AbstractID: 14499 Title: Some uses of neural networks in radiation therapy

Artificial Neural Networks (ANN) have become a staple of machine learning applications. They can be used for pattern recognition, data classification, and process control problems, several of which come up in modern radiation therapy. In this presentation we will look at two representative applications of ANNs: (1) the prediction of breathing, to compensate instrumental lag time in systems that automatically compensate for respiratory motion of a tumor; (2) the analysis of patient setup corrections generated automatically via rigid image registration, to recognize poor or failed results as a quality assurance (QA) measure.

All systems that attempt to actively compensate respiratory motion will have intrinsic delays that necessitate predicting the future tumor position by up to several hundred milliseconds. However, every patient breathes differently, which makes the use of analytical breathing models problematic. An ANN is capable of learning the breathing pattern of any given patient directly from incoming data and making an accurate prediction of its future amplitude. We will show examples of this application.

Image-guided radiation therapy (IGRT) relies on image acquisition and registration to optimally position the patient for treatment. However, rigid image registration algorithms can sometimes fall into local minima that can be far removed from the optimal setup position. If one identifies a set of significant “features” of the registration result, such as the shape of the cost function surface in the neighborhood of the solution at convergence, an ANN can use them to classify a particular registration as good or bad, according to some predetermined criteria. This provides an important QA tool to assess patient setups.

Learning objectives:
(1) learn the basic concepts of ANNs as they are used for pattern recognition and classification.
(2) learn how to use an ANN in a real-time tumor tracking process.
(3) understand how an ANN can be trained and used to recognize imperfect patient setup shifts for QA purposes.