

AbstractID: 3759 Title: Laser rangefinder for automatic SSD measurement and inter-fraction patient movement monitoring.

**Purpose:** Source to Skin Surface Distance (SSD) is one of the most frequently used reference parameters for patient setup to verify the depth of treatment for external beam treatments in clinical radiotherapy. Modern machines use an Optical Distance Indicator (ODI) mounted inside the linear accelerator or a Front Pointer (FP) where the use of the ODI is precluded. In IMRT and IGRT, more precise tools are needed to monitor and record SSD, and provide information on patient movements during therapy. Additionally, automatic capture and recording of SSD data is preferential in busy clinical settings. We describe the use of a commercially available laser rangefinder to report SSD and inter-fraction patient movement in real-time.

**Methods and Materials:** The Acuity Research Model AR4000-LV was evaluated as a tool to measure SSD and inter-fraction movement. The device emits a visible laser spot (670 nm), and a time-of-flight measurement is obtained from the reflected beam from diffuse reflectance surfaces. Output data is provided either as a voltage or as a digital stream. The device was tested both on an optical bench (for absolute measurements) and on a phantom on the treatment couch. Tests were performed statically and during measured oscillations of the phantom.

**Results:** Un-calibrated accuracy was as described by the manufacturer;  $\pm 3.8$  mm. However, precision was much better at  $\pm 0.254$  mm. Calibrated measurements improved accuracy to  $\pm 1$ mm. Measurements on non-planar and tilted surfaces were also tested, and were unchanged at angles up to  $45^\circ$ .

**Conclusions:** We show the ability of off-the-shelf technology to improve the efficiency and repeatability of SSD measurements. Also, minor patient movement can be monitored in real-time. We find the laser rangefinder to be precise, time efficient and very accurate for determining and verifying SSD. We will evaluate its use in clinical studies.