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Implementation of a patient motion monitoring system using Kinect V2 sensor

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INTRODUCTION

- ✓ ***Patient motion often compromises dosimetric accuracy***
  - ***Use different motion monitoring systems*** *in clinics to account for that.*[1-4]
  - *BUT, they are* ***mostly expensive*** *and most monitoring systems mounted provide* ***less (or zero) mobility to share*** *with other imaging and treatment systems.*[1-3]

AIM

- ✓ ***Propose a motion monitoring technique with Kinect V2 sensor.***[4]
  - *Improve installation flexibility.*
  - *Maintain monitoring system consistency in radiotherapy procedures.*

METHOD

- ✓ *Utilize a Kinect sensor to monitor a marker position.*
  - *Set the market (40 mm x 50 mm) at 600 mm ~ 700 mm distance from the Kinect at where to monitor motion.*
  - *Adjust the angle of marker on a hinge frame to directly face the Kinect sensor.*
- ✓ *Monitor the marker motion in three steps:*
  1. *Determine a reference marker position and its minimum and maximum range prior to real-time monitoring.*
  2. *Monitor a target motion in real-time with/without the intervention of imaging and treatment using given warning messages (i.e., ±3mm threshold of ranges).*
  3. *Write a log of measured and analyzed data for further uses.*
- ✓ *Implement a patient motion monitoring system using Kinect sensor on C# and .NET framework platform.*
- ✓ *Evaluate the efficiency of motion monitoring.*
  - *Simulate motions in 10, 20, 30 and 40 mm displacements.*
  - *Compare centroid motions between simulated and measured in root mean square (RMS).*

RESULTS

- ✓ *A motion monitoring system was proposed (Figure 1) and implemented to quantify the motion of cancer patients for potential intervention.*

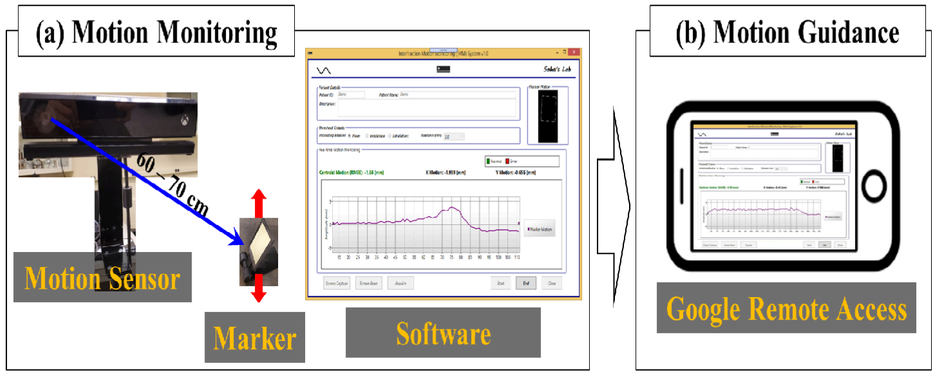
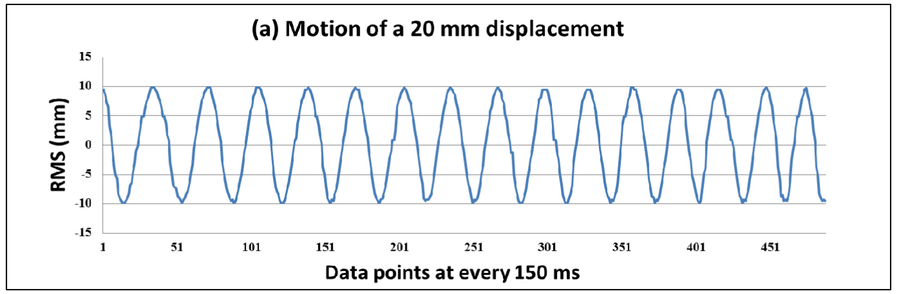
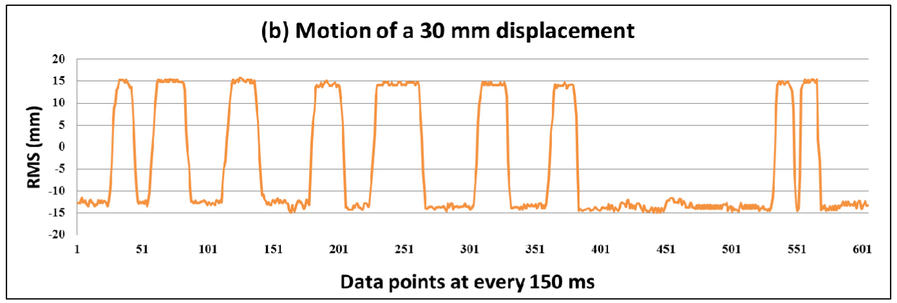


Figure 1. *The workflow of (a) motion monitoring and (b) motion guidance.*

- ✓ *The RMS of centroid marker motions was measured at 10.4 mm in range [−5.8 mm, 4.6 mm], 19.7 mm in range [−9.9 mm, 9.8 mm], 30.6 mm in range [−14.8 mm, 15.8 mm] and 39.2 mm in range [−13.5 mm, 25.7 mm] across the four displacements, respectively.*

Figure 2. *Two examples of motion monitoring with (a) a 20 mm and (b) a 30 mm displacement.*





CONCLUSIONS

- ✓ *This study demonstrated sub-millimeter accuracy in real-time motion monitoring.*
- ✓ *This will be potential for motion monitoring of cancer patients during medical imaging and radiotherapy.*
  - *Target motions during medical imaging and radiotherapy.*
- ✓ *In addition, visual guidance with motion traces is highly considered as a function of improving dosimetry accuracy.*
  - *It will potentially provide motion guidance as a function of biofeedback to improve imaging and treatment outcomes.*

REFERENCES

1. **Li XA, *et al.***, Technical and dosimetric aspects of respiratory gating using a pressure-sensor motion monitoring system. *Medical physics. 2006 Jan;33(1):145-54.*
2. **Krengli M, *et al.***, Reproducibility of patient setup by surface image registration system in conformal radiotherapy of prostate cancer. *Radiation Oncology. 2009 Dec;4(1):1-0.*
3. **Eccles C, *et al.***, Reproducibility of liver position using active breathing coordinator for liver cancer radiotherapy. *International Journal of Radiation Oncology* Biology* Physics. 2006 Mar 1;64(3):751-9.*
4. **Xia J, *et al.***, A real-time respiratory motion monitoring system using KINECT: proof of concept. *Medical physics. 2012 May;39(5):2682-5.*

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