A Method for Extracting and Processing PET/CT and Radiation Dose Images of Lung Tumor Target Regions

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ABSTRACT

This study developed a method for extracting and processing PET/CT, planning CT (pCT), and radiation dose images of lung tumor target regions. The tumor target volume was first extracted from pre-radiotherapy pCT according to contours delineated by radiation oncologists, and the target region was filled using OpenCV. Each point within the tumor volume was then matched with corresponding dose values from the dose distribution image and standardized uptake values (SUVs) from pre-radiotherapy whole-lung PET/CT. Coordinate transformation, trilinear interpolation, and nearest-neighbor matching were used to integrate data from different imaging modalities into a unified coordinate framework. The proposed method successfully generated corresponding tumor-region SUV and dose images, providing a foundational dataset for subsequent quantitative analysis of lung tumor response to radiotherapy.

REFERENCES

1. Konert, T., Vogel, W., MacManus, M. P., Nestle, U., Belderbos, J., Grégoire, V., Thorwarth, D., Fidarova, E., Paez, D., Chiti, A., & Hanna, G. G. (2015). PET/CT imaging for target volume delineation in curative intent radiotherapy of non-small cell lung cancer: IAEA consensus report 2014. Radiotherapy and Oncology, 116(1), 27–34.
2. Brock, K. K., Mutic, S., McNutt, T. R., Li, H., & Kessler, M. L. (2017). Use of image registration and fusion algorithms and techniques in radiotherapy: Report of the AAPM Radiation Therapy Committee Task Group No. 132. Medical Physics, 44(7), e43–e76.
3. Ganem, J., Thureau, S., Gardin, I., Modzelewski, R., Hapdey, S., & Vera, P. (2018). Delineation of lung cancer with FDG PET/CT during radiation therapy. Radiation Oncology, 13, 219.
4. Yin, L. J., Yu, X. B., Ren, Y. G., Gu, G. H., Ding, T. G., & Lu, Z. (2013). Utilization of PET-CT in target volume delineation for three-dimensional conformal radiotherapy in patients with non-small cell lung cancer and atelectasis. Multidisciplinary Respiratory Medicine, 8, 21.
5. De Ruysscher, D., Nestle, U., Jeraj, R., & MacManus, M. (2012). PET scans in radiotherapy planning of lung cancer. Lung Cancer, 75(2), 141–145.

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INTRODUCTION

Radiotherapy is an important treatment for lung cancer, and accurate analysis of tumor response requires the integration of anatomical, metabolic, and dosimetric information. Planning CT is commonly used for tumor target delineation and dose calculation, while PET/CT provides metabolic information through standardized uptake values. However, PET/CT, pCT, and dose distribution images are usually acquired from different devices and represented in different coordinate systems, making direct comparison difficult. Therefore, a reliable method is needed to extract the tumor target region and align multimodal imaging data into a common spatial framework. This study proposes a workflow for extracting lung tumor target regions from pCT and matching them with corresponding PET-derived SUV values and radiation dose values, thereby supporting further quantitative studies of radiotherapy response.

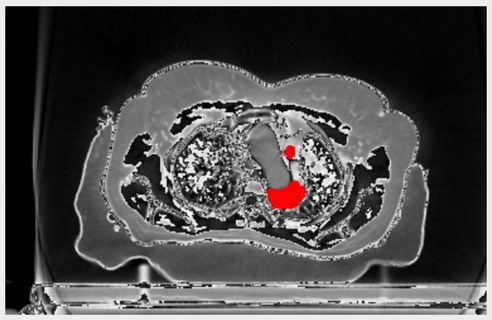

Figure 2. Resulting image of extracting the contour of the tumor target area according to the doctor's outline and fill it with OpenCV.

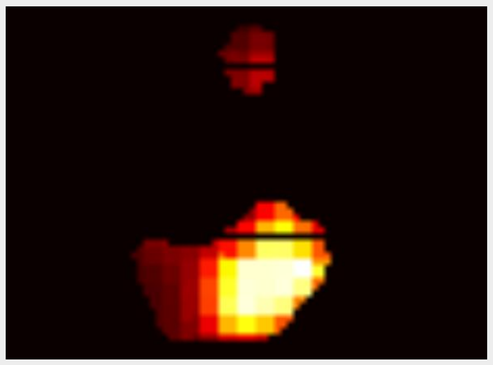

Figure 3. SUV image of the target area formed by extracting the SUV value corresponding to each point in the target area.

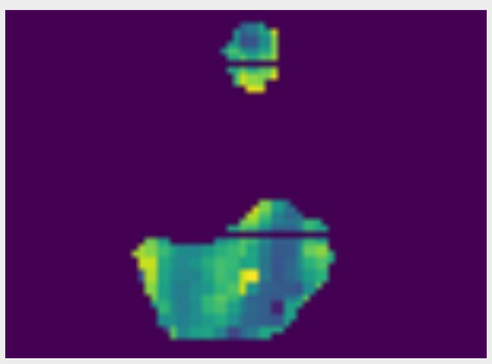

Figure 4. Dose image of the target area formed by extracting the Dose value corresponding to each point in the target area.

