Instability of OSMS Camera Caused by HVAC Vent

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Purpose/Objective(s)

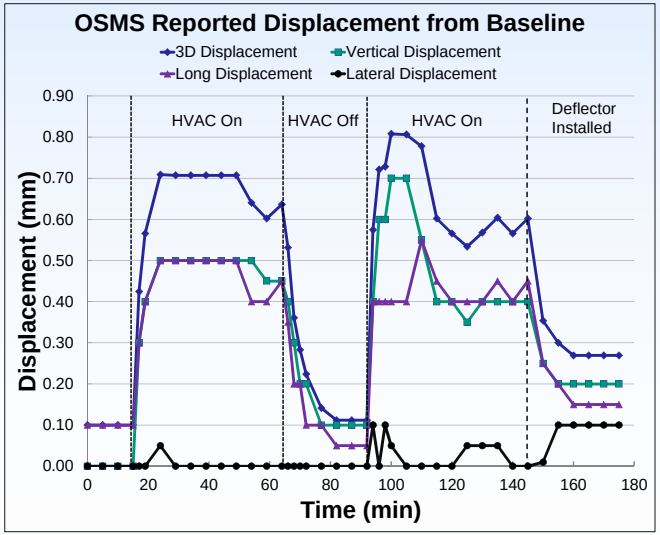
We noted during commissioning of our Optical Surface Monitoring System (OSMS) that thermal equilibrium was never reached after the camera was turned on. An oscillatory behavior was observed in the reported displacement of a static phantom being monitored by OSMS over a course of forty minutes. The purpose of this study was to investigate the effects of an HVAC unit on the thermal drift of our OSMS.

Methods/Materials

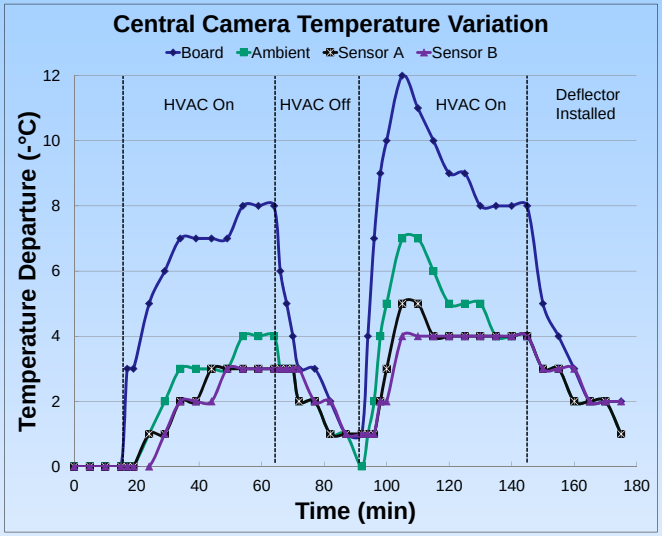
The OSMS consists of three ceiling mounted cameras: one central camera located near the end of the treatment couch and two located on either side of the couch. The central camera was installed directly in front of an HVAC vent which causes significant variation in temperature in the vicinity of the camera. The OSMS cameras report four temperature readings: ambient, board, sensor A, and sensor B. The temperature readings from the central and left cameras were recorded at the same time displacement measurements were made. The OSMS camera thermal drift was isolated by turning off the HVAC system and allowing the temperature to stabilize over an hour, with the OSMS cameras and projected speckle pattern turned on. An anthropomorphic phantom was placed on the table and a reference image was captured at time zero. Measurements were taken to show the thermal drift had stabilized, before the HVAC unit was powered on at T = 15 min. OSMS reported phantom displacements from reference conditions and camera reported temperatures were recorded at 2-5 minute time intervals while the HVAC system was manually cycled on (T = 15 min), off (T = 64 min), and then on again (T = 92 min). At T = 145 min an air deflector was installed on the ceiling vent to direct the flow of air away from the central OSMS camera.

Results

We observed an overall 3D displacement from baseline of 0.6 mm - 0.7 mm with the HVAC unit on and airflow directed at the central OSMS camera. The majority of the displacement (0.5 mm – 0.6 mm) occurred over the first four minutes of HVAC operation, with stabilization occurring after eight minutes. The return to baseline occurred more gradually after the HVAC unit was powered off, with a total time to stabilization of eighteen minutes . The longitudinal and vertical reported displacements were similar in magnitude while the HVAC was on, with a range of 0.40 mm – 0.50 mm and 0.35 mm – 0.70 mm, respectively. The lateral displacement was negligible with a range of 0.00 mm – 0.05 mm. All four temperature readings reported by the central camera indicated a decrease in temperature after the HVAC was turned on, and correlated well with the OSMS reported displacements. The peripheral cameras showed no change in temperature with respect to the HVAC unit. Installing an air deflector decreased the magnitude of displacement with the HVAC on from 0.6 mm to 0.3 mm.



Results



Conclusion

We found that variations in temperature do affect the OSMS stability. HVAC vent proximity to a camera can create an additional source of thermal displacement beyond the expected thermal drift that is seen under normal conditions. Care should be taken when having an OSMS installed and when characterizing the thermal drift. Do not mount the cameras near HVAC vents where possible or do install deflectors to minimize instability in OSMS and unnecessary complications during the delivery of high precision stereotactic treatments.

References

•Willoughby T, Lehman J, Bencomo J, *et al*. Quality Assurance for nonradiographic radiotherapy localization and positioning systems: Report of Task Group 147. *Med Phys* 2012; 39(4) 1728-1747.