DSX Definitions

The DSX Suite documentation uses some terms that are specific to DSX technology and/or to the software applications themselves. This page provides a list of these terms and their definitions.

Asynchronous X-ray Data

X-ray data in which the frame times from View #1 are not the same as the frame times from View #2. Asynchronous data capture is sometimes used to minimize cross-scatter by pulsing the X-ray emitters at different times. For DSX, synchronous is defined as there having frames from both View #1 and View #2 at the same time for each and every reporting time. A synchronous trial may have extra view times that don't correspond to a reporting time. All other timing conditions are considered asynchronous.

Binary Image

See: Mask Image.

Calibration Object

A rigid, radiolucent object with radiopaque markers embedded in it (for example, the Lego calibration cube designed by the XROMM group at Brown University). It is used to calculate the positions and orientations of the X-ray sources and image planes for a given configuration of the equipment. It can also contain motion capture markers, for calculating the transform between the X-ray lab coordinate system and the motion capture coordinate system.

Coordinate Systems

Sometimes referred to as *reference frames* or *frames.*

Object's CT coordinate system

The coordinate system implicitly defined by an object's segmented CT data file. The origin is in the lower-left corner of the first slice, with X to the right, Y going up, and Z increasing through the slices.

Object's local coordinate system (LCS)

The user-specified coordinate system for the object. It is usually calculated in Orient3D, but can also be specified directly in xManager. When the object is an anatomical object (e.g., bone), it is often called the *anatomical coordinate system (ACS)*. It is stored in the subject file as a transform from the object's CT coordinate system to its local coordinate system. All tracking results output from Locate3D

and X4D are stored as transforms between the X-ray lab coordinate system and the LCS.

X-ray lab coordinate system

The coordinate system of the X-ray imaging system. It is implicitly defined by the 3D coordinates of the beads in the calibration object.

Motion capture coordinate system

The coordinate system of the motion-capture system. Its definition is dependent on the motion capture software, but is usually defined by an L-frame during motion capture calibration.

Reference Coordinate System

Defined by the DICOM standard, this coordinate system is embedded in the person being scanned by a CT or MRI machine. Its origin can vary, but the X axis points from right to left, the Y axis from anterior to posterior, and the Z axis from inferior to superior. DSX uses this coordinate system to support working with multiple DICOM image stacks for a single subject.

Digitally Reconstructed Radiograph (DRR)

Simulated X-ray image obtained by ray casting through CT data.

Dock Widgets

The dockable widgets allow for some flexibility in the graphical interface of most of the DSX applications. These widgets can be made visible or hidden using the *View* menu. The widgets can be dragged across the screen as a normal dialog window and can be docked in predefined locations (normally the sides, top, or bottom) in the main window.

Label Image

An image in which some of its original intensities are replaced with the label value.

Landmark

A point identified in the voxel data or on the surface model of an object (e.g., ligament attachment). Once the object has been tracked in the X-ray data (using either points of interest in Locate3D or DRR-based tracking in X4D), the position of the landmark at the reporting times can be calculated and output.

Mask Image

An image consisting of only 0s and 1s.

Object

Subject Object

A 3D object (e.g., bone, implant) that can be tracked in multiple motion trials. It must have voxel data associated with it in order to be tracked in the X-ray data with X4D, or three or more beads embedded in it to be tracked with Locate3D. It must also have a polygonal surface model with a local coordinate system in order to be used in kinematic analyses in Visual3D.

Tracked Object

A subject object that is tracked in a particular motion trial or reference trial. Once subject objects have been created from voxel data, any subset of them can be chosen for tracking in each motion trial. The ones chosen for a trial are that trial’s tracked objects. Each tracked object has a link to its subject object and a pose map containing tracking data.

Parameters

Each DSX application has its own application-specific parameters that are displayed, and can be edited, in a dockable widget. The parameter values are stored in the subject file.

Point of Interest (POI)

A point of interest (usually a bead) that is tracked in X-ray data. If three or more POIs are identified in voxel data and then tracked in the X-ray images, they can then be used to calculate the pose of a 3D object (e.g., bone).

Pose

Pose for Objects

A set of 6 degrees of freedom (DOFs) that define the object's position and orientation (the pose of the object's local coordinate system in the X-ray lab frame). Objects can be bones or implants.

Pose for POI

A set of 3 translations that define the POIs position in the X-ray lab frame.

Pose Map

A set of poses, each with its own time stamp during a trial, that are interpolated by a cubic spline.

Region of Interest (ROI)

A region of interest is a geometric primitive that is used to mark a region of the surface model of an object. This region is used by Visual3D to calculate distance maps between the object and another object.

Segmentation

See: Thresholding.

Segmented Image

The resulting image after a segmentation.

Subject File

All of the DSX applications use a single subject file (*.dsx) for holding all of the information about a single subject, which can include multiple data-collection sessions. The subject file contains the following information:

1. the subject details
2. the X-ray configurations
3. links to all of the data files (both raw and processed)
4. links to all of the results files.

Each application loads the subject file to import the information that it needs and updates the file with the results of the analyses performed.

Surface

Surface Model

Triangulated representation of the segmented image data of an object. It is defined in the object's CT coordinate system.

ROI Surface Model

Triangulated representation of the segmented image data of an object after processing in Orient3D. It

is defined in the object's local coordinate system (LCS).

Synchronous X-ray Data

X-ray data in which there is a frame from both View #1 and View #2 at the same time for each and every reporting time.

Temporary Subject File

All of the DSX applications maintain a temporary subject file while you are working. This file is always kept up-to-date and can be used in case of a crash or inadvertent overwrite of the original file. When you load a subject file, each application will check to see if there is a temporary version of the file. If there is, you will be asked if you want to load the temporary or the original. Each application has a file menu which allows you to save the currently loaded subject file to the existing file or to a new file. When an application is closed, it checks whether the temporary subject file has changed since the last save and, if so, asks you to save or discard the changes.

Thresholding

Assigning a label to every intensity value in an image within a certain intensity range.

Time

Frame Time

The time stamp for a single frame of X-ray data in one view.

Reporting Time

A user-specified time point which is used to calculate and output tracking data. The reporting times do not have to match the frame times in either view. However, in most cases the X-ray images are synchronous in both views and the reporting times are the same as the X-ray frame times.

Trial

Calibration Trial

An X-ray trial used for calibrating the DSX system. There are three types: uniformity (white), grid (distortion), and calibration object. The uniformity trial, sometimes called a white trial, is used to correct for non-uniformity in the X-ray intensity levels across the images. Uniformity images should be taken at a lower kV setting than normal, so that none of the image is saturated. The grid trial is used for distortion correction, and consists of images of a grid of regularly spaced beads on a

radiotranslucent surface or regularly spaced holes in a radiopaque sheet. The kV setting used to collect these images should be that same as the one used for the uniformity trial. The calibration object trial is used to calculate the 3D configuration of the X-ray equipment.

Motion Trial

An X-ray trial of an activity for which you want to track objects and/or points of interest.

Reference Trial

An X-ray trial that is used to help process and analyze motion trials. They are usually static trials in which the subject is stationary. Reference trials are needed in order to create Visual3D linked models, which are used to generate object poses from motion capture data.