Capitol Graduate Research Summit

# Quantifying Potential Therapeutic Benefit of Spatiotemporal Dose Modulation for Cancer Treatment

Ali Adibi and Ehsan Salari

*Department of Industrial, Systems, and Manufacturing Engineering, Wichita State University*

It is estimated to have 14,400 new cancer cases in Kansas in 2017 and radiotherapy remains one of the main modalities to treat them. The goal of radiotherapy is to deliver sufficient radiation dose to the tumor region to eradicate the disease while sparing the surrounding healthy tissues to the largest extent possible. To achieve this goal, radiotherapy plans for individual cancer patients are designed to deliver the desired spatial dose distribution to the patient. The radiotherapy plan will be then used on a daily basis to deliver a fraction of the prescribed radiation dose over the course of the treatment. However, there is biological evidence suggesting that additional therapeutic gain may be achieved if we allow for temporal variation in the radiotherapy plan. This research aims at developing a spatiotemporal radiotherapy planning approach to quantify the potential benefit of varying radiotherapy plans and thus the spatial dose distribution over the treatment course. This gives rise to a large-scale non-convex treatment-plan optimization problem, which is solved using global optimization techniques. The proposed approach is applied to stylized cancer cases to test the computational performance of the solution method and to quantify the potential therapeutic benefit of varying the radiotherapy plan over the course of the treatment. The experimental results show a therapeutic gain (ranging from 2% to 20% depending on radio-biological parameters) can be achieved by using spatiotemporal dose distributions over time-invariant ones.