

# Surface Mapping of Couch Kick Cherenkov Images for Rotation-Independent Treatment Verification in External Beam Radiotherapy

Alexander Geiersbach<sup>1</sup>, David J. Gladstone, ScD<sup>1</sup>, Allison Matous, MD<sup>2</sup>, Lesley A Jarvis, MD<sup>3</sup>, PhD and Petr Bruza<sup>1</sup>  
<sup>1</sup>Thayer School of Engineering, Dartmouth College, Hanover, NH, <sup>2</sup>Dartmouth Health, Lebanon, NH, <sup>3</sup>Dartmouth Cancer Center, Lebanon, NH

## ABSTRACT

**Purpose:** During external beam radiation therapy, couch kicks are often necessary to achieve effective treatments, yet they make interpreting Cherenkov images much more challenging. We present a surface-based solution to this problem by mapping each eld onto the patient surface CT, allowing clinics to view all elds on a stationary patient.

**Methods:** Cherenkov images were preprocessed to separate each treatment eld and raycasting was utilized to project each Cherenkov image onto the corresponding rotated patient surface. Multiple Cherenkov camera angles were combined to provide sufficient patient surface coverage. A composite patient surface was reconstructed with the patient at isocenter and with zero couch rotation. To verify accuracy, a standard plan was delivered to an anatomical Annie phantom with scintillator dots present to verify spatial accuracy of the projection algorithm. Several patient datasets were analyzed using the raycasting correction.

**Results:** Cherenkov images were successfully mapped to the patient surfaces in both the phantom test and clinical cases. Reconstruction made clinical treatment monitoring significantly easier for clinical staff.

**Conclusion:** This proof-of-concept study demonstrates an efficient method to improve clinical workflow and patient safety by eliminating couch kicks as a variable in Cherenkov imaging. Therapists and physicians no longer need to spend valuable time attempting to interpret rotated images, and instead can immediately review patient treatments from a natural and intuitive point of view.

## CONTACT

Alexander Geiersbach  
 Thayer School of Engineering  
 Dartmouth College  
 Alexander.Geiersbach.TH@Dartmouth.edu  
 (302) 824-6834

