

DICOM Correction Item

Correction Number CP-1008	
Log Summary: Image Orientation in Coordinate Calculation on deformable registrations	
Type of Modification	Name of Standard
Clarification	PS 3 2009
<p>Rationale for Correction:</p> <p>The Deformable registration has the Image Position (Patient) (0020,0032) and the Image Orientation (Patient) (0020,0037) tag included in the Deformable Registration Grid Sequence, where the vector grid is defined. Both tags should determine the orientation of the vector grid in the frame of reference.</p> <p>However, the formula in C.20.3.1.1 includes the Image Position (Patient) (0020,0032), but not the Image Orientation (Patient) (0020,0037). This can easily lead none-sophisticated implementers to overlook support of the Image Orientation tag data and therefore to wrong spatial interpretation of the vector grid.</p> <p>This CP tries to make explicit the need to encounter both tag information in the calculation.</p>	
Sections of documents affected	
PS 3.3	
Correction Wording:	
<i>In PS 3.3, section C.20.3.1.1 Deformable Registration Sequence Application</i>	

Thus a source coordinate may be calculated using the following equation:
(This assumes that the center position of each deformation voxel will be transformed)

~~$$\begin{bmatrix} X_{Source} \\ Y_{Source} \\ Z_{Source} \\ 1 \end{bmatrix} = M_{Post} \left(M_{Pre} \begin{bmatrix} X_{Start} + i * X_R \\ Y_{Start} + j * Y_R \\ Z_{Start} + k * Z_R \\ 1 \end{bmatrix} + \begin{bmatrix} \Delta X_{ijk} \\ \Delta Y_{ijk} \\ \Delta Z_{ijk} \\ 0 \end{bmatrix} \right)$$~~

$$\begin{bmatrix} X_{Source} \\ Y_{Source} \\ Z_{Source} \\ 1 \end{bmatrix} = M_{Post} \left(M_{Pre} \begin{bmatrix} X_{Row} X_R & X_{Column} Y_R & X_{Depth} Z_R & X_{Start} \\ Y_{Row} X_R & Y_{Column} Y_R & Y_{Depth} Z_R & Y_{Start} \\ Z_{Row} X_R & Z_{Column} Y_R & Z_{Depth} Z_R & Z_{Start} \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} i \\ j \\ k \\ 1 \end{bmatrix} + \begin{bmatrix} \Delta X_{ijk} \\ \Delta Y_{ijk} \\ \Delta Z_{ijk} \\ 0 \end{bmatrix} \right)$$

Where:

$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Source}$

The spatial coordinate in the Source RCS.

$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Start}$

The start coordinate, in the Registered RCS, of the deformation grid as specified in the Image Position (Patient) attribute (0020,0032).

$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Row}$

The values from the row (X) direction cosine of the Image Orientation (Patient) (0020,0037) attribute.

$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Column}$

The values from the column (Y) direction cosine of the Image Orientation (Patient) (0020,0037) attribute.

$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Depth}$

The cross product between the row (X) direction cosine and the column (Y) direction cosine of the Image Orientation (Patient) (0020,0037) attribute.

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Depth} = \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Row} \times \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{Column}$$

$\begin{bmatrix} j \\ k \\ 1 \end{bmatrix}$

The index into the deformation grid in the X, Y, and Z dimension.

$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_R$

The resolution of the deformation grid in the X, Y, and Z dimension as specified in the Grid Resolution attribute (0064,0008).

$\Delta X_{ijk} \quad \Delta Y_{ijk} \quad \Delta Z_{ijk}$

The deformation specified at index (i,j,k) in the deformation grid. If the Deformation Registration Grid Sequence (0064,0005) has no items, the Δ values are zero.

M_{Pre}

The transformation matrix specified in the Pre Deformation Matrix Registration Sequence (0064,000F).

M_{Post}

The transformation matrix specified in the Post Deformation Matrix Registration Sequence (0064,0010).