC Simulations)

→ **COMPLEX TPS**

Materials and Methods

Automatic ROI Segmentation

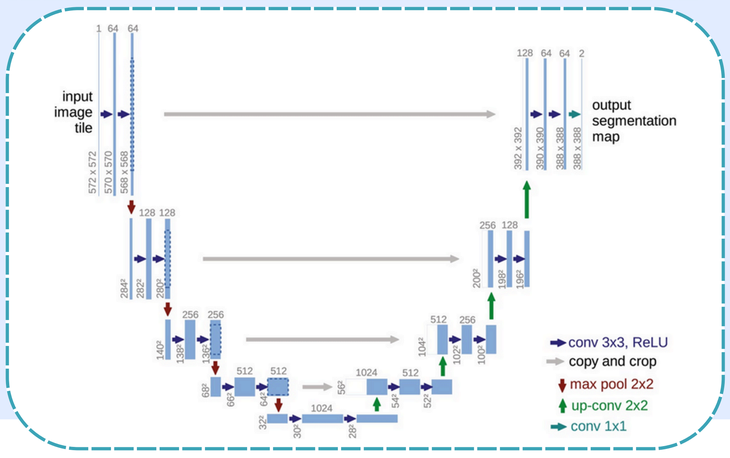
CT-based segmentation using nnUNet

Dataset: 198 Glioblastoma Multiforme cases
Trainning + Validation (152)
Testing (46)

Score Function: Dice Coefficient + Cross Entrophy

Performance Evaluation:

Dice similarity
Dosimetric comparison between manual and AI-generated contours



Dosimetry-driven Patient Positioning

Iterative algorithm aimed at optimizing the dose distribution in GTV and OAR.

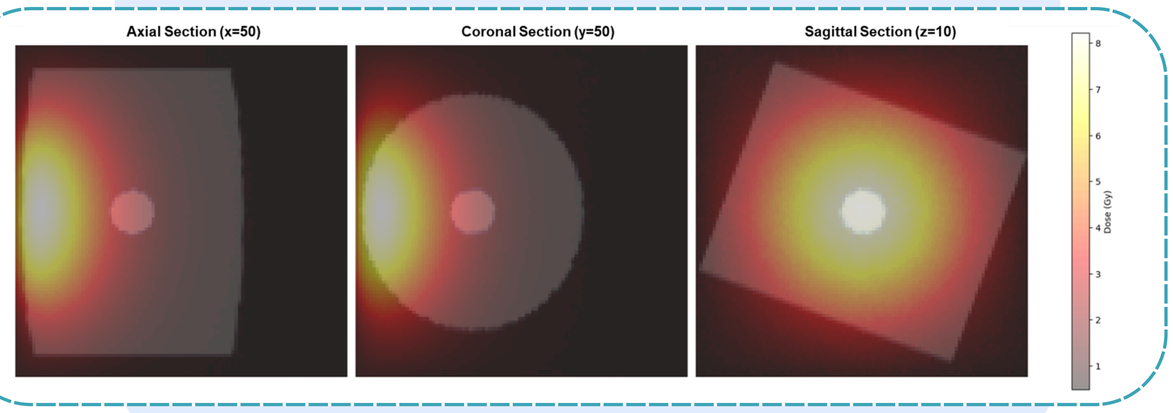
Dose distribution: fixed dose map on PMMA phantom

Search Method: Coarse-to-fine

Score maximization:

$$\text{Score} = D_{\text{mean}}^{\text{GTV}} - D_{\text{mean}}^{\text{OAR}}$$

Validation: Cylindrical geometry (preliminary test) + clinical patient geometry

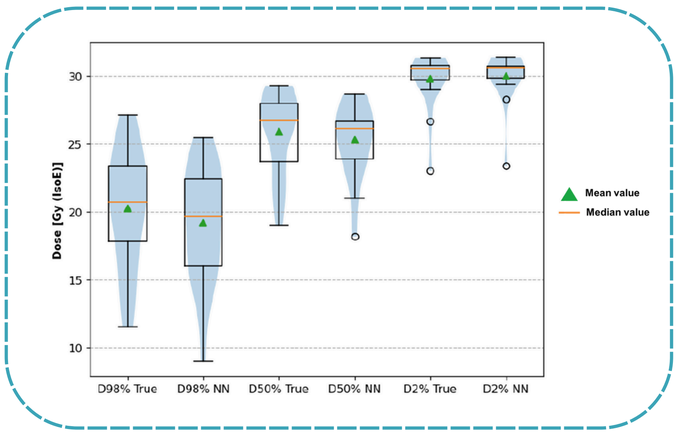


Results

Dosimetric Accuracy and Dice Correlation

GTV min and mean dose slightly lower with AI-based segmentation

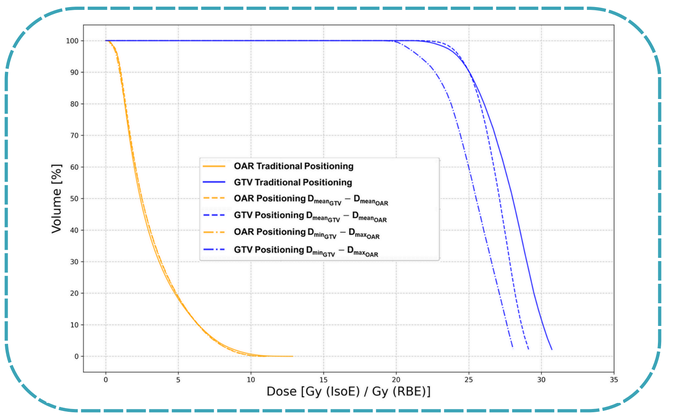
Higher Dice Coefficient corresponds to Better Dose Correspondence



Positioning Optimization

Best performance on superficial targets, decreasing efficiency with depth

DVHs comparable with the ones obtained with traditional positioning methods



Results demonstrate the feasibility and benefits of combining AI-based segmentation and automated positioning in BNCT treatment planning, improving reproducibility and systematic patient setup optimization. Future works will focus on larger datasets, PET integration, refined optimization metrics, and GPU-based acceleration toward fully automated BNCT planning.

Reference:

Pezzi C., et al. Dosimetric comparison of the BNCT treatment planning performances when using a nnU-NET to automatically segment Glioblastoma Multiforme. Health Technol. 15, 811–822 (2025).

Scan Me !

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