

Digital Imaging and Communications in Medicine (DICOM)

Supplement 151: Intravascular OCT Image Storage SOP Class

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Scope and Field of Application

5 Intravascular Optical Coherence Tomography (IVOCT) is a high-resolution imaging modality that can clearly visualize vessels. Intravascular OCT devices require a DICOM IOD for information exchange at a similar priority to Intravascular Ultrasound (IVUS) devices. WG 1 examined existing DICOM IODs, such as Ophthalmic Tomography and Ultrasound. Some of the reasons these existing IODs are not adequate are:

- 10 a. Intravascular OCT images appear analogous to IVUS images, but the underlying image acquisition technology is quite different. Additional context information is required for Intravascular OCT information exchange.
- b. Although Intravascular OCT uses the same underlying technology as Ophthalmic Tomography Images, the image display and medical application are inappropriate for Intravascular OCT. Current IVOCT products use a Secondary Capture Image IOD which limits interoperable exchange of acquisition parameters.

15 This Supplement to the DICOM Standard introduces a new IOD and two SOP Classes for Intravascular OCT imaging techniques. One SOP Class is used FOR PRESENTATION, the other is used FOR PROCESSING. The FOR PROCESSING data is stored in polar coordinates. The FOR PRESENTATION data is stored in Cartesian coordinates, having been scan converted with the appropriate corrections. The acquired images are monochrome. Since IVOCT images resemble IVUS, a tint can be applied to visually differentiate IVOCT from IVUS. A reference to an externally-defined Palette Color Lookup Table is used to convey tint information. Different pseudo-color presentation information may be applied through the use of a Palette LUT at a viewing station.

25

PART 2 Addendum

Add to table A.1-2 categorizing SOP Classes:

The SOP Classes are categorized as follows:

30

Table A.1-2
UID VALUES

UID Value	UID NAME	Category
...
<u>1.2.840.10008.5.1.4.1.1.14.1</u>	<u>Intravascular Optical Coherence Tomography Image Storage – For Presentation</u>	<u>Transfer</u>
<u>1.2.840.10008.5.1.4.1.1.14.2</u>	<u>Intravascular Optical Coherence Tomography Image Storage – For Processing</u>	<u>Transfer</u>

Part 3 Additions

Modify PS3.3 Section 4

35

4 Symbols and Abbreviations

IVOCT Intravascular Optical Coherence Tomography

40

Modify PS3.3 Table A.1-1 to add new IOD: Intravascular Optical Coherence Tomography Object

IODs Modules	<u>IVOCT</u>
Patient	<u>M</u>
Clinical Trial Subject	<u>U</u>
General Study	<u>M</u>
Patient Study	<u>U</u>
Clinical Trial Study	<u>U</u>
General Series	<u>M</u>
Clinical Trial Series	<u>U</u>
...	
<u>Intravascular OCT Series</u>	<u>M</u>
...	
Frame of Reference	<u>M</u>
Synchronization	<u>M</u>
...	
General Equipment	<u>M</u>
Enhanced General Equipment	<u>M</u>
...	
Image Pixel	<u>M</u>
Supplemental Palette Color Lookup Table	<u>C</u>
Enhanced Contrast Bolus	<u>M</u>
Multi-frame Functional Groups	<u>M</u>

Multi-frame Dimension	<u>M</u>
Device	<u>U</u>
...	
Acquisition Context	<u>M</u>
Cardiac Synchronization	<u>C</u>
<u>Intravascular OCT Image</u>	<u>M</u>
<u>Intravascular OCT Acquisition Parameters</u>	<u>M</u>
<u>Intravascular OCT Processing Parameters</u>	<u>C</u>
<u>Intravascular Image Acquisition Parameters</u>	<u>M</u>
...	
SOP Common	<u>M</u>
Common Instance Reference	<u>M</u>
Frame Extraction	<u>C</u>

45 **Add PS3.3 Annex A.XX**

A.XX Intravascular OCT Information Object Definition

This Section defines an Information Object to be used with Intravascular Optical Coherence Tomography imaging devices.

50 **A.XX.1 Intravascular OCT Image IOD Description**

The Intravascular Optical Coherence Tomography Image IOD specifies a multi-frame image acquired on an Intravascular Optical Coherence Tomography modality.

55 The Intravascular OCT Image IOD is used in two SOP Classes as defined in PS 3.4 Storage Service Class, a SOP Class for storage of images intended for presentation, and a SOP Class for storage of images intended for further processing before presentation. These are distinguished by their SOP Class UID and by the Enumerated Value of the mandatory Attribute in the Intravascular OCT Series Module, Presentation Intent Type (0008,0068).

60 IVOCT stores frames of polar data arranged in a rectangular format when “FOR PROCESSING” is specified. The A-lines in a frame are arranged in row order, with the catheter optics toward the left of the image. A-lines are always stored from top to bottom, in order of acquisition. The A-lines are evenly spaced (in angles) to form a complete 360 degrees of acquisition.

Application entities creating IVOCT FOR PRESENTATION SOP instances shall apply all needed processing (e.g., Z offset and refractive index correction) to the IVOCT image for correct presentation.

65 **A.XX.2 Intravascular OCT Image IOD Entity-Relationship Model**

The E-R Model in Section A.1.2 of this Part depicts those components of the DICOM Information Model that are referenced by the Intravascular Optical Coherence Tomography Image IOD. Table A.XX.3-1 specifies the Modules of the Intravascular Optical Coherence Tomography Image IOD.

70 **A.XX.3 Intravascular OCT Image IOD Modules**

**Table A.XX.3-1
INTRAVASCULAR OCT IMAGE IOD MODULES**

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
	Intravascular OCT Series	C.8.X.X1	M
Frame of Reference	Frame of Reference	C.7.4.1	M
	Synchronization	C.7.4.2	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Image	Image Pixel	C.7.6.3	M
	Supplemental Palette Color Lookup Table	C.7.9	C – Required if Pixel Presentation (0008,9205) in the IVOCT Image Module equals COLOR.
	Enhanced Contrast/Bolus	C.7.6.4	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	M
	Device	C.7.6.12	U
	Acquisition Context	C.7.6.14	M
	Cardiac Synchronization	C.7.6.18.1	C – Required if cardiac synchronization was used
	Intravascular OCT Image	C.8.X2	M
	Intravascular OCT Acquisition Parameters	C.8.X3	M
	Intravascular OCT Processing Parameters	C.8.X.4	C – Required if Presentation Intent Type (0008,0068) is FOR PROCESSING.
	Intravascular Image Acquisition Parameters	C.8.X.5	M
	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	M
Frame Extraction	C.12.3	C - Required if the SOP Instance was created in response to a Frame-Level retrieve request	

A.XX.3.1 Intravascular OCT Image IOD Content Constraints

75 The following constraints on Image attributes take precedence over the descriptions given in the Module Attribute Tables.

A.XX.3.1.1 Contrast/Bolus Agent Sequence

For Contrast/Bolus Agent Sequence (0018,0012), the Defined Context Group is 3850.

80

A.XX.3.1.2 Prohibited Modules

The Overlay Plane Module and VOI LUT Module shall not be used in a Standard Extended SOP Class of the Intravascular Optical Coherence Tomography Image.

85 **Note:** In order to annotate images, whether during acquisition or subsequently, SOP Instances of the Grayscale Softcopy Presentation State Storage or the Structured Report Storage SOP Classes that reference the image SOP Instance may be used.

Pseudo-color presentation information may be applied through the use of separate Pseudo-color Softcopy Presentation State SOP instances.

90 No standard mechanism is provided for inclusion of annotations within the image SOP Instance itself and implementers are discouraged from using private extensions to circumvent this restriction.

A.XX.4 Intravascular OCT Image Functional Group Macros

95 Table A.XX.4.3-1 specifies the use of the Functional Group macros used in the Multi-frame Functional Group Module for the Intravascular Optical Coherence Tomography Image IOD.

**Table A.XX.4.3-1
INTRAVASCULAR OCT FUNCTIONAL GROUP MACROS**

Function Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	C - Required if Presentation Intent Type (0008,0068) is FOR PRESENTATION.
Frame Content	C.7.6.16.2.2	M – May not be used as a Shared Functional Group.
Derivation Image	C.7.6.16.2.6	C – Required if the image or frame has been derived from another SOP Instance.
Frame Anatomy	C.7.6.16.2.8	M
Cardiac Synchronization	C.7.6.16.2.7	C – Required if Cardiac Synchronization Technique (0018,9037) equals other than NONE May be present otherwise.
Frame VOI LUT	C.7.6.16.2.10	U
Pixel Intensity Relationship LUT	C.7.6.16.2.13	C - Required if Pixel Intensity Relationship (0028,1040) equals LOG. May be present otherwise.
Intravascular OCT Frame Type	C.8.X.6.1	M

Intravascular Frame Content	C.8.X.6.2	C – Required if Intravascular Acquisition (0018,3100) equals MEASURED or Presentation Intent Type (0008,0068) equals FOR PRESENTATION.
Intravascular OCT Frame Content	C.8.X.6.3	C - Required if Presentation Intent Type (0008,0068) equals FOR PROCESSING.