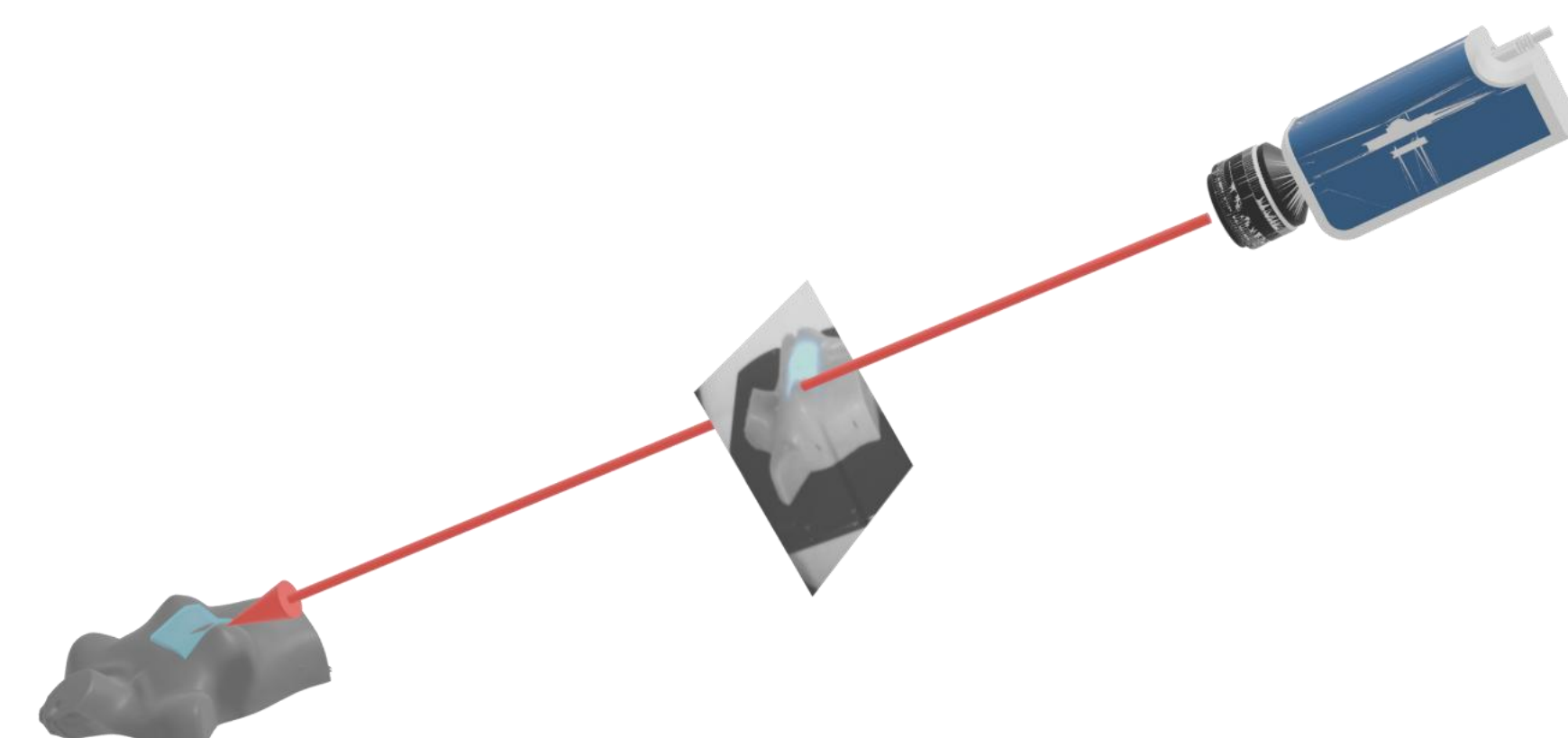
## INTRODUCTION

Cherenkov images are incredibly useful for qualitatively assessing treatment fields are delivered correctly during RT treatments. However, patients with couch kicks during treatment result in ghosted cumulative images that are hard for clinical teams to interpret. This work virtually transforms the couch kicks to a 0-degree couch position to remove ghosting artifacts and accumulate images from a patient-centric point of view.

