



PT1.045: Cross-modal virtual PET synthesis for decoding the clinicogenomic landscape of non-small cell lung cancer: a multicenter CPT trial

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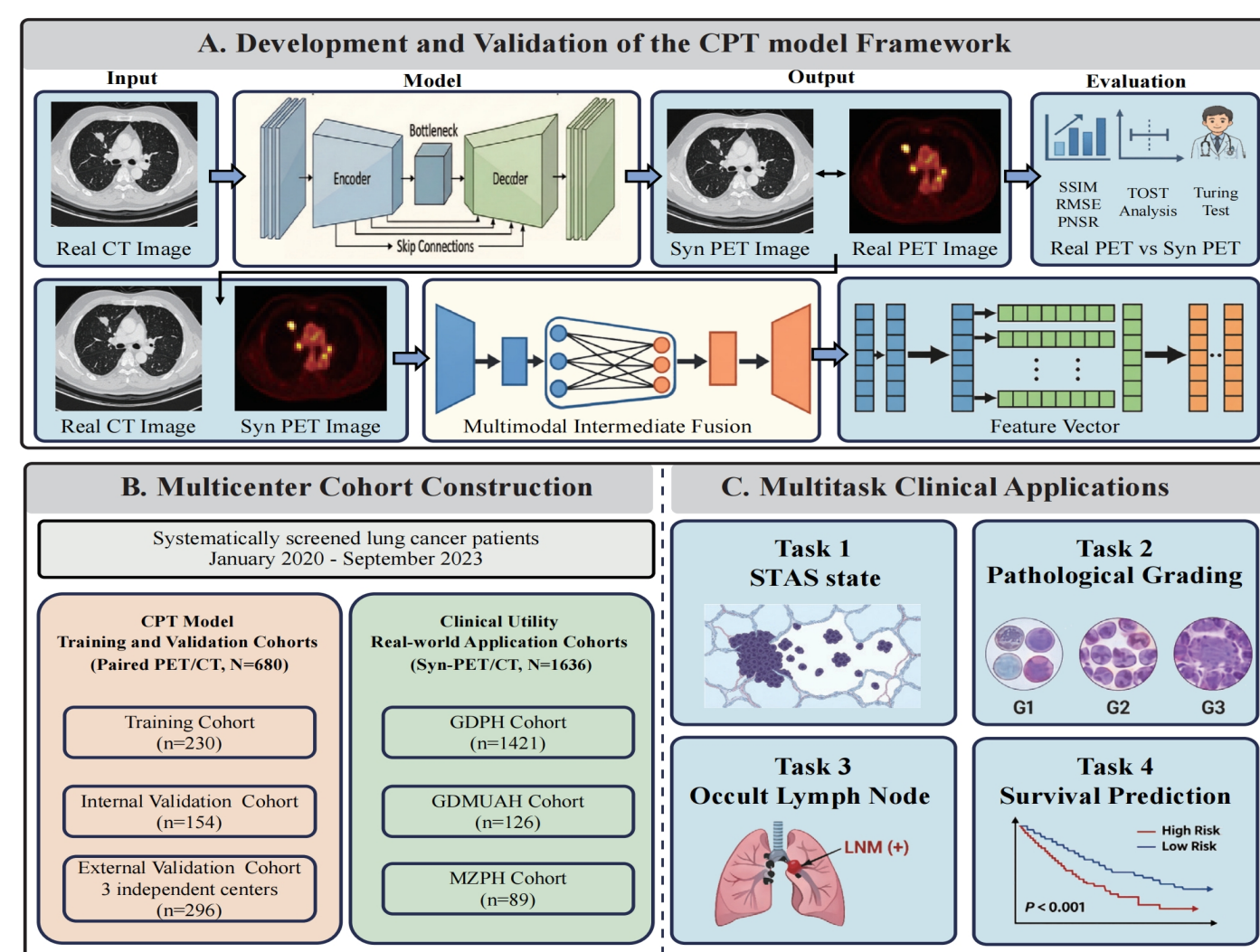
IASLC 2026 World
Conference on Lung Cancer
SEPTEMBER 12 – 15, 2026
SEOUL, REPUBLIC OF KOREA

INTRODUCTION

- Growing Need for Risk Stratification:** The increasing detection of lung adenocarcinoma, particularly through low-dose CT screening, highlights the need for accurate, non-invasive risk assessment.
- Limitations of Current Imaging:** CT is widely accessible but lacks metabolic information, whereas [¹⁸F]FDG PET/CT provides functional insights but is constrained by cost and limited availability.
- Potential of Cross-Modal Synthesis:** Generating synthetic PET (synPET) from routine CT may provide PET-like functional information without requiring additional imaging.
- Proposed Framework:** We developed a cross-modal CT-to-PET Translation (CPT) framework for virtual PET synthesis and multi-task characterization of non-small cell lung cancer.
- Objective:** To develop and validate a CT-to-PET translation framework across multiple centers and assess the utility of CT-derived synPET for predicting STAS, histopathological grade, occult lymph node metastasis, and survival in patients with NSCLC.

METHODS

Design: A Multicenter CPT Trial



- Study Cohorts:**
 - Paired PET/CT cohorts from multiple centers were used for model development and evaluation. (N=680)
 - Real-world application cohorts were used to assess the clinical utility of synPET. (N=1636)
- Model Development: CT-to-PET Translation(CPT) model**
 - A 3D Pix2PixHD conditional GAN was developed to generate synPET from CT images.
- Clinical Evaluation:**
 - The utility of synPET was evaluated for predicting STAS, histopathological grade, occult lymph node metastasis, and survival.