100

A.XX.4.1 Intravascular OCT Image Functional Group Macros Content Constraints

A.XX.4.1.1 Frame Anatomy Function Group Macro

The Defined Context ID for the Anatomic Region Sequence (0008,2218) shall be CID 3604 - Arterial lesion locations. The Defined Context ID for the Anatomic Region Modifier Sequence (0008,2220) shall be CID 3019 - Cardiovascular Anatomic Location Modifiers.

105

Modify PS3.3 Annex C for Intravascular Optical Coherence Tomography Modality

C.7.3.1.1.1 Modality

Defined Terms for the Modality (0008,0060) are:

IVOCT = **Intravascular Optical Coherence Tomography** ...

110

Modify PS3.3 Annex C Enhanced Contrast/Bolus Module

C.7.6.4b Enhanced Contrast/Bolus Module

Table C.7-12b specifies the Attributes that describe the contrast/bolus used in the acquisition of the Image.

115

**Table C.7-12b
ENHANCED CONTRAST/BOLUS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent Sequence	(0018,0012)	1	Sequence that identifies one or more contrast agents administered prior to or during the acquisition. Shall contain one or more Items.
...
>Contrast/Bolus Ingredient Concentration	(0018,1049)	2	Milligrams of active ingredient per milliliter of agent.
<u>>Contrast/Bolus Ingredient Percent by Volume</u>	<u>(0052,0001)</u>	<u>3</u>	<u>Percentage by volume of active ingredient in the total volume.</u>

Add to PS3.3 Annex C the Intravascular OCT Modality Modules

120

C.8.X Intravascular Optical Coherence Tomography Modules

C.8.X.1 Intravascular OCT Series Module

Table C.8.X.1-1 specifies the Attributes that identify and describe general information about the Intravascular Optical Coherence Tomography Series.

125

**Table C.8.X.1-1
INTRAVASCULAR OCT SERIES MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Type of equipment that originally acquired the data used to create the images in this Series. Enumerated Values: IVOCT See section C.7.3.1.1.1 for further explanation.
Series Number	(0020,0011)	1	A number that identifies this Series.
Referenced Performed Procedure Step Sequence	(0008,1111)	1C	Uniquely identifies the Performed Procedure Step SOP Instance to which the Series is related (e.g. a Modality or General-Purpose Performed Procedure Step SOP Instance). The Sequence shall have one Item. Required if the Modality Performed Procedure Step SOP Class or General Purpose Performed Procedure Step SOP Class is supported.
>Referenced SOP Class UID	(0008,1150)	1	Uniquely identifies the referenced SOP Class.
>Referenced SOP Instance UID	(0008,1155)	1	Uniquely identifies the referenced SOP Instance.
Presentation Intent Type	(0008,0068)	1	Identifies the intent of the images that are contained within this Series. Enumerated Values: FOR PRESENTATION FOR PROCESSING

C.8.X.1.1 Intravascular OCT Series Attribute Descriptions

130 **C.8.X.1.1.1 Presentation Intent Type**

Presentation Intent Type (0008,0068) identifies the intent for the purposes of display or other presentation of all Images within this Series.

Notes: 1. Since this is a Series level attribute, all Images within a Series have the same value for this Attribute.

135 2. The intent of this restriction is to ensure that FOR PRESENTATION and FOR PROCESSING images are placed in separate Series, so that no confusion can arise as to which images are suitable for diagnostic reading as determined by local policy.

140 A Series of Images intended for viewing by an observer shall have an Enumerated Value of FOR PRESENTATION. The value shall not be set to FOR PRESENTATION unless Z Offset correction, refractive index correction and polar to rectangular conversion have been applied

145 Images or individual frames of a FOR PRESENTATION image shall reference their associated source FOR PROCESSING frames, if any exist, using the Derivation Image Functional Group Macro, with the Derivation Code (113093, DCM, "Polar to Rectangular Scan Conversion") and the Purpose of Reference Code (121358, DCM, "For Processing Image").

- Notes:
1. FOR PRESENTATION images are still be of Image Type (0008,0008) and Frame Type (0008,9007) ORIGINAL rather than DERIVED despite having undergone processing, such as corrections for Z Offset, Refractive index and Polar to Rectangular conversion. In this case a DERIVED image would have undergone yet further processing to make it substantially different from the original. See Figure C.8-X. The Derivation Image Functional Group Macro may be used even if Image Type (0008,0008) and Frame Type (0008,9007) is ORIGINAL.
 2. FOR PRESENTATION images may still be subjected to processing or further processing, if appropriate, depending on the application.
 3. FOR PRESENTATION images are intended for display on a device, without (further) processing, since that device may not be capable of image processing. The quality of the displayed image or its suitability for any purpose is beyond the scope of the DICOM Standard.
 4. If all of the frames of a FOR PRESENTATION image are created by processing all of the frames of a FOR PROCESSING image, then a reference to the FOR PROCESSING SOP Instance only, without reference to specific frame numbers, in the Shared Functional Group Sequence avoids the need for a frame-by-frame reference in each Per-Frame Functional Group, though there is no requirement that the order of the frames or the number of frames in the FOR PROCESSING and FOR PRESENTATION instances correspond.

FOR PROCESSING images may have Z Offset correction applied to the A-line data and/or Refractive Index applied to A-line Pixel Spacing (0052,0014). However, due to irreversible loss of information, images that have had Polar to Rectangular scan conversion applied shall not be stored as FOR PROCESSING images.

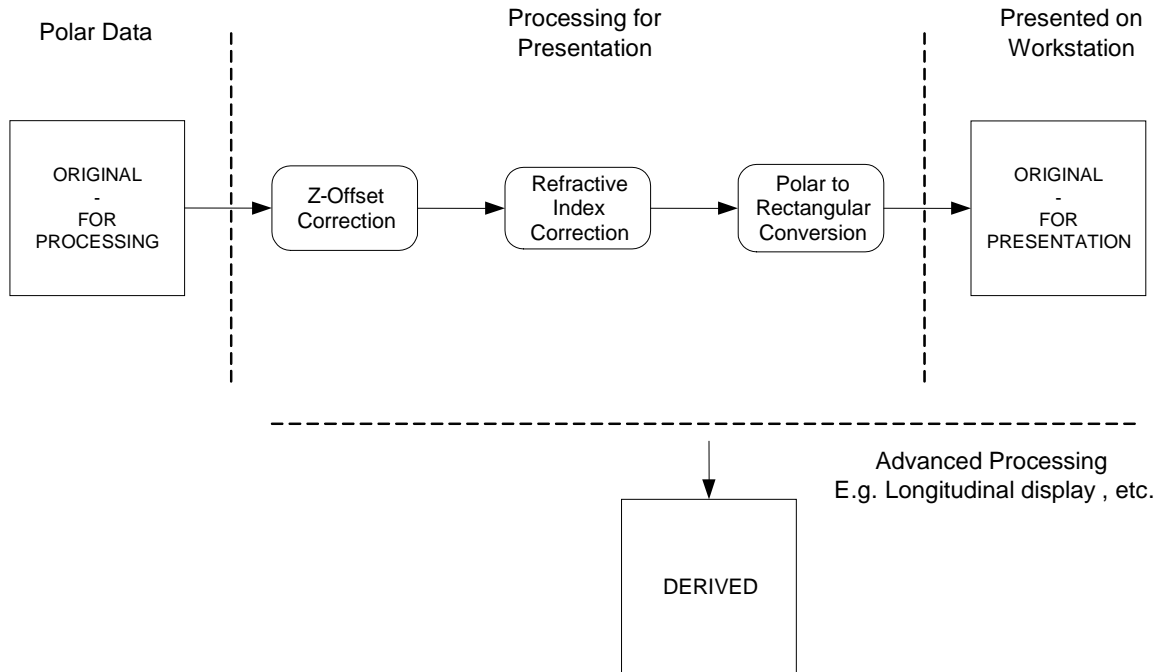


Figure C.8-X - Explanation of Presentation Intent Type

C.8.X.2 Intravascular OCT Image Module

175 Table C.8.X.2-1 specifies the Attributes that describe an Image produced by Intravascular OCT imaging modalities.

**Table C.8.X.2-1
INTRAVASCULAR OCT IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image identification characteristics. See C.8.X.2.1 for specialization.
Volumetric Properties	(0008,9206)	1	Indication if geometric manipulations are possible with frames in the SOP Instance. See C.8.X.2.2.
Pixel Presentation	(0008,9205)	1	Indication of the presence or absence of color information that may be used during rendering. See C.8.X.2.3 for a description and Enumerated Values.
Samples Per Pixel	(0028,0002)	1	Number of samples (planes) in this image. Enumerated value shall be 1.
Acquisition Datetime	(0008,002A)	1	The date and time that the acquisition of data started. Note: The synchronization of this time with an external clock is specified in the synchronization Module in Acquisition Time synchronized (0018,1800) .
Acquisition Duration	(0018,9073)	1C	The scan time in seconds used to create all frames of an Intravascular Optical Coherence Tomography image. Required if Image Type (0008,0008) Value 1 is ORIGINAL. May be present otherwise.
Acquisition Number	(0020,0012)	1	A number identifying the single continuous gathering of data over a period of time which resulted in this image.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. Enumerated Value shall be MONOCHROME2.
Pixel Representation	(0028,0103)	1	Data representation of pixel samples. Enumerated Value shall be 0.
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. See C.8.X.2.4 for specialization.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. See C.8.X.2.4 for specialization.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. High Bit (0028,0102) shall be one less than Bits Stored (0028,0101).