METHODS AND MATERIALS

1. Extracting the target volume contouring from the pre-radiotherapy (pre-RT) pCT, as delineated by the radiation oncologist.
2.Matching each pixel point in the tumor volume on the pCT to the corresponding pixel point of dose distribution in the same CT image.
3.Co-registering the coordinate framework between the pCT and the pre-RT whole lung PET/CT.
4.Matching each pixel point in the tumor volume on the pCT with the corresponding pixel point of standardized uptake value (SUV) in the pre-RT whole lung PET/CT image.

The process includes transforming the coordinates of the target volume between the pCT or PET/CT device coordinate system and image space. OpenCV is used for contour filling, while trilinear interpolation and nearest neighbor matching methods are utilized to achieve precise data co-registration.

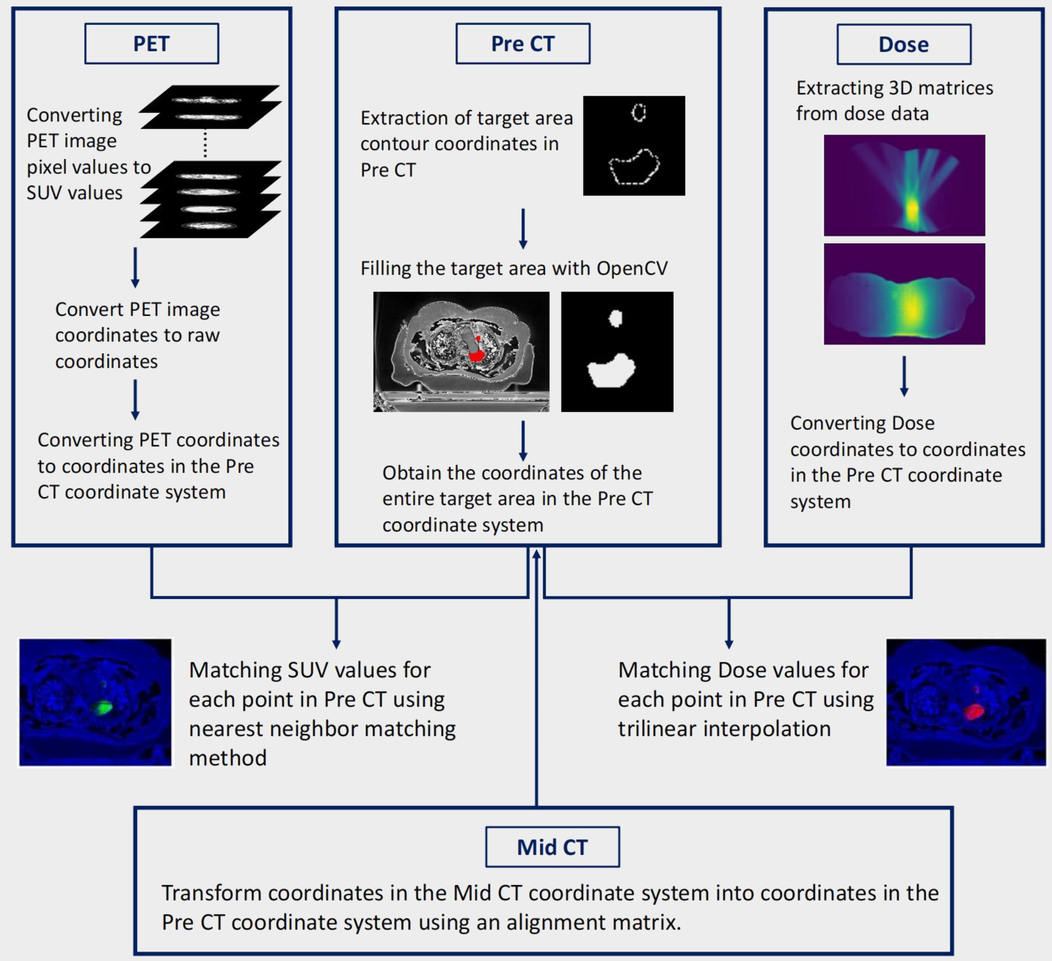

Figure 1. Flow chart of data processing.

DISCUSSION

The proposed method provides a practical workflow for integrating PET/CT, pCT, and radiation dose information within lung tumor target regions. By converting physician-delineated tumor contours into filled image masks and matching each target-region point with corresponding SUV and dose values, the method enables pixel- or voxel-level analysis of anatomical structure, metabolic activity, and dose distribution in a unified coordinate system. This provides an important basis for future studies on the relationship between tumor metabolism, radiation dose, and treatment response. However, the accuracy of the method depends on image registration quality, coordinate transformation precision, and potential respiratory motion effects in lung imaging. Future work should further validate the method using larger clinical datasets and may incorporate deformable registration or motion correction to improve robustness and clinical applicability.

RESULTS

The proposed method successfully extracted the tumor volume from the pre-RT pCT and aligned data from different devices (such as pre-RT whole lung PET/CT image) into a common coordinate system. This alignment provided a foundational dataset for subsequent research on tumor response to radiotherapy.

CONCLUSIONS

The developed method effectively addresses the challenge of extracting and processing PET/CT and pCT. By converting data taken from multiple devices to a unified coordinate framework, the method sets the foundation for further studies on the effectiveness of lung tumor radiotherapy. The method's effectiveness has been validated through testing, and it offers a valuable tool for medical image processing in oncology.