# Direct On Patient Image Display with a Laser PicoP Projector For Medical Device Placement

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## Introduction

Positioning of medical devices on or in the patient before an MR-guided procedure is hampered by the need to pull the patient out of the imaging system for the initial placement. Visualization of the anatomy below the skin surface could provide a quick assessment of the device placement. The purpose of this work was to demonstrate the feasibility of displaying images directly on patients from above the scanner to aid in device placement.

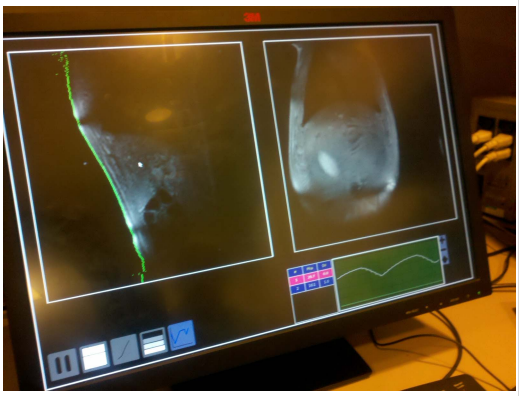

*Figure 2: User interface highlighting the sagittal (left) and coronal (right) images collected. The green line on the sagittal image represents the edge determined from filter.*

## Methods

A laser PicoP projector (PicoP Evaluation Kit, Microvision, Inc, Redmond, WA) was mounted above the table of a 3T scanner (GE Signa Excite, GE Healthcare, Waukesha, WI), as shown in Figure 1. The projector was aligned such that it pointed directly down onto the patient table. A laser PicoP projector utilizes a laser and a scanning MEMS mirror to rapidly raster pixel information along a grid [1]. The rastering occurs fast enough such that to a human eye a normal image is displayed. Because collimated lasers are used to project images, laser PicoP projector images are always in focus no matter the distance from the device, no matter the surface. The projector's throw ratio was also modified such that the image dimensions on the table were identical to table width itself. The projected image was next calibrated with a four point calibration at two elevations: the base of the table and the magnet's isocenter. Using these measurements, each point in space could then be related to the projector pixel location that would illuminate this point.

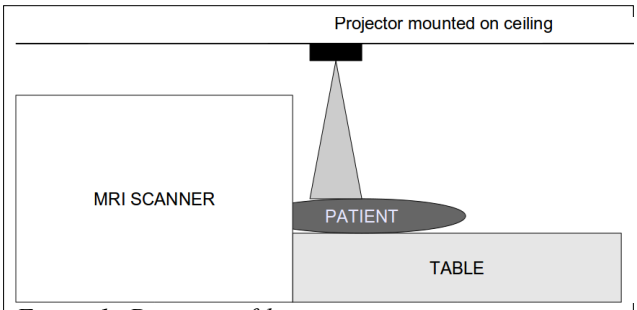


*Figure 1: Diagram of laser projector projecting on top of patient lying just outside the magnet.*

To demonstrate the concept of direct on patient imaging a pig was inserted into the magnet and multi-slice coronal and sagittal scans were acquired throughout it, shown in Figure 2. The anterior edge of each sagittal image was determined using a simple [-1 1] kernel edge detection algorithm. The magnet space of each of these edge pixels was determined and then converted into projector pixel space. The animal was then brought back out of the magnet and the projector was activated. Using a custom interface, a user could project the acquired coronal slices on the surface of the animal and pan through the previously acquired slices. The experiment was also performed in a standard phantom.

*Figure 3: Representative images displayed on a phantom (left) and in an in vivo demonstration (right). The in vivo one has the image displayed on a piece of paper above the animal to make the image visible from the limited photography camera angle.*

## Results and Discussion:

Figure 3 shows an example image of the phantom and animal images being displayed on itself. A white chuck was placed on the phantom to make the image more discernable, especially since the phantom was transparent. While the lights had to be reduced to improve visibility of the projected image, in both cases the image data was visualized. Visibility could be improved by increasing the laser power, but for this study maintaining a lower class laser safety setting was desired.

This experiment was a proof of concept of displaying images with this laser projector on top of an object on the table. One immediate use is transducer placement for high intensity focused ultrasound. For transducer placement, multiple options exist. First, the coronal images, similar to as displayed in this study, could be used to visualize the anatomy underneath the skin before determining where to place the device. These volume images could also be tied into treatment planning software, which could more precisely determine optimum treatment location and display on the patient; the technologist would merely need to place the device in the directed location. Further modifications could include accelerometers for determining transducer tilt in addition to its general location.

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**References:** Freeman et al. Scanned Laser Pico projectors: Seeing the Big Picture (with a Small Device). Optics and Photonics News 2009; 20(5): 28-34.