Presentation LUT Shape	(2050,0020)	1C	<p>Specifies an identity transformation for the Presentation LUT, such that the output of all grayscale transformations defined in the IOD containing this Module are defined to be P-Values.</p> <p>Enumerated Value: IDENTITY = output is in P-Values.</p> <p>Required if Presentation Intent Type (0008,0068) equals FOR PRESENTATION.</p>
Lossy Image Compression	(0028,2110)	1C	<p>Specifies whether an Image has undergone lossy compression (at a point in its lifetime).</p> <p>Enumerated Values: 00 = Image has NOT been subjected to lossy compression. 01 = Image has been subjected to lossy compression.</p> <p>Once this tag has been set to 01 it shall not be reset.</p> <p>See C.7.6.1.1.5</p> <p>Required if Lossy Compression has been performed on the Image.</p>
Lossy Image Compression Ratio	(0028,2112)	1C	<p>Describes the approximate lossy compression ratio(s) that have been applied to this image.</p> <p>Required if Lossy Image Compression (0028,2110) has a value of "01".</p> <p>See C.7.6.1.1.5 for further explanation.</p> <p>May be multi-valued if successive lossy compression steps have been applied.</p> <p>Notes: 1. For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30. 2. For historical reasons, the lossy compression ratio should also be described in Derivation Description (0008,2111).</p>
Lossy Image Compression Method	(0028,2144)	1C	<p>A label for the lossy compression method(s) that have been applied to this image.</p> <p>See C.7.6.1.1.5 for further explanation.</p> <p>May be multi-valued if successive lossy compression steps have been applied; the value order shall correspond to the values of Lossy Image Compression Ratio (0028,2112).</p> <p>Required if Lossy Image Compression (0028,2110) has a value of "01".</p> <p>Note: For historical reasons, the lossy compression method should also be described in Derivation Description (0008,2111).</p>

Burned In Annotation	(0028,0301)	1	Indicates whether or not image contains sufficient burned in annotation to identify the patient and date the image was acquired. Enumerated Value: NO
Recognizable Visual Features	(0028,0302)	1	Indicates whether or not the image contains sufficiently recognizable visual features to allow the image or a reconstruction from a set of images to identify the patient. Enumerated Values: NO
Referenced Instance Sequence	(0008,114A)	3	A sequence which provides reference to a set of non-image SOP Class/Instance pairs significantly related to this Image, including waveforms that may or may not be temporally synchronized with this image. One or more Items may be included in this sequence.
<i>>Include 'SOP Instance Reference Macro' Table 10-11</i>			
>Purpose of Reference Code Sequence	(0040,A170)	1	Code describing the purpose of the reference to the SOP Instances. Only a single Item shall be permitted in this sequence.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>			<i>Defined Context ID is CID 7004 for referenced waveforms.</i>
Image Comments	(0020,4000)	3	User-defined comments about the image.
Recommended Display Frame Rate	(0008,2144)	3	Recommended rate at which the frames of an Intravascular OCT image should be displayed in frames/second.
Interpolation Type	(0052,0039)	1C	The type of interpolation used for the Polar to Cartesian scan-conversion. Defined Terms: REPLICATE BILINEAR CUBIC Required if Presentation Intent Type (0008,0068) equals FOR PRESENTATION.
Referenced Color Palette Instance UID	(0028,0304)	1C	The identifier of a color palette (i.e., an instance of the Color Palette Storage SOP Class "1.2.840.10008.5.1.4.39.1") that may be used during rendering. See PS 3.4 Color Palette Storage Service Class and PS 3.6 Well-Known Color Palettes. Required if Pixel Presentation (0008,9205) is COLOR_REF.

180 **C.8.X.2.1 Image Type and Frame Type**

In addition to the requirements specified in C.8.16.1 Image Type, the following additional requirements and Defined Terms are specified.

Value 1 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.1. No additional requirements or Defined Terms.

185 Value 2 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.2. No additional requirements or Defined Terms.

Value 3 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.3. .

Table C.8.x.2-2 specifies the Defined Terms for IVOCT for Value 3 for Image Type (0008,0008) and Frame Type (0008,9007).

190

Table C.8.X.2-2
IVOCT IMAGE TYPE AND FRAME TYPE VALUE 3

Defined Term Name	Defined Term Description
AXIAL	An image that has an orientation that is perpendicular to the long axis of the vessel. (I.e. cross-sectional).
LONGITUDINAL	An image that has an orientation that is parallel to the long axis of the vessel.

Value 4 of Image Type (0008,0008) and Frame Type (0008,9007) is discussed in C.8.16.1.4. No additional requirements or Defined Terms.

195

C.8.X.2.2 Volumetric Properties

The value of the Volumetric Properties attribute (0008,9206) allows applications doing geometric manipulations to determine if the image is an appropriate candidate for an operation without having to know all the details of the generating application.

200 Table C.8.X.2-3 specifies the Enumerated Values for the Volumetric Properties (0008,9206) attribute.

Table C.8.X.2-3
VOLUMETRIC PROPERTIES ATTRIBUTE VALUES

Enumerated Value Name	Enumerated Value Description
DISTORTED	Frames do not represent the true geometry of the vessel.

205

C.8.X.2.3 Pixel Presentation

Pixel Presentation (0008,9205) is used to indicate whether a color tint is intended to be applied to the IVOCT image. See Table C.8.X.2-4.

210

Table C.8.X.2-4
PIXEL PRESENTATION ATTRIBUTE VALUES

Enumerated Value Name	Enumerated Value Description
COLOR	Image is intended to be displayed in color using Supplemental Palette Color LUTs, but can be displayed in grayscale if current display does not support color or with a user selected LUT. See section C.8.13.3.1.2.1.
COLOR_REF	Image is intended to be displayed in color using an externally defined Palette Color LUTs, but can be displayed in grayscale if current display does not support color, or with a user selected LUT. I.e., the encoded pixel values are still continuous grayscale values (and not arbitrarily order indices)

	into a lookup table).
MONOCHROME	Image is intended to be displayed in grayscale only.

C.8.X.2.4 Bits Allocated, Bits Stored and Samples Per Pixel

215 For IVOCT images, Bits Allocated (0028,0100), Bits Stored (0028,0101) Samples Per Pixel (0028,0002) are specified to use the following values for Presentation Intent Type (0008,0068) attribute:

**Table C.8.X.2-5
BITS ALLOCATED/STORED**

Presentation Intent Type	Bits Allocated / Bits Stored	Samples Per Pixel
FOR PRESENTATION	8/8, 16/12 or 16/16	1
FOR PROCESSING	8/8, 16/12 or 16/16	1

220 **C.8.X.3 Intravascular OCT Acquisition Parameters Module**

Table C.8.X.3-1 describes the parameters used to acquire an Intravascular Optical Coherence Tomography image.

**Table C.8.X.3-1
INTRAVASCULAR OCT ACQUISITION PARAMETERS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
OCT Focal Distance	(0052,0002)	2	Distance from focal point to center of catheter, in mm (measured in air).
Beam Spot Size	(0052,0003)	2	The full width at half maximum (FWHM) of the point spread function (PSF) or line spread function (LSF), in μm (measured in air). Also known as Transverse Resolution.
Effective Refractive Index	(0052,0004)	2C	Index of refraction of the tissue and flush medias used during the Intravascular OCT acquisition. Required if Presentation Intent Type (0008,0068) is FOR PROCESSING. May be present otherwise.
OCT Acquisition Domain	(0052,0006)	1	The type of OCT acquisition domain. Defined Terms: TIME FREQUENCY SPECTRAL
OCT Optical Center Wavelength	(0052,0007)	2	Center optical wavelength of the OCT light source, in μm .
Axial Resolution	(0052,0008)	2	The full width at half maximum (FWHM) of the axial plane response function, in μm (measured in air)
Ranging Depth	(0052,0009)	1	Maximum detectable sample-to-reference path displacement, in mm (measured in air). This is the radius of the FOR PRESENTATION image in air. Note: Ranging Depth is distinct from Penetration Depth, which is the depth to which one can obtain an OCT signal in tissue.
A-line Rate	(0052,0011)	1	The number of IVOCT A-lines acquired per second in Hz.
A-lines Per Frame	(0052,0012)	1	Number of A-lines acquired in an IVOCT frame, including unused (padded) A-lines. Note: Will be the same as Rows (0028,0010) for a FOR PROCESSING image.