DISCUSSION AND CONCLUSION

Conclusion

- The CPT framework generated realistic synPET images with stable fidelity across multiple centers.
- Integrating CT, virtual PET, and metadata improved STAS prediction, although the added value of synPET varied across clinical tasks.
- CPT may extend routine CT with PET-like functional information and provide a scalable approach for preoperative risk assessment in NSCLC.

Future Direction for Research

- Conduct prospective validation in larger and more diverse external cohorts.
- Refine task-specific multimodal fusion, particularly for histopathological grading.
- Further validate occult lymph node metastasis, survival prediction, and assess model calibration and clinical utility.

REFERENCES & ACKNOWLEDGEMENTS

Key References:

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- [2]Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024;74(3):229-263.
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RESULTS

Multicenter Performance of the CPT Framework.

- Structural Fidelity:** SSIM remained stable across validation cohorts, ranging from approximately 0.85 to 0.89.
- Reconstruction Accuracy:** MSE was lowest in GDPH and SH and highest in Lung_Dx, indicating generally consistent reconstruction across centers.
- Visual Realism:** In 360 assessments by six raters, 46.94% of images were considered indistinguishable, while 26.67% were classified as real PET and 26.39% as synPET.

Clinical Predictive Performance.

- STAS Prediction:** The model combining CT, virtual PET, and virtual metadata achieved the highest AUC of 0.942, outperforming CT alone (0.920) and CT combined with real PET and real metadata (0.912). Decision curve analysis also showed the greatest net benefit for multimodal fusion.
- Histopathological Grade Prediction:** CT alone achieved the highest AUC of 0.863, followed by real PET (0.725), CT plus virtual PET (0.700), CT plus real PET (0.688), and virtual PET alone (0.512).

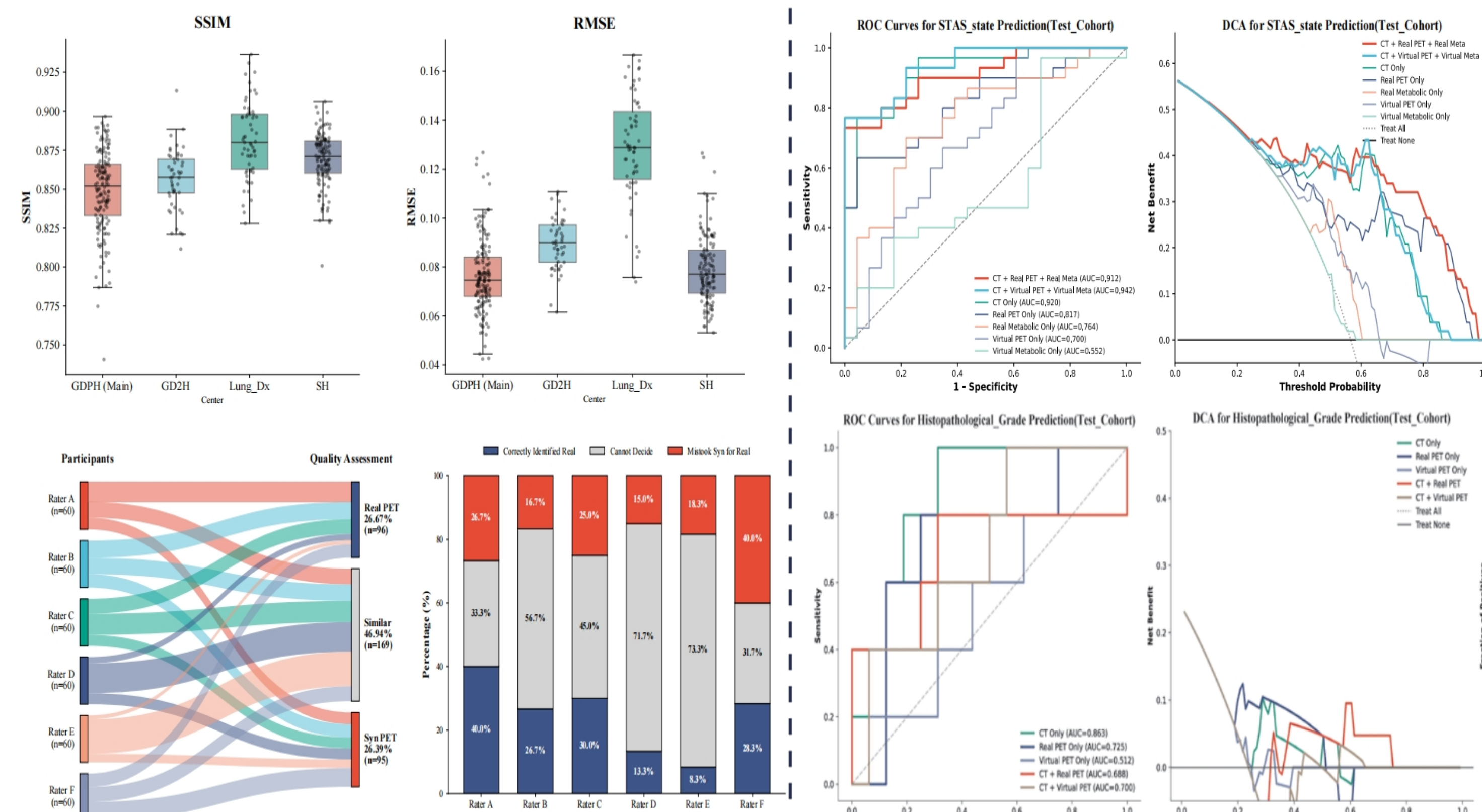


Figure 1: Multicenter validation of synPET generation using SSIM, RMSE, and reader-based Turing testing.

Figure 2: ROC and decision curve analyses of multimodal models for STAS and histopathological grade prediction.