O-51

TWO-DIMENSIONAL MAGNETIC CATHETER NAVIGATION WITH APPLICATIONS IN ENDOSCOPY

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Abstract

Aims: The aim of this project was to design and construct a two-dimensional electromagnetic navigator for steering an endoscopic magnetic catheter and to demonstrate the integrated system in endoscopic navigation in a model of the human lung.

Background: Lung cancer is the leading cause of global cancer death accounting for 1.4 million deaths annually[1]. Suspected nodules will generally require further biopsy and endoscopic access to the lung, (*i.e.*, bronchoscopy) is the safest and most cost effective method[2]. Traditional endoscopic biopsy has limited range and is unable to access peripheral lung nodules where early-stage cancers are most likely to occur[2,3]. Alternative approaches (*e.g.*, CT-guided needle biopsy and surgery) carry significant rates of complication and added cost.

Methods: The current system was designed to facilitate 2D guidance of a magnetically-tipped catheter using two orthogonal electromagnetic coils. A simple catheter consisting in a guidewire with an attachment of connected permanent magnetic spheres was constructed. In the presence of a magnetic field, the catheter tip could be deflected by up to 90 degrees. Various magnetic tips were investigated and characterized. The catheter was steered using a gaming joystick.

Results: Magnetic catheter steering was demonstrated in a rigid benchtop model of the human lung. The axial insertion of the catheter through the model was achieved with a motorised jockey wheel. By recording the angle of tip deflection from the joystick, the real-time position of the catheter tip within the lung model was visualised in a 3D augmented reality view of the model.

Conclusions: This simple benchtop model demonstrates the potential for electromagnetic steering coupled to virtual navigation as a tool for accessing peripheral nodules in the human lung. Future work will seek to improve the steerability and control of the magnetic catheter as well as implementing 3D navigation. A video abstract to accompany this work is available at http://youtu.be/HbbnPGzmyfM

References

1. WHO Cancer Statistics. (2008) World Health Organisation. [Online]. www.who.int/mediacentre/factsheets/fs297/en/

2. Patricia M. Rivera and Frank Detterbeck, "Diagnosis of Lung Cancer," CHEST, vol. 123, no. 1, pp. 129S - 136S, 2003.
3. Peter Mazzone, "Bronchoscopy and needle biopsy techniques for diagnosis and staging of lung cancer," Clinics In Chest Medicine, vol. 23, no. 1, pp. 137-158, March 2002.