Docket #: S24-153

On-Treatment Joint CT-MR Imaging from Sparse X-Ray Measurements

CT imaging and MR imaging are two essential and widely used techniques for diagnostics. Currently, the two imaging techniques are performed sequentially, which is time-consuming and prone to errors due to anatomical changes that occur between the scans. To address these challenges, a team at Stanford has developed a framework to simultaneously acquire CT and MR images on-treatment, significantly reduces radiation exposure of the patients and enhances accuracy of diagnostics.

They created a method to reconstruct CT and MR image pairs simultaneously, using sparse X-ray data and a generalizable neural representation algorithm (gNeRP). This approach combines the benefits of both imaging modalities—enhanced soft tissue contrast from MR and precise electron density maps from CT—without the drawbacks of conventional image registration methods. An anatomy-adaptive layer within a multi-layer perceptron (MLP) neural network quickly adjusts to new anatomical data, reducing dependency on large datasets and accelerating the image acquisition process.

This patient-specific model overcomes previous barriers of data diversity and generalization. It minimizes the reliance on large-scale datasets and speeds up image acquisition and all downstream application tasks, all while reducing additional patient irradiation.

Stage of Development: Prototype; looking to integrate with existing CT imaging systems to experimentally verify the proposed approach.

Applications

- **On-treatment reconstruction of CT and MRI images**
- **Image-guided radiation oncology, surgery or other interventions**

- **Preventive medicine and screening**

Advantages

- **Enhance speed of image acquisition**
- **Reduce patient radiation exposure**
- **Improve image quality**
- **Reduce operational cost**

Publications

- Oscar Pastor-Serrano et al. (2024). On-Treatment Joint CT-MR Imaging with a Single Pair of Prior Images and Sparse X-Ray Projections. *AAPM 66th Annual Meeting & Exhibition*.

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