

AbstractID: 12091 Title: MR imaging for real-time radiotherapy guidance

The exquisite soft tissue contrast, 3D imaging capability, and lack of radiation dose brings magnetic resonance imaging into consideration for guiding external beam radiation therapy of thoracic and abdominal tumors which undergo significant intrafraction motion. For example, in the case of lung cancer, which accounts for 13% of radiation therapy recipients, tumors may move on the order of 20 mm at a rate of 10 mm/s. MRI is ideally suited to continuously monitor the geometry of the tumor for real-time modification to the treatment protocol. However, there are technical challenges to integrating a radiation therapy system into an MRI system. In this talk, we discuss the considerations for the MRI system in MR-guided radiotherapy.

For the MRI system geometry, several MR systems have been proposed that vary in field strength and system geometry. In the evaluation of these geometries, consideration should include system performance and requirements. Deviation from the conventional cylindrical MRI system affects the field strength, gradient performance, and magnetic field homogeneity. Even with a given magnet geometry, there are tradeoffs in the imaging choices that can be made. Since the signal-to-noise ratio is proportional to the field strength, the voxel volume, and the square root of the acquisition time, the voxel volume can be traded off for temporal resolution. Different pulse sequences have different inherent contrasts and signal levels. All of these affect the ability to perform the imaging task, but must be considered within the context of the goal to localize the boundary of the tumor target with sufficient temporal and spatial resolution.

Other system considerations might include the use of radiation transparent RF coils. Another consideration is the effect on the MRI of other equipment. High magnetic susceptibility metals such as iron, steel, and many stainless steels experience large forces that would pull them into the MRI system. Lower magnetic susceptibility metals such as aluminum and lead can be safely used within the MRI magnetic field, although care must be taken to minimize eddy currents that may be induced in them, as this may affect imaging performance.

Learning Objectives:

1. Understand the tradeoffs in imaging capabilities with different MRI system geometries
2. Understand the tradeoffs in MR imaging of tumors for real-time therapy guidance