Simplified 3D dosimetry in Radiopharmaceutical Therapy from two planar measurements

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Background: Planar scintigraphy is a fast and cost-effective alternative to SPECT for activity estimation for dosimetry in radiopharmaceutical therapy (RPT). However, its limited 2D information dampers its application and reliability for accurate 3D dosimetry.

Innovation: Our patient-specific solution aims to provide 3D dosimetry from planar scintigraphy by leveraging pre-therapy information of the patient. For that we generate patient specific datasets with synthetic plausible 3D uptake maps of the radiopharmaceuticals based on variations of the pre-therapy PET of a theranostic conjugate pair (e.g. ^{68}Ga or ^{18}F-PSMA for ^{177}Lu-PSMA therapy). This is followed by an AI controlled generative model in which we included physical information (scanner, attenuation model) and we enforce matching with the acquired orthogonal planar measurements (anterior and posterior). We have validated our method both using 10 actual planar acquisitions of ^{177}Lu-PSMA at Inselspital Bern and compared to SPECT acquisitions on the same day (< 2h).

Our method achieved:

- 3D activity distribution from two planar measurements.
- Differences in uptake in key organs (kidneys, liver, salivary glands) ca. 20% compared to SPECT acquisitions within 2 hours after planar.
- Increased resolution compared to SPECT, enabled by training the generative model with images derived from high-resolution PET.
- Simplified dosimetry applications: fast and cost-effective (ca. 8 x faster than SPECT).

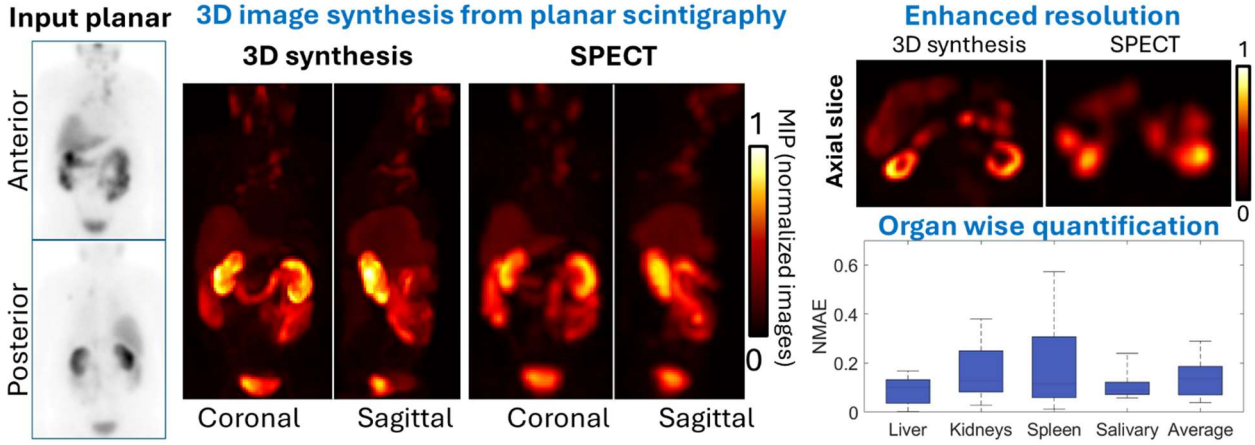

Figure 1: Summary of the main achievements of our method including an example of 3D synthesis from planar of a patient injected with ^{177}Lu-PSMA, axial slice depicting resolution enhancement compared to SPECT and quantification in organs as differences with same-day SPECT acquisitions.

Patent Status Patent Application filed

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