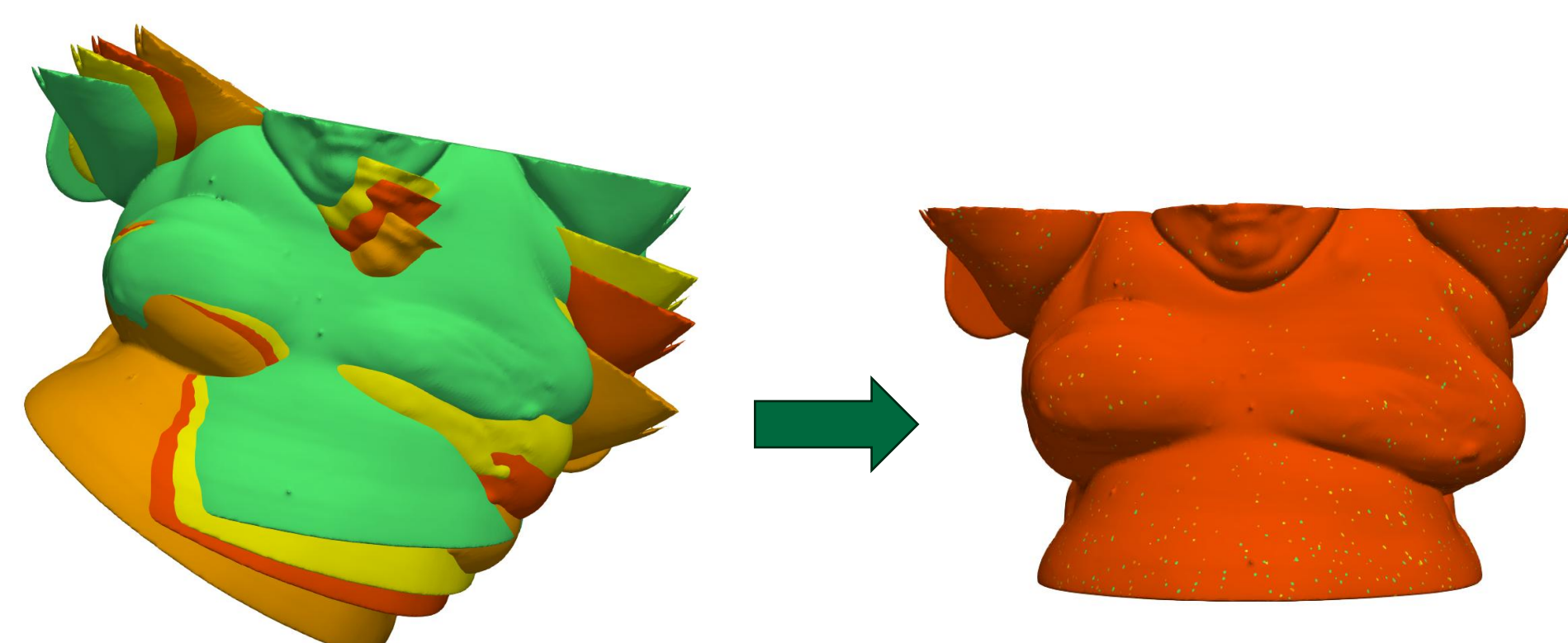
## METHODS AND MATERIALS



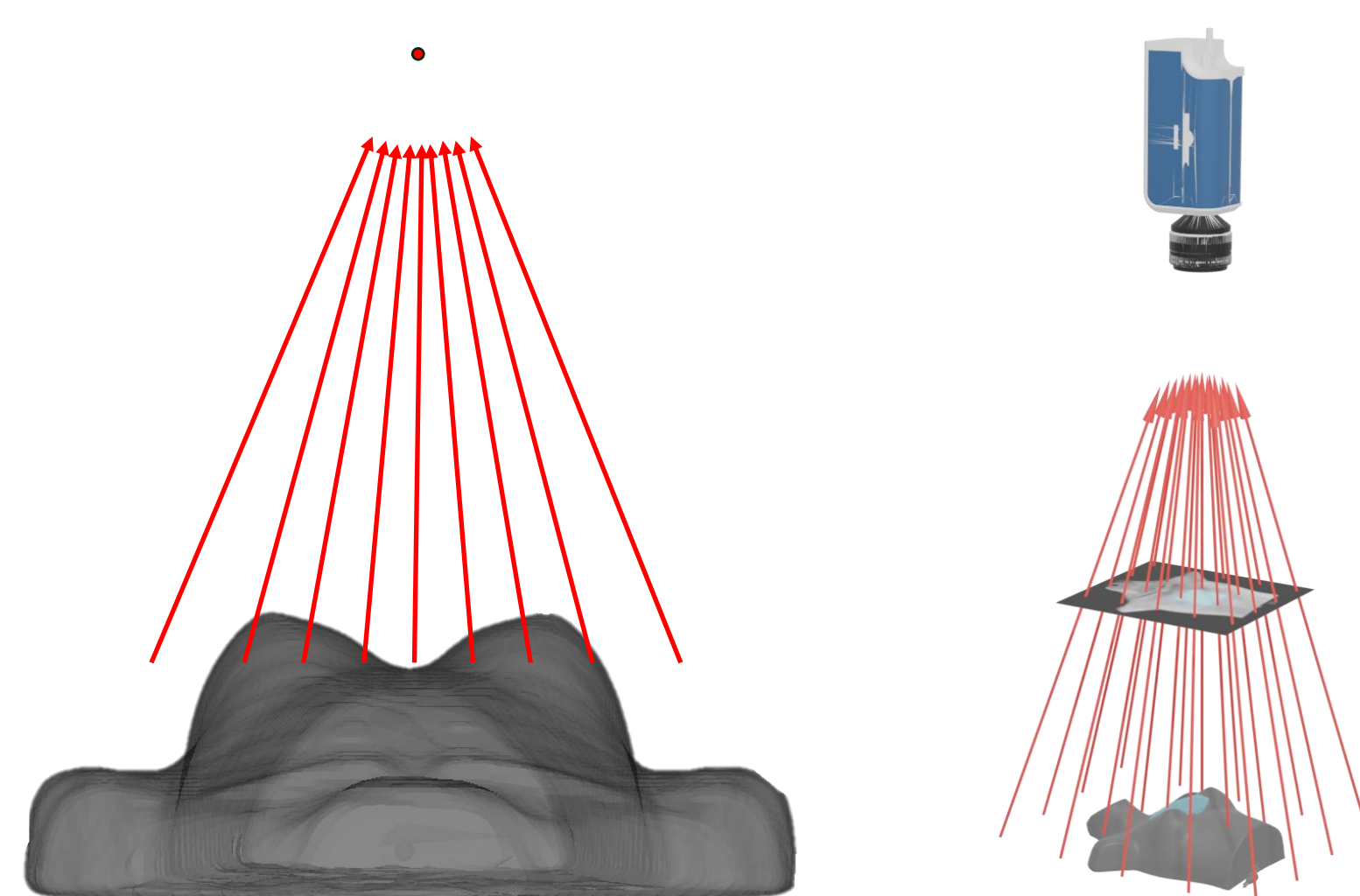
1. Couch kick angles identified and raw images split into individual treatment fields



