

Theme: Physics

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Abstract Title: Clinical commissioning for application of synthetic CT-based online adaptive radiotherapy

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Background / Aims:

- This study proposes a robust commissioning method using RayStation Synthetic CT (synCT).
- It aims to integrate synCT into adaptive radiotherapy workflows to enhance treatment accuracy across various anatomical and clinical cases.

Subjects and Methods:

- RayStation 2024A (Virtual CT) was commissioned to generate synCT from CBCT scans.
- A hybrid deformable registration, constrained by the CBCT field of view, accounted for anatomical shifts.
- Dose discrepancies were evaluated by comparing synCT-based deformed dose distributions with planned CT doses.
- Multiple phantom tests assessed imaging and dosimetric consistency under motion (up to 3 cm), metal artifacts, and gas anomalies.

Results:

- S20-synCT showed better HU-density agreement with CT, than M20-synCT.
- One set of images compares a CT and synCT, revealing distinct differences due to variable density overrides (Fig. 1,2).
- ± 3 cm motion scenario (Average 4D CT)
 - QUASAR Phantom images showed only minor structural differences (simCT vs. synCT).

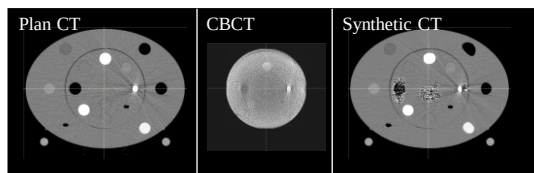
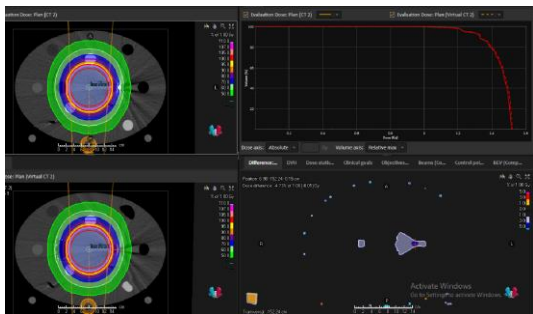
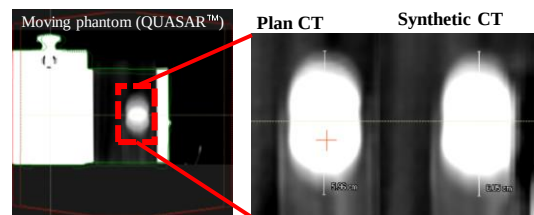


Fig 1. Plan CT, CBCT, and synCT images (CIRS phantom)



↑ Fig 2. Dosimetric comparison (plan CT vs. synCT)

← Fig 3. Moving phantom comparison (plan CT vs. synCT)

- Overall, synCT delivered acceptable dose accuracy, with the largest deviations in cases of over 2 cm anatomical deformation or substantial density anomalies.
- Notably, adaptive plans using synCT improved dose conformity in patients with significant anatomical changes.

Conclusion:

- We established a reproducible synCT-based adaptive planning framework supported by imaging and dosimetric validation.
- This approach demonstrates its clinical feasibility and enables straightforward integration into routine adaptive workflows.