225

C.8.X.4 Intravascular OCT Processing Parameters Module

Table C.8.X.4-1 describes the parameters used for processing an Intravascular Optical Coherence Tomography polar data image.

Table C.8.X.4-1

230

INTRAVASCULAR OCT PROCESSING PARAMETERS MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Description
OCT Z Offset Applied	(0052,0026)	1	Indicates whether or not Z offset correction was applied to the OCT image frames. Enumerated Values: YES NO
Refractive Index Applied	(0052,003A)	1	Indicates whether or not Refractive Index correction was applied. Enumerated Values: YES NO See section C.8.X.4.1 for further explanation.
A-line Pixel Spacing	(0052,0014)	1	Spacing of pixels in the A-line (X-axis), in mm.
Pixel Intensity Relationship	(0028,1040)	1	The relationship between the pixel sample values and the IVOCT A-line intensity. See Section C.8.X.4.2.
First A-line Location	(0052,0034)	1	Orientation in degrees at which the 1 st A-line in the frame should be displayed. Value shall be between 0 and 360, with zero representing vertical.

C.8.X.4.1 Refractive Index Applied

For Refractive Index Applied (0052,003A) a value of YES indicates that Effective Refractive Index (0052,0004) correction has been applied to the reported A-line Pixel Spacing (0052,0014) attribute. A value of NO indicates that Effective Refractive Index (0052,0004) correction has not been applied (i.e. A-line Pixel Spacing corresponds to the pixel spacing in air).

235

C.8.X.4.2 Pixel Intensity Relationship

Pixel Intensity Relationship (0028,1040) shall identify the relationship of the pixel values to the IVOCT A-line intensity. Defined terms are:

LIN Approximately proportional to A-line intensity.

LOG Non-linear “Log Function”; A Pixel Intensity Relationship LUT shall be included with the image to allow it to be scaled back to its proportional A-line intensity value.

240

C.8.X.5 Intravascular Image Acquisition Parameters Module

Table C.8.X.5-1 describes the parameters and characteristics of an intravascular image acquisition. These parameters are common to both IVUS and IVOCT.

**Table C.8.X.5-1
INTRAVASCULAR IMAGE ACQUISITION PARAMETERS MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
IVUS Acquisition	(0018,3100)	1	Type of Intravascular Image Acquisition. Enumerated Values are: MOTORIZED MANUAL SELECTIVE MEASURED See section C.8.X.5.1.
IVUS Pullback Rate	(0018,3101)	1C	Intravascular imaging catheter pullback rate. Specified in units of mm/sec. Required if IVUS Acquisition (0018,3100) value is MOTORIZED. See section C.8.X.5.2.
IVUS Pullback Start Frame Number	(0018,3103)	1C	Frame number at which the motorized portion of the acquisition begins. Required if IVUS Acquisition (0018,3100) value is MOTORIZED. See section C.8.X.5.1.
IVUS Pullback Stop Frame Number	(0018,3104)	1C	Frame number at which the motorized portion of the acquisition is complete. Required if IVUS Acquisition (0018,3100) value is MOTORIZED. See section C.8.X.5.1.
Catheter Direction of Rotation	(0052,0031)	1C	Direction of rotation of the Intravascular rotating catheter during acquisition, from the perspective of the motor, proximal to distal. Enumerated Values: CW = clockwise CC = counter-clockwise Required if rotational catheter is used.
Catheter Rotational Rate	(0052,0013)	1C	Rate of rotation of the Intravascular rotating catheter during acquisition, in Hz. Required if rotational catheter is used.
Mode of Percutaneous Access Sequence	(0052,0016)	2	Mode of access of the Intravascular Imaging Catheter.
>Include 'Code Sequence Macro' (Table 8.8-1).			Defined Context ID is 3746 Percutaneous Entry.

245

C.8.X.5.1 IVUS Acquisition

The attribute IVUS Acquisition (0018,3100) denotes the method used to acquire the Intravascular Images.

250 MOTORIZED: The Intravascular imaging catheter is positioned in the blood vessel proximal or distal to the anatomical structures to be examined. The catheter is attached to a motorized mechanism capable of either pushing forward or pulling back the catheter through the vessel at a constant velocity, as specified by the IVUS Pullback Rate (0018,3101). The motorized acquisition takes place during the time between acquisition

255 of the IVUS Pullback Start Frame Number (0018,3103), and acquisition of the IVUS Pullback Stop Frame Number (0018,3104).

MANUAL: The Intravascular imaging catheter is positioned in the blood vessel proximal or distal to the anatomical structures to be examined. The catheter is then manually pulled back or pushed forward through the vessel segment of interest.

260 SELECTIVE: The Intravascular imaging catheter is positioned in the blood vessel. The catheter is then manually pushed forward and/or pulled back to examine the anatomical structures in the vessel.

265 MEASURED: The Intravascular imaging catheter is positioned in the blood vessel near the anatomical structures to be examined. The catheter is then pulled back or pushed forward through the vessel segment of interest. The longitudinal movement between each acquired frame is measured and recorded. See C.8.X.6.2 for more information.

C.8.X.5.2 IVUS Pullback Rate

270 The attribute IVUS Pullback Rate (0018,3101) specifies the constant velocity of longitudinal movement of the Intravascular imaging catheter. Positive values indicate movement from Distal to Proximal (pulling back). Negative values indicate movement from Proximal to Distal (pushing forward).

C.8.X.6 Intravascular OCT Functional Group Macros

The following sections contain Functional Group macros specific to the Intravascular OCT IOD.

275

C.8.X.6.1 Intravascular OCT Frame Type Macro

Table C.8.X.6.1-1 specifies the attributes of the Intravascular OCT Frame Type Functional Group.

**Table C.8.X.6.1-1
INTRAVASCULAR OCT FRAME TYPE MACRO ATTRIBUTES**

280

Attribute Name	Tag	Type	Attribute Description
Intravascular OCT Frame Type Sequence	(0052,0025)	1	Identifies characteristics of this frame. Only a single Item shall be permitted in this sequence.
>Frame Type	(0008,9007)	1	Type of Frame. A multi-valued attribute analogous to the Image Type (0008,0008). Enumerated Values and Defined Terms are the same as those for the four values of the Image Type (0008,0008) attribute, except that the value MIXED is not allowed. See section C.8.X.2.1.

C.8.X.6.2 Intravascular Frame Content Macro

285 Table C.8.X.6.2-1 specifies the attributes of the Intravascular Frame Content Functional Group.

**Table C.8.X.6.2-1
INTRAVASCULAR FRAME CONTENT MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Intravascular Frame Content Sequence	(0052,0027)	1	A sequence that describes a general description of this image or frame. Only a single Item shall be permitted in this sequence.
>Intravascular Longitudinal Distance	(0052,0028)	1C	Longitudinal distance in millimeters between this frame and the previous acquired frame. Positive values indicate movement is from Distal to Proximal (pull back). Negative values indicate movement is from Proximal to Distal (push forward). Required if Intravascular Acquisition (0018,3100) equals MEASURED.
>Seam Line Location	(0052,0033)	2C	Clockwise rotational orientation (in degrees) at which the seam line in the frame is displayed, relative to vertical (zero degrees). Required if Presentation Intent Type (0008,0068) equals FOR PRESENTATION.

290 **C.8.X.6.3 Intravascular OCT Frame Content Macro**

Table C.8.X.6.3-1 specifies the attributes of the Intravascular OCT Frame Content Functional Group.

