Log Summary: Deprecation of multiple FORs in Structure Set

Name of Standard
PS 3.3 2011
PS 3.6 2011

Rationale for Correction:
In CP 1213, the understanding of transformations in respect to the terminology ‘affine’ and ‘homogenous’ is clarified. In that context, the question came up, what the transformation in the RT Structure Set can convey. WG-07 has discussed that topic and concluded the following: Rather to refine / further describe terminology, the concept of having several frame of references annotated in RT Structures Sets is outdated. Since we definition of the Spatial Registration SOP, there is no need any more to use a structure set to carry registrations. Rather then, the structure set should plainly and simply reference the one frame of reference and eventually the images of those FOR on which basis the structures have been primarily defined. Registrations to other frame of references should be handled much more generically with registrations. This conclusion was e.g. also drawn by IHE-RO. So the profiles of IHE-RO do not allow the annotation of several FORs in the Structure set is not allowed.

Therefore this CP deprecates the use of several FORs in the Structure Set.

Correction Wording:

In PS 3.3, Section C.8.8.5 RT Structure Set Module, Table C.8.41, make the following changes:

| Referenced Frame of Reference Sequence | (3006,0010) | 3 | Introduces sequence of items describing Frames of Reference in which the ROIs are defined. **One or more items are permitted in this sequence. Only a single Item is permitted in this sequence.**
| Note: The use of more than one sequence item has been retired, together with the use of the Frame of Reference Relationship Sequence (3006,00C0). See PS 3.3 2011.
| > Frame of Reference UID | (0020,0052) | 1 | Uniquely identifies Frame of Reference within Structure Set.
| > Frame of Reference Relationship Sequence | (3006,00C0) | 3 | Introduces sequence of transforms that relate other Frames of Reference to this
C.8.8.5.1 Frames of Reference

The Referenced Frame of Reference Sequence (3006,0010) describes a set of frames of reference in which some or all of the ROIs are expressed. Since the Referenced Frame of Reference UID (3006,0024) is required for each ROI, each frame of reference used to express the coordinates of an ROI shall be listed in the Referenced Frame of Reference Sequence (3006,0010) once and only once.

Notes:
1. As an example, a set of ROIs defined using a single image series would list the image series in a single Referenced Frame of Reference Sequence (3006,0010) item, providing the UID for this referenced frame of reference (obtained from the source images), and listing all pertinent images in the Contour Image Sequence (3006,0016).
2. As an example, a set of ROIs containing ROIs referencing more than one frame of reference would list the referenced images in two or more different Referenced Frame of Reference Sequence (3006,0010) items, providing in each case the UID for this referenced frame of reference (obtained from the source images), and listing all pertinent images in the Contour Image Sequence (3006,0016). Each ROI would then reference the appropriate Frame of Reference UID (0020,0052).

C.8.8.5.2 Frame of Reference Transformation Matrix
Retired. See PS 3.3 2011.

The concept of definition of registered frame of references using the Frame of Reference Relationship Sequence (3006,00C0) formerly present in the standard is retired. The use of Registration IODs is advised since the introduction of Spatial Registration IOD, which is a much stronger and more general concept, and independent from the specifics or RT Structure Sets. Additionally it is of importance, that registrations are decoupled from image and segmentation objects itself.

In a rigid body system, two coordinate systems can be related using a single 4 x 4 transformation matrix to describe any rotations and/or translations necessary to transform coordinates from the related coordinate system (frame of reference) to the primary system. The equation performing the transform from a point (X',Y',Z') in the related coordinate system to a point (X,Y,Z) in the current coordinate system can be shown as follows, where for homogeneous transforms $M_{41} = M_{42} = M_{43} = 0$ and $M_{44} = 1$:

\[
\begin{align*}
X &= M_{11}X' + M_{12}Y' + M_{13}Z' + M_{14} \\
Y &= M_{21}X' + M_{22}Y' + M_{23}Z' + M_{24} \\
Z &= M_{31}X' + M_{32}Y' + M_{33}Z' + M_{34} \\
1 &= M_{41}X' + M_{42}Y' + M_{43}Z' + M_{44}
\end{align*}
\]
In PS 3.6, Section 6 Registry of DICOM data elements, make the following changes:

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<thead>
<tr>
<th>Tag ID</th>
<th>Description</th>
<th>Type</th>
<th>Length</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3006,00C4</td>
<td>Frame of Reference Transformation Type</td>
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<td></td>
<td>RET</td>
</tr>
<tr>
<td>3006,00C6</td>
<td>Frame of Reference Transformation Matrix</td>
<td>DS</td>
<td></td>
<td>RET</td>
</tr>
</tbody>
</table>