

RESEARCH PROPOSAL

Development of a Soft Robotics Diaphragm to Simulate Respiratory Motion

Primary liver cancer is globally the most frequent cancer and the leading cause of death from cancer. In order to increase the success rate in diagnosis (i.e. biopsy) and treatment (e.g. ablation) of liver cancer, surgeon needs to accurately target the lesion. Being located right below the diaphragm, liver undergoes considerable motion during respiration. The outcomes of the surgery highly depend on the compensation for the respiratory motion of the liver during the operation and the expertise of the surgeon.

A robotic system that simulates the respiratory motion of the liver can help testing and improving surgical techniques for accurate targeting of the lesion. Besides, the system can be used for training clinicians on imaging-guided percutaneous interventions such as biopsy and ablation. Liver tumors are often detected using MRI. MRI is preferable over other imaging modalities include absence of ionizing radiation, superior soft tissue contrast resolution, and multiplanar imaging capabilities.

In order to train clinicians to compensate for the liver respiratory motion during intervention, and also test needle insertion robotics technologies, a realistic liver motion simulator is of great interest which can be used inside MRI scanner.

An MR-compatible robotic phantom can simulate the liver respiratory motion in two directions using two directional pneumatic actuators corresponding for SI and AP motions. Respiratory-induced motion due to applied displacement on liver by surrounding tissue can help in better understanding of the tumor and liver motion/deformation. A bio-inspired robotic simulator can beneficially provide a platform to realize realistic features during respiration (i.e. liver deformation) while inputting measurable motions (from real cases) to the phantom (i.e. diaphragm motion).