ABSTRACT

This capstone project presents an innovative approach to improving the Transcatheter Aortic Valve Implantation (TAVI) procedure. Our team has developed a novel program that autonomously computes the coordinates of fiducial markers from medical DICOM imagery, which are then sent to the space resection code to determine the angles of the C-Arm X-ray machine. By providing doctors with an efficient and precise means of obtaining a view of the patient’s anatomy, our solution minimizes the risk of the potentially harmful fluoroscopic dye that is typically administered during the TAVI procedure. This enhanced efficiency and precision enable smoother and more successful insertion of the prosthetic valve into the aorta, thereby reducing the risk of the procedure and increasing its viability for a greater number of patients. Our findings suggest that this technology has the potential to significantly improve the outcomes of TAVI procedures, ultimately enhancing the quality of life for many patients.

MATERIALS AND METHODS

Materials
- MATLAB (Space Resection, Point Identification, DICOM file loading)
- Python (Space Resection)
- Philips Medical AlluraXper (Fluoroscope)
- Siemens SOMATOM Force (CT Scanner)

Methodology
- BB Pellets located on patients’ skin
- Pre-operative CT Scan taken
- BB identification in CT images
- Patient in OR
- Fluorescopic images taken
- BB identification in Fluoroscopic imagery
- Space resection to determine C arm alignment

RESULTS

Space Resection
The developed program was able to successfully converge and compute the fluoroscopes orientation, as well as its precision and using back projection and comparing expected vs. computed fluoroscopic output.

The resultant orientation values showed some deviation from expected camera location. The expected rotation angles were [0, 0, 180] degrees, while the expected translation was [0, 0, 800] mm. This deviation significantly from the results of [20.2, -5.4, 179.0] degrees in rotation and [961.5, -495.61, 620.91] mm in translation. The adjustment in rotation could be attributed to the control measurement orientation. While a translation of ~500mm from expected seems large, it could be explained based on the size of the C-Arm/CT machine, and an adjustment in coordinate origin.

Point Identification
Using the edge detection algorithm, we were able to define a region of interest to limit the search of the region property’s function. This same approach was taken to identify the BB locations within the 3D CT images. The results, when contrasted with the 2D point identification, are more ideal as all the control points were found in a sequential manner and none of the control points were missed. The example image to follow shows a BB located on both the segmented and original CT image slice.

REFERENCES
