A Novel CNN-GCNN Framework with Scattering Transforms for Lung Cancer Diagnosis

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Abstract. Lung cancer is a serious health problem worldwide, and catching it early can save lives. Traditional ways of finding it, like looking at CT scans by hand, take a lot of time and can differ from one doctor to another. In this paper, we suggest a new method that mixes Graph Convolutional Neural Networks (GCNNs) and scattering transforms with regular deep learning to spot lung cancer better. Our approach uses graphs to understand how parts of an image connect and adds scattering transforms to make the results steady even if the pictures twist or change a bit. We achieved an AUC-ROC score of 0.92, showing that our method could really help doctors in real hospitals. We'll also talk about some challenges and ideas for making it even better in the future.
Keywords: Lung cancer detection, Graph Convolutional Neural Networks, Scattering transform, Deep learning, Medical imaging

1 Introduction

Lung cancer remains one of the leading causes of cancer-related deaths globally, accounting for approximately 18% of all cancer mortalities [1]. Early detection is critical, as the five-year survival rate for stage I lung cancer is 60–80%, but this drops to under 5% for stage IV [2]. Advances in medical imaging, particularly computed tomography (CT), have improved detection rates, but manual interpretation by radiologists is time-consuming and subject to inter-observer variability [3].

Artificial Intelligence (AI) has emerged as a powerful tool to assist clinicians, offering faster and more consistent analysis of medical images [4]. Deep learning models, such as Convolutional Neural Networks (CNNs), have shown promise in identifying lung nodules in CT scans [5]. However, CNNs often struggle with capturing long-range dependencies in images, especially for irregularly shaped tumors. To address this, we propose a hybrid model that integrates Graph Convolutional Neural Networks (GCNNs) with scattering transforms. GCNNs model spatial relationships as graphs, capturing global context, while scattering transforms ensure robustness to deformations [6]. This paper presents our approach, tested on the LIDC-IDRI dataset, achieving an AUC-ROC of 0.92, demonstrating its potential for clinical use.