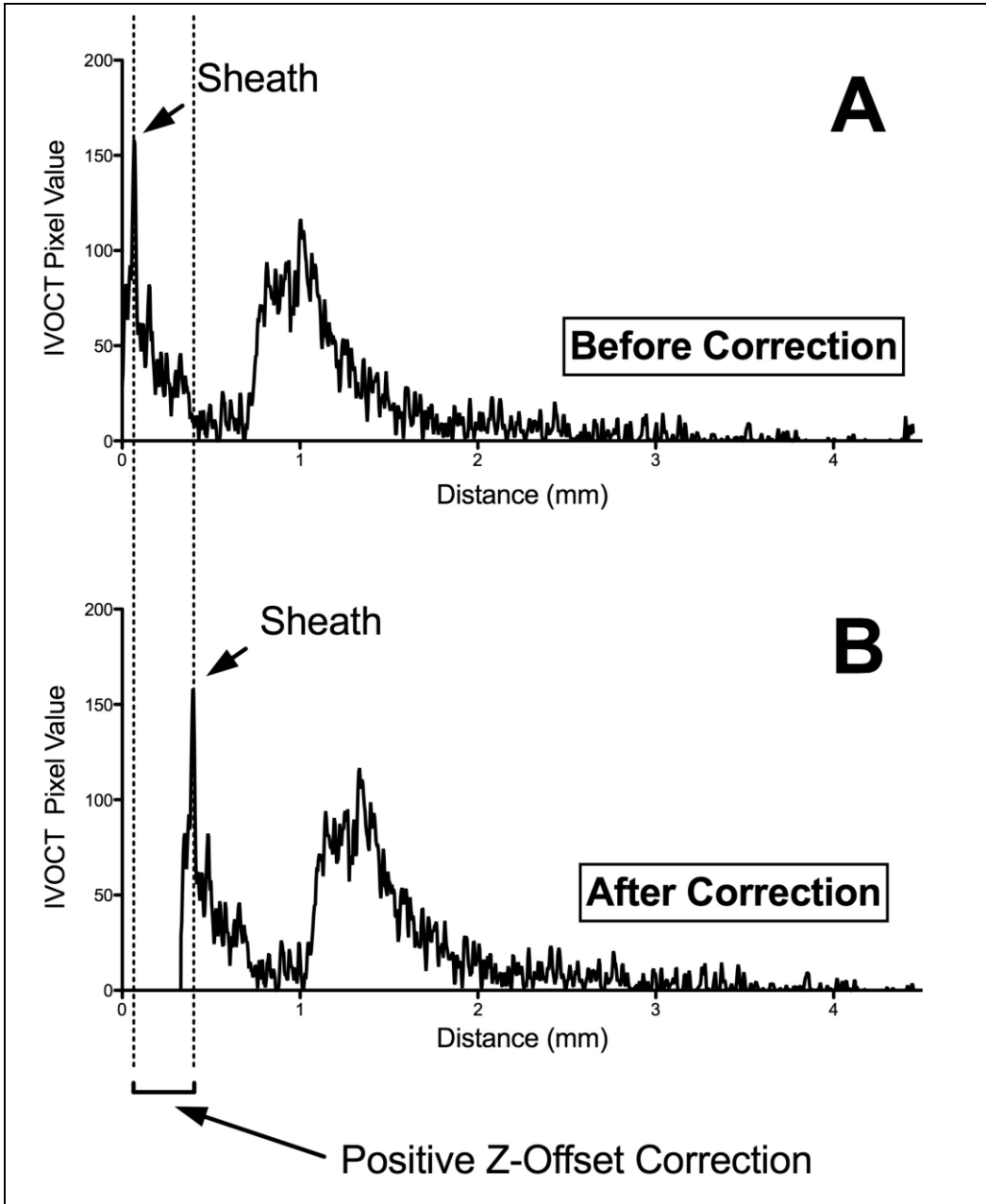
**Table C.8.X.6.3-1
INTRAVASCULAR OCT FRAME CONTENT MACRO ATTRIBUTES**

295

Attribute Name	Tag	Type	Attribute Description
Intravascular OCT Frame Content Sequence	(0052,0029)	1	A sequence that describes a general description of this image or frame. Only a single Item shall be permitted in this sequence.
>OCT Z Offset Correction	(0052,0030)	1	The amount to shift the frame along the axial direction, in pixels, to correct for interferometer path-length mismatch. See section C.8.X.6.3.1 for further explanation.
>Seam Line Index	(0052,0036)	1	The A-line number (zero index) that coincides with the seam line as indicated with the First A-line Location (0052,0034) attribute.
>Number of Padded A-lines	(0052,0038)	1C	The number of padded A-lines contained in the FOR PROCESSING image frame. Required if the FOR PROCESSING image contains padded A-lines. See section C.8.X.6.3.2 for further explanation.

C.8.X.6.3.1 OCT Z Offset Correction

300 OCT Z Offset Correction (0052,0030) specifies the number of pixels to shift the A-lines of the frame to correct for the path length difference between the OCT Sample arm and Reference arm (in air). A positive value of Z Offset correction means pixels are shifted further away from the catheter optics. A negative value of Z Offset correction means pixels are shifted closer to the catheter optics. See Figure C.8.X-2



305

Figure C.8.X-2 OCT Z Offset Correction Example

C.8.X.6.3.2 A-line Padding

Padded A-lines shall not be used in FOR PRESENTATION frames. Padded A-lines shall only be encoded in the high order rows of the FOR PROCESSING frame and shall be contiguous. Padded A-lines may contain arbitrary pixel values.

Part 4 Additions

315

Modify to PS3.4 Annex B.5.

B.5 Standard SOP Classes

**Table B.5-1
STANDARD SOP CLASSES**

SOP Class Name	SOP Class UID	IOD (See PS 3.3)
...		
<u>Intravascular Optical Coherence Tomography Image Storage – For Presentation</u>	<u>1.2.840.10008.5.1.4.1.1.14.1</u>	<u>IVOCT IOD (see B.5.1.X)</u>
<u>Intravascular Optical Coherence Tomography Image Storage – For Processing</u>	<u>1.2.840.10008.5.1.4.1.1.14.2</u>	<u>IVOCT IOD (see B.5.1.X)</u>

320

Add to PS3.4 Annex B.5.

B.5.1.X Intravascular OCT Image Storage SOP Classes

The Intravascular OCT Image Storage - For Presentation SOP Class shall use the IVOCT IOD with an Enumerated Value of FOR PRESENTATION for Presentation Intent Type (0008,0068).

325

The Intravascular OCT Image Storage - For Processing SOP Class shall use the IVOCT IOD with an Enumerated Value of FOR PROCESSING for Presentation Intent Type (0008,0068).

An SCU or SCP of the Intravascular OCT Image Storage - For Processing SOP Class shall also support the Intravascular OCT Image Storage - For Presentation SOP Class.

330

Notes: 1. The intent of this requirement is to ensure a useful level of interoperability by avoiding the situation where an SCU might support only the Intravascular OCT Image Storage - For Processing SOP Class and an SCP only the Intravascular OCT Image Storage - For Presentation SOP Class, or vice versa. The burden is therefore to support the Intravascular OCT Image Storage - For Presentation SOP Class as a “baseline”.

335

2. The term “support” is used in this section in the sense that an SCU or SCP must be capable of sending or receiving the For Presentation SOP Class. There is no intent to imply that an SCU must always send an instance of the For Presentation SOP Class when an instance of the For Processing SOP Class is sent.

340

Nor is there any intent to imply that during Association establishment, that a Presentation Context for the For Presentation SOP Class has to be proposed by the initiator. However, an association acceptor may reject a For Presentation SOP Class Presentation Context if it accepts a For Processing SOP Class Presentation Context, and prefers that SOP Class, in which case it may no longer be able to “pass on” the object later as an SCU unless it is able to generate a For Presentation object.

345

It is not possible for an SCP to determine from proposed Presentation Contexts whether or not an SCU “supports” (is capable of sending) both For Processing and For Presentation SOP Class Instances. Such a determination requires a priori knowledge of the information contained in the Conformance Statement for the SCU, as well as how the SCU is configured and operated. An SCU that supports both SOP Classes may well choose to only propose one or the other during Association establishment, depending on which Instances it actually intends to send over that particular association (although the SCU must be capable of sending instances of the For Presentation SOP Class if the SCP does not accept the For Processing).

350

The intent of the requirement is that if an SCU is only capable of sending the For Presentation SOP Class, any SCP will be guaranteed to be able to receive it. Conversely, if an SCP is only

capable of receiving the For Presentation SOP Class, any SCU will be guaranteed to be able to send it.

355

Add to PS3.4 Annex I.4.

