MRSD Team C - Fall Validation Test:

- **Location**: NSH B512
- **Objective**: Demonstrate that the system is capable of autonomously localizing, planning, and executing an acetabular reaming operation as it would be utilized in an operating room.
- **Equipment:** Atrascys camera and Vesa mount, Sawbone pelvis and vise, Kinova Gen-3 robot rrm, Vention table, reaming end-effector
- **Personnel**: One team member interacting with the robot arm and work environment, one team member monitoring the Surgeon I/O and presenting.
- **Requirements**: M.P.1.1, M.P.1.2.1, M.P.1.2.2, M.P.2, M.P.3.1, M.P.3.2, M.P.4.1, M.P.4.2, M.P.4.3, M.P.5, M.P.6, M.P.7, M.P.8
- **Procedure**:
    a. Begin by setting up the work environment by clamping the Sawbone pelvis in a new position in a vise, fixing a fiducial marker screw mount on the pelvis, and placing the fiducial marker onto the end-effector of the robot arm.
    b. Utilizing a probe, the pelvis will be localized using a point cloud to fit the pelvis to a known pelvis mesh, from which the end-point of the reaming operation will be determined
    c. Utilizing free motion mode, the robot arm will be placed near the center of the acetabulum.
    d. The reaming operation would then be started, allowing the robot arm to localize itself with respect to the pelvis and begin generating a motion plan.
    e. Once the reaming motor turns on and the arm begins to move, making contact with the pelvis, the e-stop is hit to demonstrate the safety of the system.
    f. The robot arm will then be reset with free motion mode and the reaming operation would then be allowed to progress freely.
    g. As the robot arm begins to ream the acetabulum, the pelvis would be shifted by hand using the vise, to demonstrate the robot arm's capability of adapting to pelvic motion.
    h. When the robot arm has completed the reaming operation, it will remove itself from the pelvis, and the resulting acetabulum can be analyzed.
- **Validation**:
    - Pelvis pose must be localized with a latency ≤50ms.
    - End-effector pose must be localized with a latency ≤ 50ms.
    - Error in pelvis pose must be calculated with a latency ≤ 50ms, a position error of ≤ 1 mm and orientation error ≤ 1.5 degrees.
    - Personnel can move robot arm freely during free motion mode
    - Once the e-stop is pressed, the system stops moving and the reamer stops spinning within 500 ms
    - Trajectory is generated within 150 ms
    - New trajectory is planned when pelvis is moved more than 1 mm or more than 1.5 degrees, and the execution is using the new trajectory
    - Using the Quantitative Trajectory Evaluator, evaluate the desired trajectory (from the trajectory planner) with the actual trajectory (recorded by the camera and joint encoders). The error must be below 1 mm and 1.5 degrees
    - Surgeon I/O shows progress and performance metrics during the reaming