Quantitative Medical Imaging Analysis across Diseases
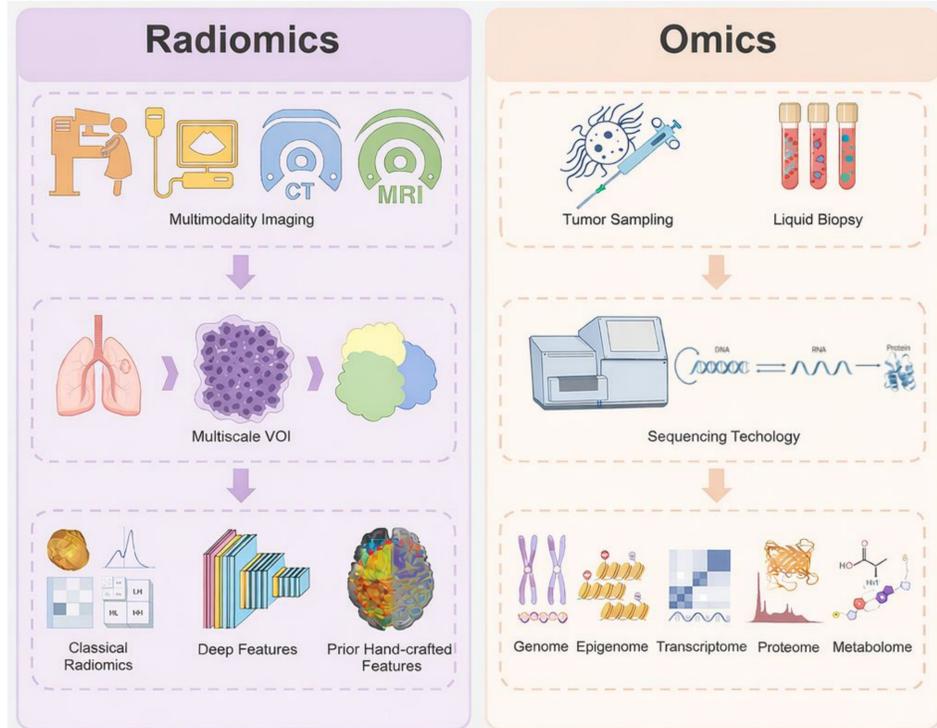
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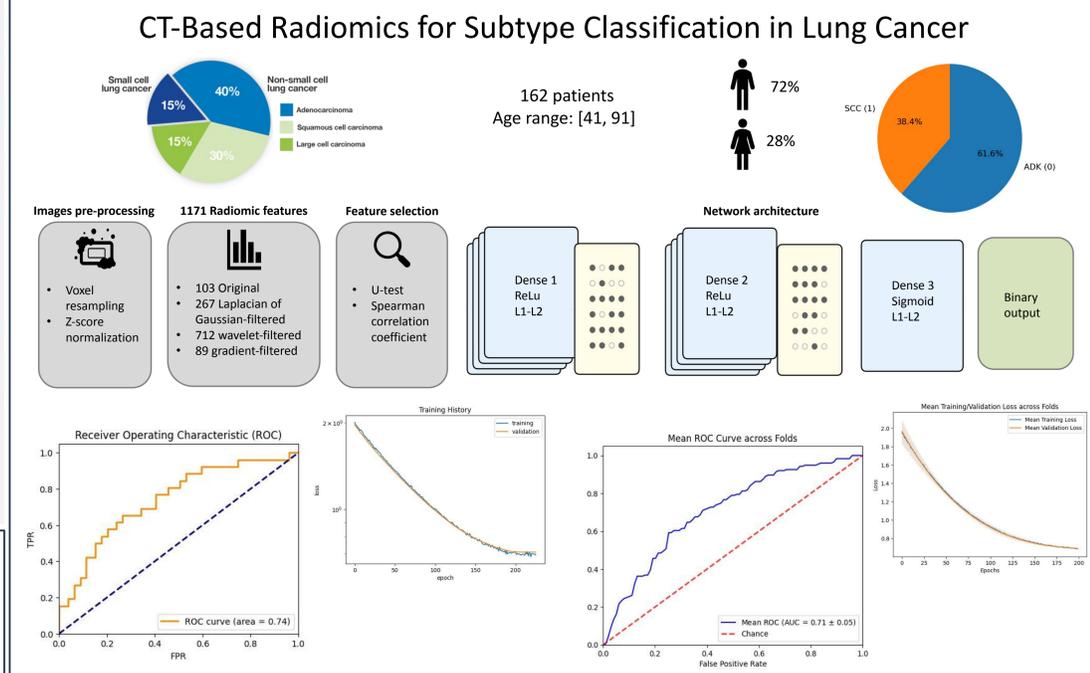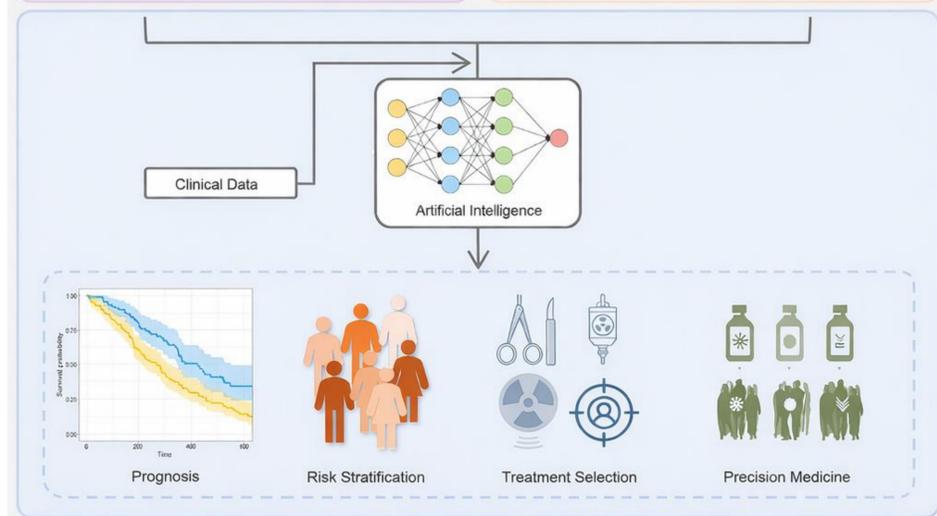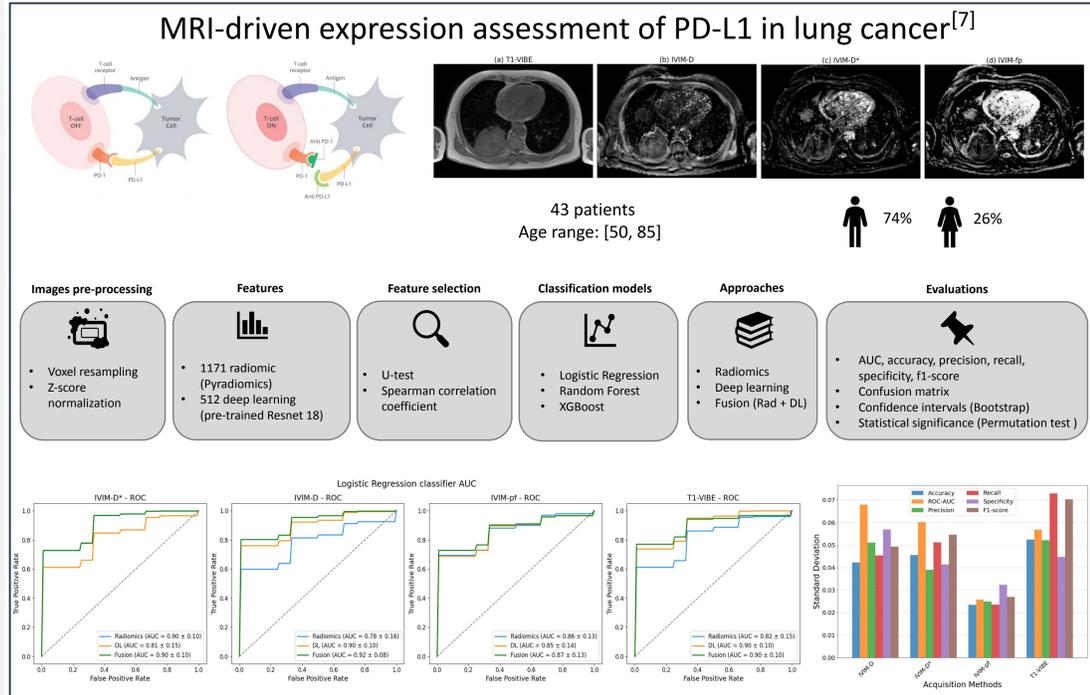2 National Institute for Nuclear Physics (INFN), Italy
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INTRODUCTION Radiomics is a quantitative approach through which medical images are converted into mineable data, called **radiomic features**. These features are mathematical quantities that relate to different aspects of **tissue pathophysiology** and thus the main aim of Radiomics is to provide deeper insights and to improve decision-making in clinical practice [1,2,3]. Furthermore, the cross-scale integration of radiomics and multi-omics tumour data, holds substantial potential for advancing cancer decoding. This integrative approach can elucidate mechanisms of tumor development, identify clinically relevant biomarkers, and enable the construction of sophisticated markers of disease and underlying physiology [4, 5,6].

