

Optical guidance (OG), such as optical distance indicator (ODI), in-room laser alignment, and live-video camera monitoring, has been routinely used in conventional radiotherapy for patient setup and monitoring. Now, emerging OG using optical tracking and topologic imaging (stereovision) techniques can provide remote operators with real-time measurements of patient body (or support apparatus) position, shape, and movement. The temporal and spatial OG will be an essential component in any advanced image-guided radiotherapy (IGRT) when patient or organ motion are considered during the dose delivery. In assisting users to become familiar with the new OG techniques, this education session will start with an introduction on basic photogrammetry, general camera calibration, triangulation principle for 3D optical imaging, surface extraction and registration, and what OG systems can and cannot do. Then, the session will move to the clinical use of infrared patient positioning and tracking systems (IPT) with particular attention to the combined use with other imaging systems, detection and correction with six degrees of freedom for rigid body displacement, and issues in attachment of the infrared reflection markers. That will lead up to actual use ISG, integrated stereovision-guided patient reposition and monitoring systems, focusing on quantification of the body position and displacement prior to and during beam or arc irradiation. ISG adaptive radiotherapy of the brain, H&N, lung, and breast cancer will be demonstrated using examples from early clinical trials. The effects of target motion and deformation, skin tones and room light conditions are also discussed.

Learning Objectives:

1. Understand the spatial and temporal characteristics of advanced OG
2. Understand the basic operation principle of 3D optical systems
3. Know how to check and calibrate the optical camera systems
4. Understand why multiple infrared reflection markers have to be fastened to the patient
5. Know how to quantify and correct the displacements with six-degrees of freedom
6. Know how to surrogate optical surface images with CT/MR volumetric images
7. Know how to acquire reliable surface images prior to and during X-ray irradiation
8. Understand the limits and benefits in application of OG in clinical settings