I.4 Media Standard Storage SOP Classes

Table I.4-1
Media Storage Standard SOP Classes

SOP Class Name	SOP Class UID	IOD (See PS 3.3)
...		
<u>Intravascular Optical Coherence Tomography Image Storage – For Presentation</u>	<u>1.2.840.10008.5.1.4.1.1.14.1</u>	<u>Intravascular Optical Coherence Tomography Image</u>
<u>Intravascular Optical Coherence Tomography Image Storage – For Processing</u>	<u>1.2.840.10008.5.1.4.1.1.14.2</u>	<u>Intravascular Optical Coherence Tomography Image</u>

360

Part 6 Additions

Add the following data elements to PS 3.6:

365

Tag	Name	Keyword	VR	VM
(0052,0001)	Contrast/Bolus Ingredient Percent by Volume	ContrastBolusIngredientPercentByVolume	FL	1
(0052,0002)	OCT Focal Distance	OCTFocalDistance	FD	1
(0052,0003)	Beam Spot Size	BeamSpotSize	FD	1
(0052,0004)	Effective Refractive Index	EffectiveRefractiveIndex	FD	1
(0052,0006)	OCT Acquisition Domain	OCTAcquisitionDomain	CS	1
(0052,0007)	OCT Optical Center Wavelength	OCTOpticalCenterWavelength	FD	1
(0052,0008)	Axial Resolution	AxialResolution	FD	1
(0052,0009)	Ranging Depth	RangingDepth	FD	1
(0052,0011)	A-line Rate	ALineRate	FD	1
(0052,0012)	A-lines Per Frame	ALinesPerFrame	US	1
(0052,0013)	Catheter Rotational Rate	CatheterRotationalRate	FD	1
(0052,0014)	A-line Pixel Spacing	ALinePixelSpacing	FD	1
(0052,0016)	Mode of Percutaneous Access Sequence	ModeOfPercutaneousAccessSequence	SQ	1
(0052,0025)	Intravascular OCT Frame Type Sequence	IntravascularOCTFrameTypeSequence	SQ	1
(0052,0026)	OCT Z Offset Applied	OCTZOffsetApplied	CS	1
(0052,0027)	Intravascular Frame Content Sequence	IntravascularFrameContentSequence	SQ	1
(0052,0028)	Intravascular Longitudinal Distance	IntravascularLongitudinalDistance	FD	1
(0052,0029)	Intravascular OCT Frame Content Sequence	IntravascularOCTFrameContentSequence	SQ	1
(0052,0030)	OCT Z Offset Correction	OCTZOffsetCorrection	SS	1
(0052,0031)	Catheter Direction of Rotation	CatheterDirectionOfRotation	CS	1
(0052,0033)	Seam Line Location	SeamLineLocation	FD	1
(0052,0034)	First A-line Location	FirstALineLocation	FD	1
(0052,0036)	Seam Line Index	SeamLineIndex	US	1
(0052,0038)	Number of Padded A-lines	NumberOfPaddedALines	US	1
(0052,0039)	Interpolation Type	InterpolationType	CS	1
(0052,003A)	Refractive Index Applied	RefractiveIndexApplied	CS	1

Tag	Name	Keyword	VR	VM
(0028,0304)	Referenced Color Palette Instance UID	ReferencedColorPaletteInstance UID	UI	1

Modify PS3.6 Annex A

370

**Table A-1
UID VALUES**

UID Value	UID NAME	UID TYPE	Part
...			
<u>1.2.840.10008.5.1.4.1.1.14.1</u>	<u>Intravascular Optical Coherence Tomography Image Storage – For Presentation</u>	<u>SOP Class</u>	<u>PS 3.4</u>
<u>1.2.840.10008.5.1.4.1.1.14.2</u>	<u>Intravascular Optical Coherence Tomography Image Storage – For Processing</u>	<u>SOP Class</u>	<u>PS 3.4</u>

**Table A-3
CONTEXT GROUP UID VALUES**

Context UID	Context Identifier	Context Group Name
...
1.2.840.10008.6.1.122	3487	<u>Intravascular IVUS</u> Volumetric Regions
...
<u>1.2.840.10008.6.1.934</u>	<u>3850</u>	<u>Intravascular OCT Flush Agent</u>

375

Part 16 Additions

Modify Annex A Structured Reporting Templates (Normative)

TID 3255 IVUS Volume Measurement

380 **TID 3255**
IVUS Volume Measurement
Type: Extensible

	NL	Relation with Parent	Value Type	Concept Name	VM	Req Type	Condition	Value Set Constraint
1			INCLUDE	TID (300) Measurement	1	M		\$Measurement = DCID (3485) IVUS Volume Measurements \$Units = EV (mm3, UCUM, "mm3") \$TargetSite = BCID (3487) Intravascular IVUS Volumetric Regions

385 **Add or Modify the following definitions to Part 16 Annex B DCMR Context Groups (Normative)**

CID 12 Radiographic Contrast Agent

Context ID 12
Radiographic Contrast Agent
Type: Extensible Version: 2005140420110609

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)	Trade Name (Informative) (From http://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm)
...	
SRT	C-B0332	loversol	Optiray™ (Mallinckrodt)
<u>SRT</u>	<u>C-B03H2</u>	<u>iopromide</u>	<u>Ultravist or Imeron</u>
<u>SRT</u>	<u>C-B0303</u>	<u>ioxilan</u>	<u>Imagenil</u>

390 **CID 29 Acquisition Modality**

Context ID 29
Acquisition Modality
Type: Extensible Version: 20110609

Coding Scheme Designator	Code Value	Code Meaning
...
DCM	OCT	Optical Coherence Tomography
<u>DCM</u>	<u>IVOCT</u>	<u>Intravascular Optical Coherence Tomography</u>
...

395

CID 3411 Intracoronary Devices

400 **Context ID 3411**
Intracoronary Devices
Type: Extensible Version: 20110609

Coding Scheme Designator	Code Value	Code Meaning	NCDR Equivalent	Trade Name (Informative)
...
SRT	R-00312	Intravascular Ultrasound (IVUS) Device	113-9	
<u>SRT</u>	<u>A-00D87</u>	<u>Intravascular Optical Coherence Tomography Device</u>		
<u>SRT</u>	<u>A-00927</u>	<u>Guide Wire</u>		
<u>SRT</u>	<u>A-26802</u>	<u>Guiding Catheter</u>		
...

CID 3487 Intravascular IVUS Volumetric Regions

405 This context group is the set of regions where Intravascular IVUS volumetric measurements can be made.

Context ID 3487
Intravascular IVUS Volumetric Regions
Type: Extensible Version: 20110609

Code Scheme	Code Value	Concept Name
...
SRT	M-01000	Lesion
<u>SRT</u>	<u>R-002EF</u>	<u>Culprit Lesion</u>

410 **CID 3850 Intravascular OCT Flush Agent**

Context ID 3850
Intravascular OCT Flush Agent
Type: Extensible Version: 20110609

<u>Coding Scheme Designator (0008,0102)</u>	<u>Code Value (0008,0100)</u>	<u>Code Meaning (0008,0104)</u>	<u>Trade Name (Informative) (From http://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm)</u>
<u>SRT</u>	<u>C-A7220</u>	<u>Dextran</u>	
<u>SRT</u>	<u>C-70841</u>	<u>Saline</u>	
<u>SRT</u>	<u>C-70434</u>	<u>Lactated Ringer's</u>	
<u>INCLUDE CID 12 Radiographic Contrast Agent</u>			

415 **CID 7202 Source Image Purposes of Reference**

Context ID 7202
Source Image Purposes of Reference
Type: Extensible Version: 20110609

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
...
DCM	121330	Lossy compressed predecessor
<u>DCM</u>	<u>121358</u>	<u>For Processing predecessor</u>

420

CID 7203 Image Derivation

Context ID 7203
Image Derivation
Type: Extensible Version: 20110609

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
...
DCM	113090	Image stitching
<u>DCM</u>	<u>113093</u>	<u>Polar to Rectangular Scan Conversion</u>

425

Replace the content of CID 3746 with the following:

CID 3746 Percutaneous Entry

430 This Context Group includes concepts for Percutaneous entry that are the most relevant children of SNOMED concept 297211001 “transvascular approach”. Other concepts from that hierarchy may be used as local extensions to this Context Group.

**Context ID 3746
Percutaneous Entry**

435 **Type: Extensible Version: ~~20030327~~ 20110609**

Coding Scheme	Code Value	Code Meaning	Equivalent SNOMED-CT Concept ID
SRT	G-D067	Via femoral artery	260590008
SRT	G-D1E4	Via radial artery	444850002
SRT	G-D05F	Via brachial artery	260585005
SRT	G-D054	Via artery	103387006
SRT	G-D0C6	Via arm vein	261459001
SRT	G-D071	Via femoral vein	260601006
SRT	G-D052	Via vein	103386002

Note: In prior editions, this Context Group included NCDR 2.0b codes as the primary set. These have been replaced with equivalent SNOMED codes. (See PS3.16-2009)

440

Add the following definitions to Part 16 Annex D - DICOM Controlled Terminology Definitions (Normative)

Annex D DICOM Controlled Terminology Definitions (Normative)

445 This Annex specifies the meanings of codes defined in DICOM, either explicitly or by reference to another part of DICOM or an external reference document or standard.