PIPELINE

APPLICATIONS

MRI-driven expression assessment of PD-L1 in lung cancer[7]

43 patients
Age range: [50, 85]   74%   26%

CT-Based Radiomics for Subtype Classification in Lung Cancer

162 patients
Age range: [41, 91]   72%   28%

Multi-scale Radiogenomic Pipeline in NSCLC

The radiogenomic analysis pipeline adopted in this ongoing study describes data acquisition, processing and statistical analyses for investigating associations between radiomic features and gene expression.

56 patients
28 ADK
28 SCC

Radiomic Features	Genomic data processing	Feature selection	Radiogenomic analysis	Statistical evaluation
• Clinical CT and high-resolution µCT images • Radiomic feature extraction (PyRadiomics)	• NanoString nCounter technology • Quality control (nSolver) • Housekeeping gene normalization	• Removal of low-variance features • Subtype-aware analysis (ADK vs SCC)	• Radiomic features vs single-gene expression • Multi-scale comparison (CT and microCT)	• Spearman correlation coefficient (ρ) • Multiple testing correction (FDR, Benjamini–Hochberg) • Significance thresholds: $|\rho| \geq 0.3$, FDR < 0.05

3D CNN with Grad-CAM for Paranasal Sinus Disease Diagnosis on CT Images

Global ROC-AUC: 0.94

Representative CT slices with Grad-CAM overlays

Other studies:

- CT and MRI radiomic features of lung cancer (NSCLC): comparison and software consistency[8]
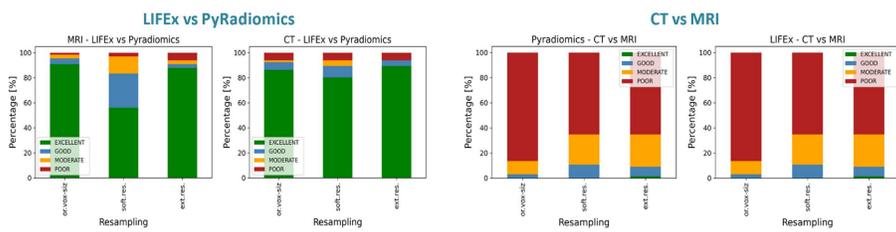
- Radiomics-based CT-µCT comparison
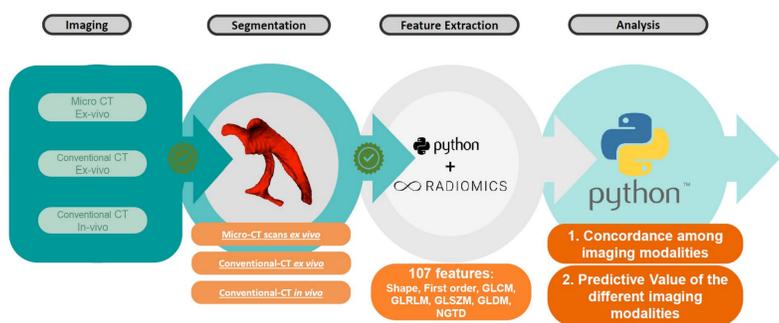
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