Investigations of Scatter Correction Methods in Quantitative PET using Deep Learning

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Layman's Summary

Positron Emission Tomography (PET) is a well-established imaging procedure most commonly used to obtain images for cancer examinations. Research has found that cancerous cells need a lot of energy to replicate faster than healthy cells. These increased energy needs are usually supplied by sugar molecules found in the body of the diseased person. When such a person undergoes a PET examination, a special sugar-based substance is administered to them. This substance has a special property. It can act as a source of electromagnetic radiation or, more simply, light. This kind of light is invisible to the human eye, and it can go through materials, such as a thin wall or a human body. Once this substance enters the person who has cancer, it will be slowly attracted toward locations where the cancerous cells reside. Therefore, if a method existed to allow us to see this light, we would be able to inspect if any cancer cells exist in the body and their location.

Capturing this light is exactly what a PET examination aims to achieve, by using a donut-shaped system that is sensitive to this kind of light. The person that was administered the sugar-like substance, is inserted into the system's hole through which it detects that light. Using that light, we can obtain images depicting the locations of increased substance concentration, which tends to be clustered around areas with tumors.

To obtain good images, however, we need to correct the scatter effect. This effect happens when the light originating from the substance, interacts with objects, like the patient's body, changing its original trajectory. If that light gets detected by the system, it deceives its light-to-image process and reduces the quality of the final images. Since this effect can significantly degrade the obtained images, multiple ways to correct it exist already. However, the most accurate ones require too much time for them to be applicable for clinical examinations.

In this work, we are attempting to use Artificial Intelligence (AI) to predict these corrections almost instantaneously. Here by AI, we describe an algorithm that learns to make predictions. To achieve this, you need to show that algorithm multiple examples of pairs of initial conditions- outcomes. In our case, these examples of pairs are consisted of captured light and pre-computed scatter corrections. Therefore, multiple such pairs were created, and we made the AI algorithm to learn from them.

By the end of this process, the algorithm was able to make very accurate predictions. The very short time that it requires to make such predictions can potentially enable the use of it in clinical PET examinations and improve the final images.