DICOM Code Definitions (Coding Scheme Designator “DCM” Coding Scheme)

Code Value	Code Meaning	Definition	Notes
<u>121358</u>	<u>For Processing predecessor</u>	<u>Source image from which FOR PRESENTATION images were created.</u>	
<u>113093</u>	<u>Polar to Rectangular Scan Conversion</u>	<u>Conversion of a polar coordinate image to rectangular (Cartesian) coordinate image.</u>	

Part 17 Additions

450

Add Annexes to Part 17

Annex X Intravascular OCT Images (Informative)

X.1 Purpose of this Annex

455 The purpose of this annex is to explain key IVOCT FOR PROCESSING parameters, describe the relationship between IVOCT FOR PROCESSING and FOR PRESENTATION images. It also explains Intravascular Longitudinal Reconstruction.

X.2 IVOCT FOR PROCESSING Parameters

X.2.1 Z Offset Correction

460 When an OCT image is acquired, the path length difference between the reference and sample arms may vary, resulting in a shift along the axial direction of the image, known as the Z Offset. With FOR PROCESSING images, in order to convert the image in Cartesian coordinates and make measurements, this Z Offset should be corrected, typically on a per-frame or per-image basis. Z Offset is corrected by shifting Polar data rows (A-lines) + OCT Z Offset Correction (0052,0030) pixels along the axial dimension of the image.

465 Z Offset correction may be either a positive or negative value. Positive values mean that the A-lines are shifted further away from the catheter optics. Negative values mean that the A-lines are shifted closer to the catheter optics. Figure X.2-1 illustrates a negative Z Offset Correction.

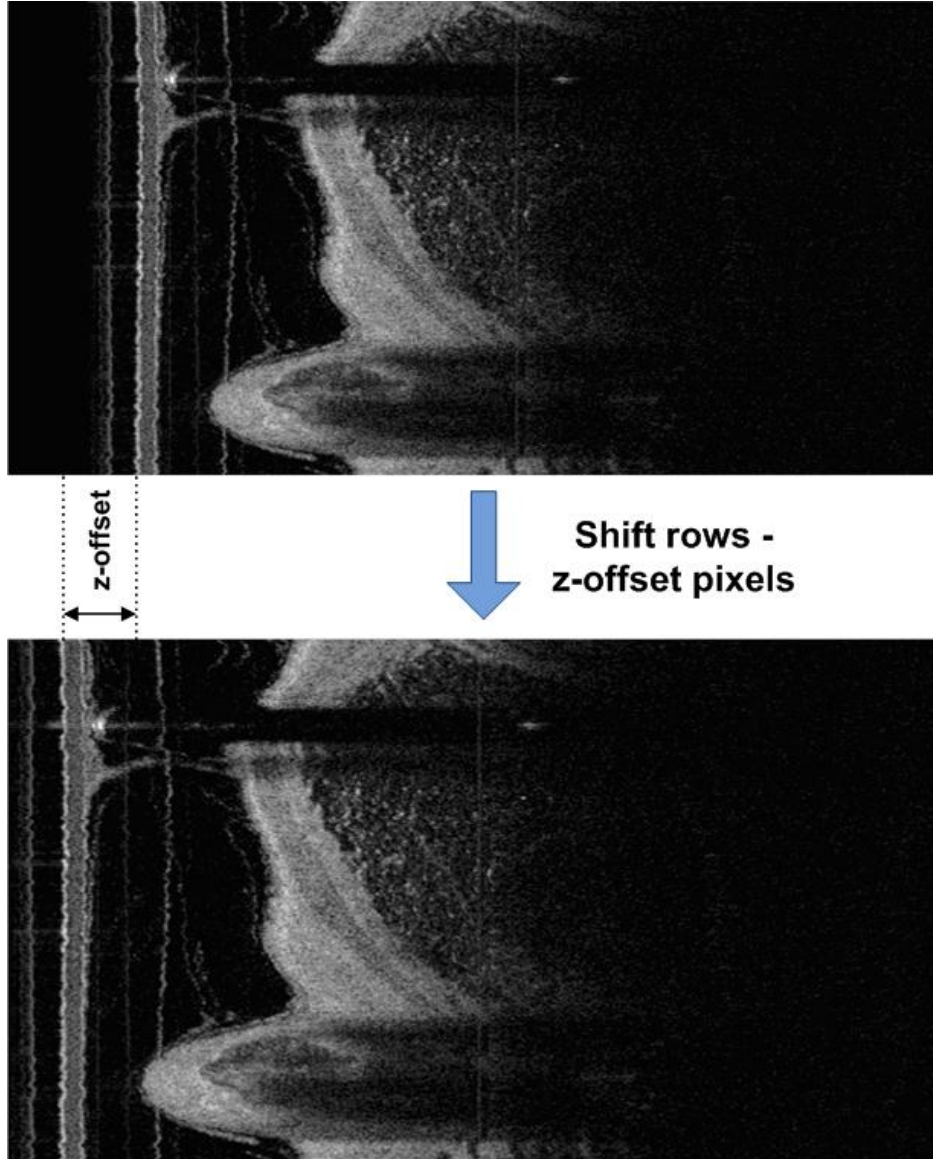


Figure X.2-1 - Z Offset Correction

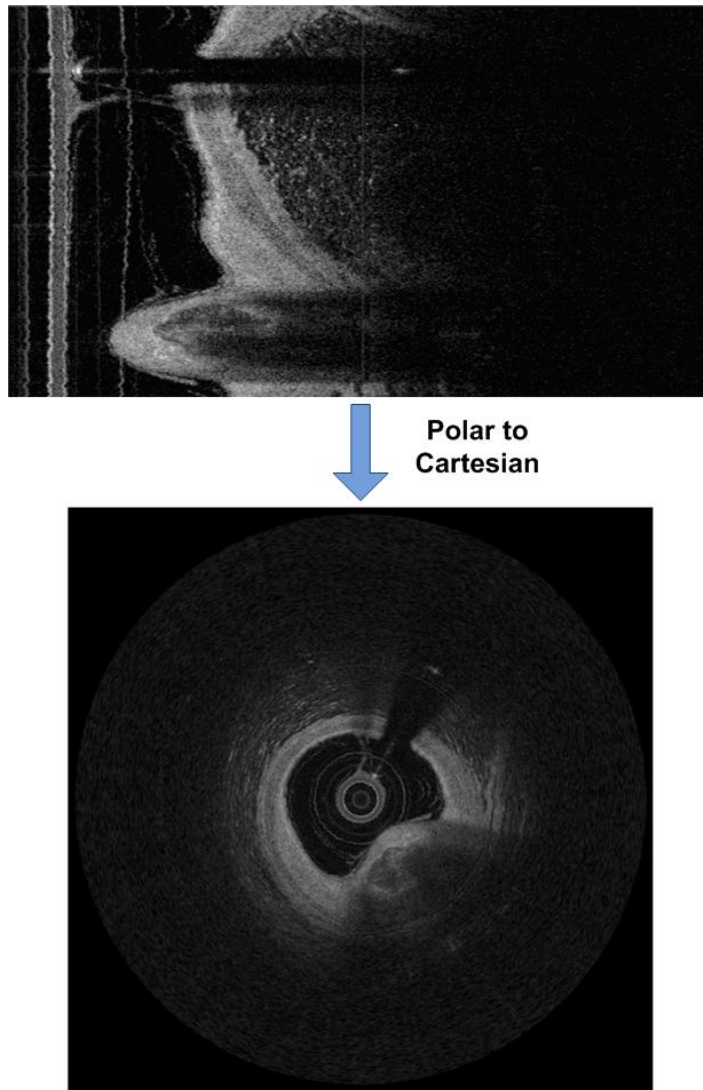
470 **X.2.2 Refractive Index Correction**

The axial distances in an OCT image are dependent on the refractive index of the material that IVOCT light passes through. As a result, in order to accurately make measurements in images derived from FOR PROCESSING data, the axial dimension of the pixels should be globally corrected by dividing the A-line Pixel Spacing (0052,0014) value (in air) by the Effective Refractive Index (0052,0004) and setting the Refractive Index Applied (0052,003A) to YES.

475 Although not recommended, if A-line Pixel Spacing (0052,0014) is reported in air (i.e. not corrected by dividing by Effective Refractive Index) then the Refractive Index Applied value shall be set to NO.

480 **X.2.3 Polar-Cartesian Conversion**

FOR PROCESSING Polar data is specified such that each column represents a subsequent axial (z) location and each row an angular (θ) coordinate. Following Z Offset and Refractive Index Correction, Polar data can be converted to Cartesian data by first orienting the seam line position so that it is at the correct row location. This can be accomplished by shifting the rows Seam Line Index (0052,0036) pixels so that its Seam Line Location (0052,0033) is located at row "A-lines Per Frame * Seam Line Location / 360". Once the seam line is positioned correctly, the Cartesian data can be obtained by remapping the Polar (z, θ) data into Cartesian (x, y) space, where the leftmost column of the Polar image corresponds to the center of the Cartesian image. Figure X.2-2 illustrates the Polar to Cartesian conversion. The scan-converted frames are constructed using the Catheter Direction of Rotation (0052,0031) attribute to determine the order in which the A-lines are acquired. Scan-converted frames are constructed using A-lines that contain actual data (I.e. not padded A-lines). Padded A-lines are added at the end of the frame and are contiguous. Figure X.2-2 is an example of Polar to Cartesian conversion.



