Real-time Integration of Fully Automatic 2D/3D Pelvic Registration with Robotic X-ray Acquisition

- **Students will:** Integrate anatomical landmark detection, intensity-based registration, and robotic X-ray imaging, providing patient pose with respect to an optically tracked patient array.
- **Deliverables:**
  - **Minimum**: CT-based registration of Loop-X 2D images with the patient array in a documented, user-friendly solution, validated on phantom.
  - **Expected:** The above, validated on cadaveric images, with a novel view-rendering application for projective visualization.
  - **Maximum**: The above, plus integration with mixed reality visualization of relevant anatomy. Submission to a peer-reviewed conference or journal.
- **Group size:** 1-3
- **Skills:** Python, C++, bash, computer vision.
- **Mentors:** Benjamin Killeen (killeen@jhu.edu), Prof. Mathias Unberath (unberath@jhu.edu)

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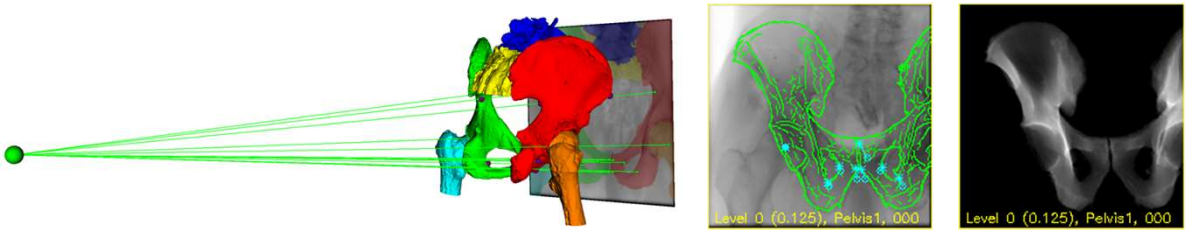
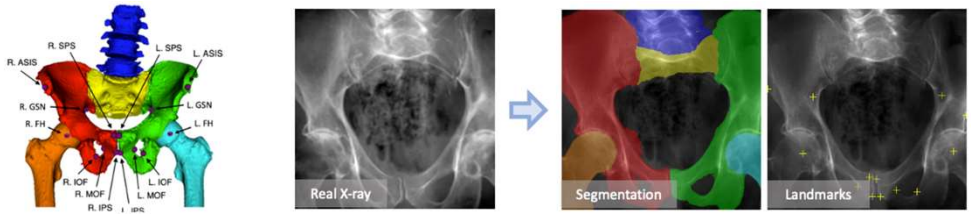
Technical Details

- **Intensity-based** 2D/3D registration (fine, low capture range)



- **Automatic landmark detection** (coarse, large capture range)



Grupp, Robert B., et al. "Automatic annotation of hip anatomy in fluoroscopy for robust and efficient 2D/3D registration." International Journal of Computer Assisted Radiology and Surgery (2020): 1-11.

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Summary

- **Loop-X:** A mobile, fully robotic X-ray device with built-in navigated CT and X-ray (for gold-standard ground truth comparison).

Retrieve Loop-X images

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Landmark detection

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Intensity-based registration

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AR Visualization

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