Respiratory motion management is crucial for spot-scanned proton therapy, where motion-induced dosimetric "interplay" effects can severely perturb the planned dose distribution. Our proton therapy vendor developed a stereoscopic kV x-ray image guidance platform along with a 3D/2D image matching algorithm for 6 degree-of-freedom patient positioning with a robotic couch (6DOF couch). However, this vendor-provided imaging platform lacks the capability to adequately handle real-time kV fluoroscopy, which is crucial for aspects of motion management.

### Objectives

- **Real-time Handling of Pulsed Fluoroscopy**
  - Interleave imaging frames with proton spots
  - Allow real-time internal organ motion verification
  - Reduce imaging dose to the patient
- **Accurate Overlay of DICOM RT-STRUCT Contours**
  - Overlay structures (e.g. ITVs) on top of live fluoroscopy
  - Correct geometrical errors in FPD placement

### Methods

1. **Fast video-splitting to passively copy fluoroscopic frames from vendor platform**

2. **Custom acrylic phantom with steel BBs for room-specific geometry calibration**

3. **User interface integrated with treatment planning system (TPS)**

### Results

1. **Projective geometry calibration**

   - Mean-squared Error at iso-center: ~0.015 cm

2. **End-to-end verification with clinical liver fiducial case**

3. **Preliminary results for marker-less lung target tracking**

### Conclusions

- We built a Windows GUI application for reliable high-speed acquisition and real-time processing of fluoroscopic x-ray frames from wall-mounted FPDs.
- The accompanying custom phantom and calibration routine were developed to correct the positional deviations of the FPDs from specification.