Cone-beam CT to CT harmonization by learning disentangled representations

Layman Summary

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Chest computed tomography (CT) is a commonly used imaging modality used to examine the chest for various health issues. There are two main types of CT scans depending on the way they are acquired: Fan-beam CT (FBCT) and Cone-beam CT (CBCT). CBCT aims to reduce radiation exposure, which can sometimes lead to lower image quality, limiting its use in high-precision medical evaluations, such as radiotherapy treatment and planning. Additionally, CBCT images also tend to have a narrower view and more image artifacts, which are distortions, that affect their quality compared to FBCT.

To address these challenges, this study focused on improving CBCT images so they match the quality of FBCT images. This can be achieved by using a technique called image harmonization, which adjusts CBCT images to resemble FBCT images while maintaining important anatomical details. Recent advancements in other imaging fields, such as magnetic resonance imaging, have used similar techniques to separate image information into anatomy, contrast, and artifacts, to account for anatomical differences between imaging modalities. To this end, our study aimed to perform image synthesis harmonization between CBCT and FBCT to capture the anatomy of CBCT while preserving the quality and resolution from FBCT. We evaluated the harmonized images by analyzing different details, such as lung lobes, cancer nodules, and airways.

Our results showed that the harmonized CBCT images had fewer artifacts and improved quality, which improved the ability to identify lung lobes and airways compared to regular CBCT images. However, some details in airways and nodules were still missing. Overall, this method significantly improves CBCT image quality and demonstrates potential for increasing the effectiveness of CBCT in various medical applications. Future work could focus on refining the harmonization process to better address a wider range of clinical scenarios.