

# Marker-based XROMM

**\*\*UNDER CONSTRUCTION\*\***

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**There are eight steps in the marker-based XROMM workflow:**

## 1) Implant radiopaque bone markers

## 2) Record biplanar x-ray videos of movement

- For Brown Users: Getting trained and certified to use x-ray machines and Operating C-arm x-ray machines during data collection
- We recommend reading Radiographics papers for background on x-ray imaging

## 3) Create 3D polygonal mesh bone and marker surface models

- Creating 3D models from CT scans using Amira software
- Creating 3D models with Microscan Laser Scanner
- Creating 3D models with Horos
- Cleaning up 3D models with Geomagic

## 4) Measure XYZ coordinates of marker centroids relative to polygonal mesh bone models

- For models from CT scans, measure CT marker coordinates in Maya.
- Procedures for models made from laser scans can be found in Gidmark et al., 2012 (JEB, 215: 2262-2272)

## 5) Calibrate

- Calculate undistortion transform from grid images
- Undistort calibration cube images, **but DO NOT undistort the X-ray videos for marker-based XROMM**
- Create a framespec file for your calibration object, if necessary
- Calibrate both cameras to get DLT coefficients and mayaCam files
- Check your calibration by creating Maya X-ray cameras and importing the calibration frame (*i.e.* cube) specifications (framespec).

## 6) Analyze x-ray videos to extract XYZ coordinates of radiopaque markers

- Digitizing x-ray movies using the MATLAB XrayProject.mat procedure.
  - XrayProject MATLAB program written by Ty Hedrick and Dave Baier, and modified and updated by Loretta Reiss

## 7) Calculate rigid body kinematics from XYZ marker positions

- z\_\*OBSOLETE\* Calculate Rigid Body Motion in Matlab

## 8) Produce XROMM animations in Autodesk Maya

- Import and animate bones in Maya
- Check your digitized XYZ points and bone animations with MayaCams

## Working with XROMM animations in Autodesk Maya

- [Maya analysis and visualization methods](#)
- We recommend doing a **rigid body precision study** to determine the precision of the measurements you plan to make from your XROMM animation