2. Cherenkov and background images projected onto patient surface mesh

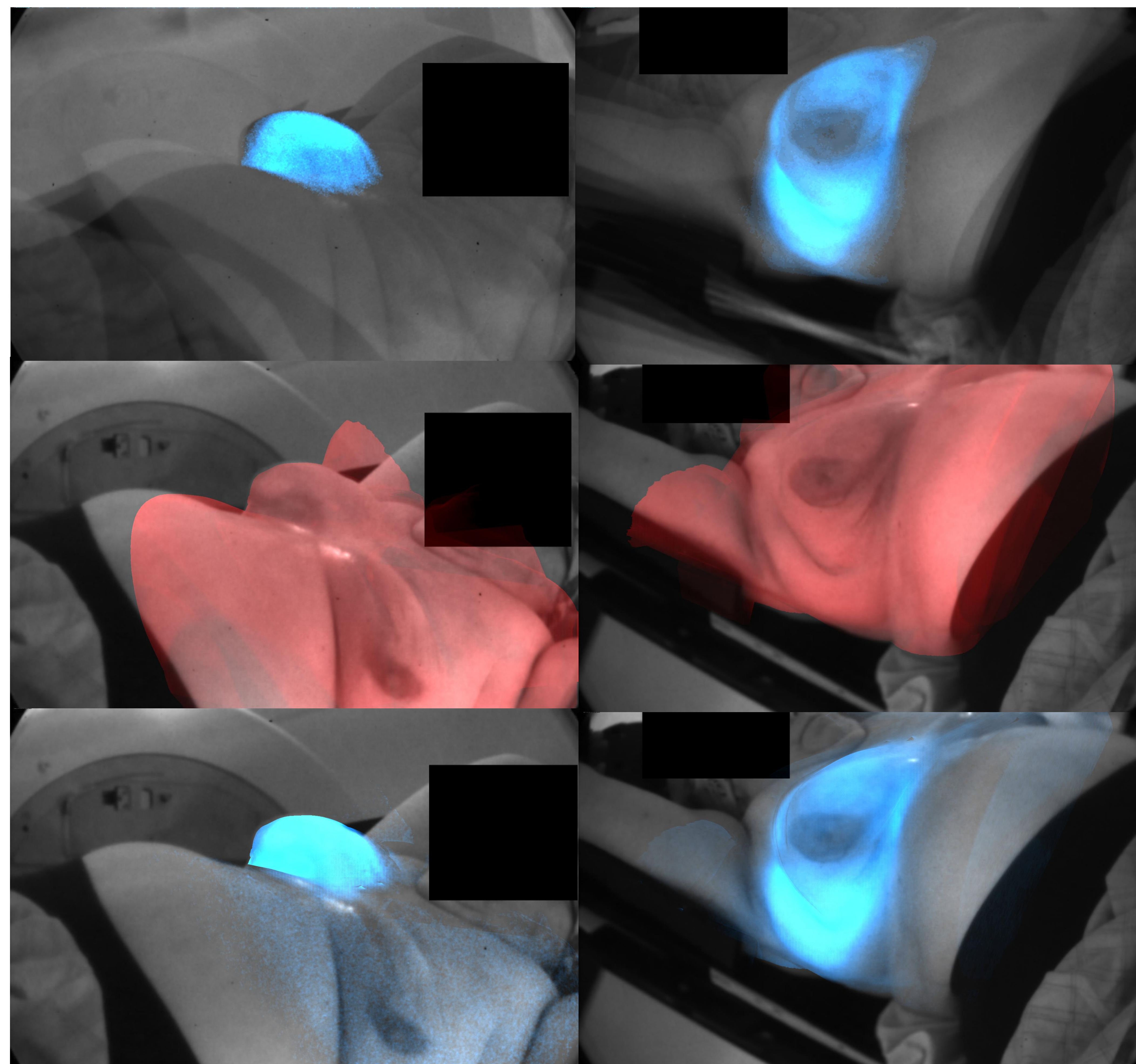


3. Surface projections rotated to a virtual couch angle of 0 degrees



4. Virtual 0 degree image generated from Cherenkov camera positions

## RESULTS



- **Top:** Patient surface overlay showing original image with ghosting artifacts and plan vs treatment alignment.  
**Bottom:** Virtual cumulative Cherenkov image accumulated on patient surface without ghosting artifacts

