Repurposing Microsoft Kinect for Motion Correction in the MRI environment

P. J. Noonan PhD, J.W.Howard PhD.

Target audience

There are many potential uses for motion tracking in medical imaging. Advances in digital cameras and depth sensing have simplified the use and reduced the cost of motion tracking, bringing this capability within the reach of various healthcare fields.

PURPOSE

The purpose of this study is to evaluate the feasibility of using the Microsoft Kinect in an MRI or MR-PET environment: Acquiring information from a sequence of MRI images is done by applying statistical techniques that assume the location of a given voxel within the brain does not change. However, there is often some subject motion during the data acquisition, which results in reduced image quality.

METHODS

The Kinect is a motion sensing input device by Microsoft for Xbox game consoles. The v2 Kinect uses a state-of-the-art infrared laser projector, camera and time-of-flight depth sensing technology that enables users to interact with the computer through the use of natural gestures. The Kinect samples depth at 30 frames per second and KinectFusion, a GPU based registration algorithm, allows for the position and orientation of a rigid object to be measured in real-time. Multiple views of a rigid object allow the Kinect to obtain many lower resolution depth images of the object that are then registered together to produce a higher resolution 3D model. Positron Emission Tomography brain scans can last over 60 minutes and accurate motion tracking is essential to motion correct high resolution PET images. A mirror was used to enable the Kinect to view the head face-on inside the PET/CT gantry and subjects undergoing PET/CT studies were motion tracked using the Kinect.

RESULTS

Pose estimation of the head was accomplished using the Kinect. An example 90 minute data set is presented showing that the small (~1 mm) motion of the head caused by breathing can be resolved.

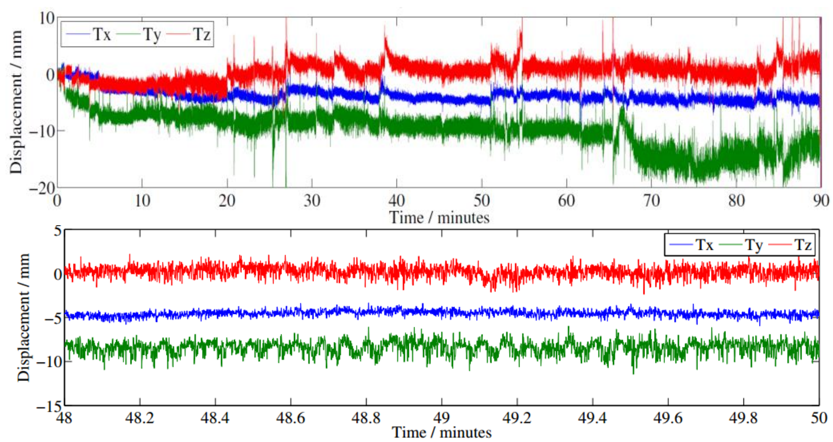

Figure 1. (Top) KinectFusion was used to register single Kinect frames onto a global volume. This enables the rigid body motion of the head to be measured at 30 Hz. KinectFusion creates a mesh of the surface of the face detected by the Kinect, which allows to the registration to the CT volume

Figure 1. (Bottom) A two minute segment of the previous data is shown. Small motion can be resolved even with the limited depth resolution offered by the Kinect v1 sensor.

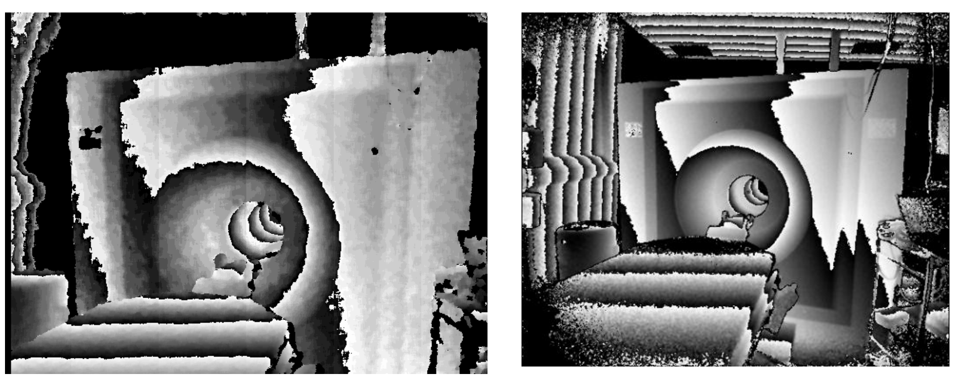

Figure 2. Greyscale depth images modulo every 256 mm obtained with the Kinect v1 (Left) and v2 (Right). This figure highlights the improved depth resolution of the v2 and its larger field of view. Both sensors were placed at approximately the same location relative to the PET scanner.

DISCUSSION

In an attempt to translate the techniques we have developed for PET across to the MRI environment, preliminary experiments are currently being performed on a 3T Tim Trio system (Siemens Erlangen, Germany) equipped with a Kinect unit contained within an RF shielded enclosure. The Kinect is positioned at a distance of 3m to the peak field strength and is capable of operating and sending data via an optical USB link to the host PC. The superior depth resolution of the Kinect v2 allows for the senor to be positioned at the increased distance from the peak field strength whilst retaining sufficient sampling points on the surface of the subject.

CONCLUSION

An application is presented using the Kinect to demonstrate the technology's potential for motion tracking in medical imaging. Our work in PET has demonstrated that rigid body head motion can be measured in real time without any contact to the patient and we anticipate that these techniques will allow for sub-millimetre motion tracking at 30Hz in the MRI environment.