CANCER PREVENTION & RESEARCH INSTITUTE OF TEXAS

Award ID:
RP110329

Project Title:
Personalized Online Adaptive Radiation Therapy

Award Mechanism:
Individual Investigator

Principal Investigator:
Mao, Weihua

Entity:
The University of Texas Southwestern Medical Center

Lay Summary:

While radiation therapy is an essential modality in the treatment of cancer and is used in over 50% of all people with cancer, numerous shortcomings and challenges remain. In the current radiation therapy paradigm, a course of treatment is based on a single CT scan. The treatment plan devised from this CT scan is delivered in daily fractions and may continue for up to 45 fractions over 9 weeks without change. During this time, changes in patient anatomy due to weight loss and tumor response are common. These patient-specific, time dependent changes significantly degrade the accuracy of radiation therapy. Tumor control can be compromised by a failure to deliver an adequate dose and critical structures may be overdosed, resulting in severe complications. We propose a personalized online solution in which patient-specific anatomic changes will be assessed and the treatment updated on a daily basis. This solution includes a novel imaging process and online plan evaluation and re-planning. The imaging process will incorporate a priori knowledge from the planning CT, correlated with daily 2D projections, to provide updated images suitable for treatment re-planning. Each treatment plan will be evaluated automatically based on the new images. If the dose distribution is out of a pre-defined tolerance, re-planning will be performed. A novel and efficient computation technique using graphics processing units (GPUs) will allow all elements to be completed in several minutes, ensuring that daily treatment workflow won't be compromised. Additionally, the imaging method uses much fewer x-ray projections than a conventional 3D scan, thus the dose received by patients due to imaging procedures can be greatly reduced. In this manner, every treatment delivered is based on the exact daily anatomy and positions. This methodology will significantly improve the efficacy of cancer treatment through more accurate tumor targeting and sparing of sensitive structures and normal tissues.