495

Figure X.2-2 – Polar to Cartesian Conversion

X.3 Intravascular Longitudinal Image

500 An Intravascular Longitudinal Image (L-Mode) is a constrained three-dimensional reconstruction of an IVUS or IVOCT multi-frame image. The Longitudinal Image can be reconstructed from either FOR PROCESSING or FOR PRESENTATION Images. Figure X.3-1 is an example of an IVUS cross-sectional image (on the left) with a reconstructed longitudinal view (on the right).

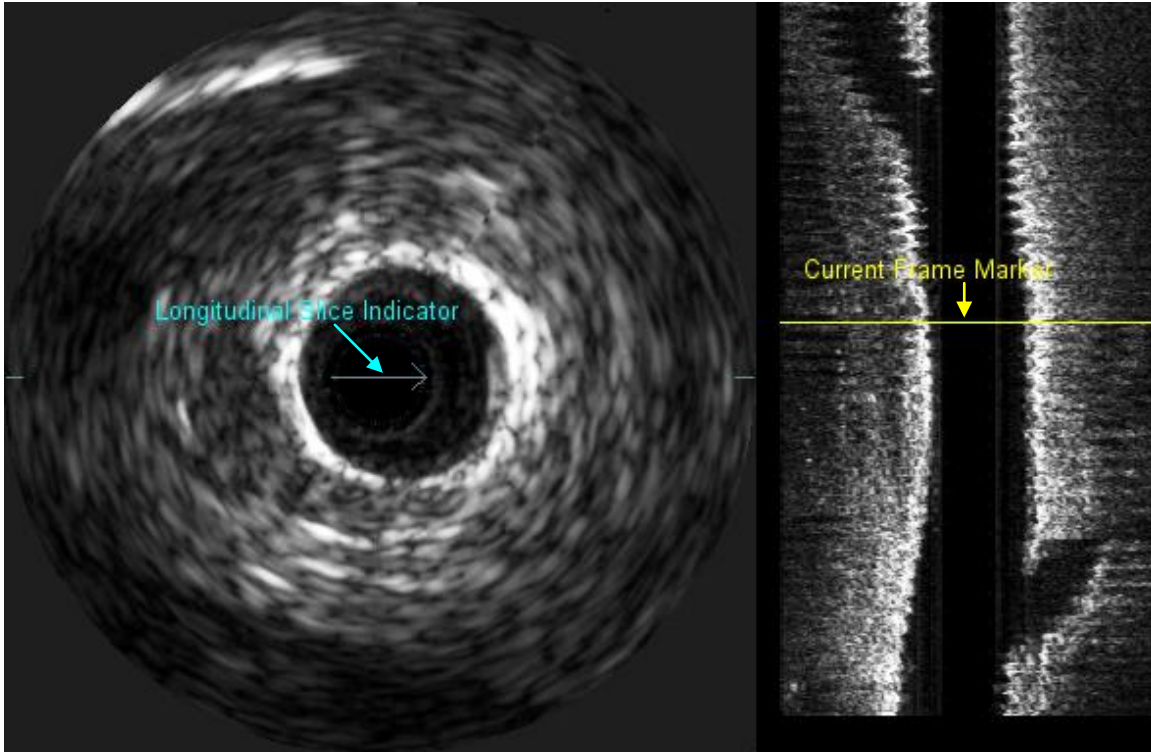


Figure X.3-1 - IVUS Image with Vertical Longitudinal View

505

The Longitudinal reconstruction is comprised of a series of perpendicular cut planes, typically consisting of up to 360 slices spaced in degree increments. The cut planes are perpendicular to the cross-sectional plane, and rotate around the catheter axis (i.e. center of the catheter) to provide a full 360 degrees of rotation. A longitudinal slice indicator is used to select the cut plane to display, and is normally displayed in the associated cross-sectional image (e.g. blue arrow cursor in figure X.3-1). A current frame marker (e.g. yellow cursor located in the longitudinal view) is used to indicate the position of the corresponding cross-sectional image, within the longitudinal slice.

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515 When pullback rate information is provided, distance measurements are possible along the
catheter axis. The Intravascular Longitudinal Distance (0052,0028) or IVUS Pullback Rate
(0018,3101) attributes are used along with the Frame Acquisition DateTime (0018,9074) attribute
to facilitate measurement calculations. This allows for lesion, calcium, stent and stent gap length
measurements. Figure X.3-2 is an example of an IVOCT cross-sectional image (on the top), with
520 a horizontal longitudinal view on the bottom. The following example also illustrates how the tint
specified by the Palette Color LUT is applied to the OCT image.

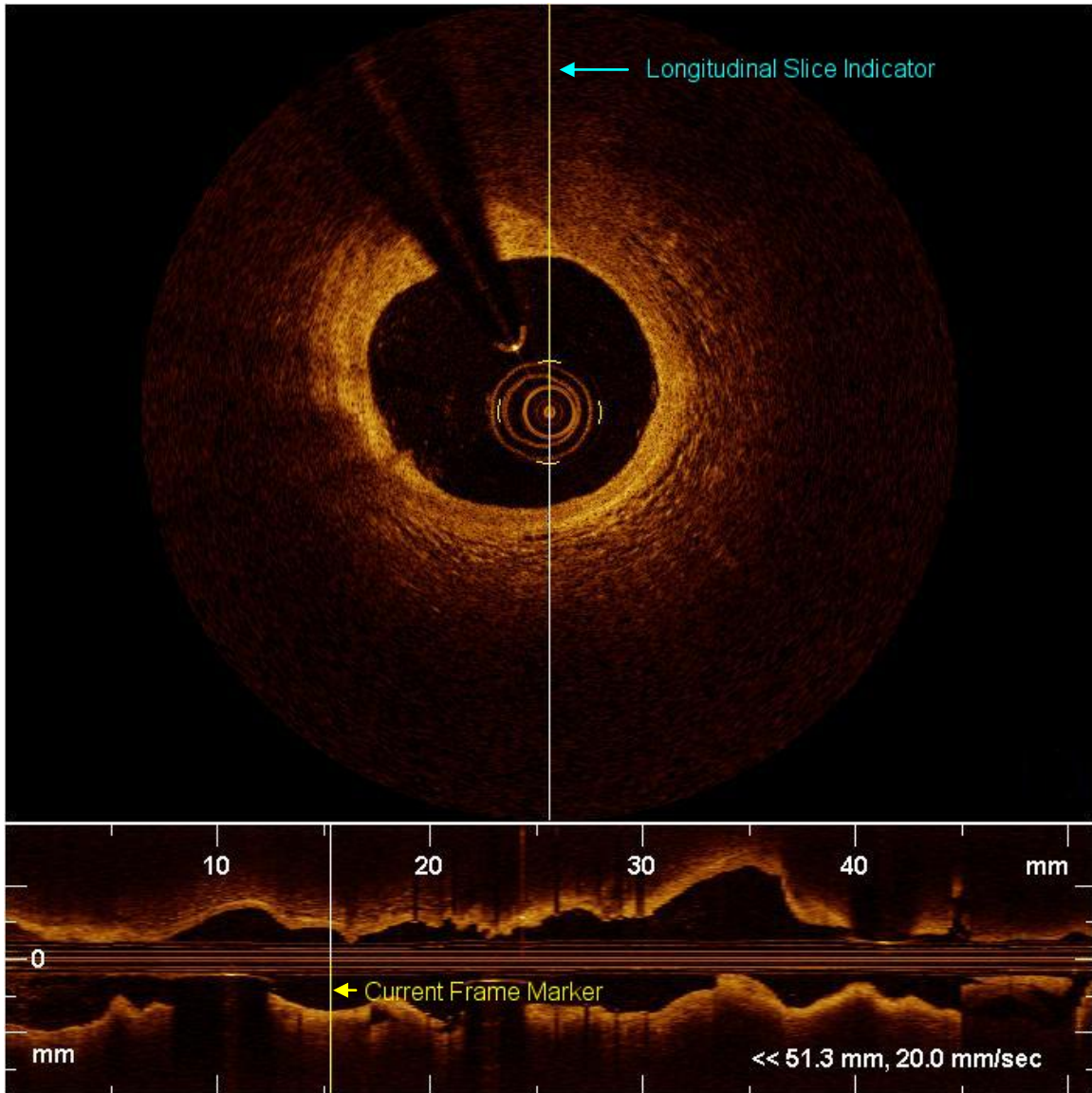
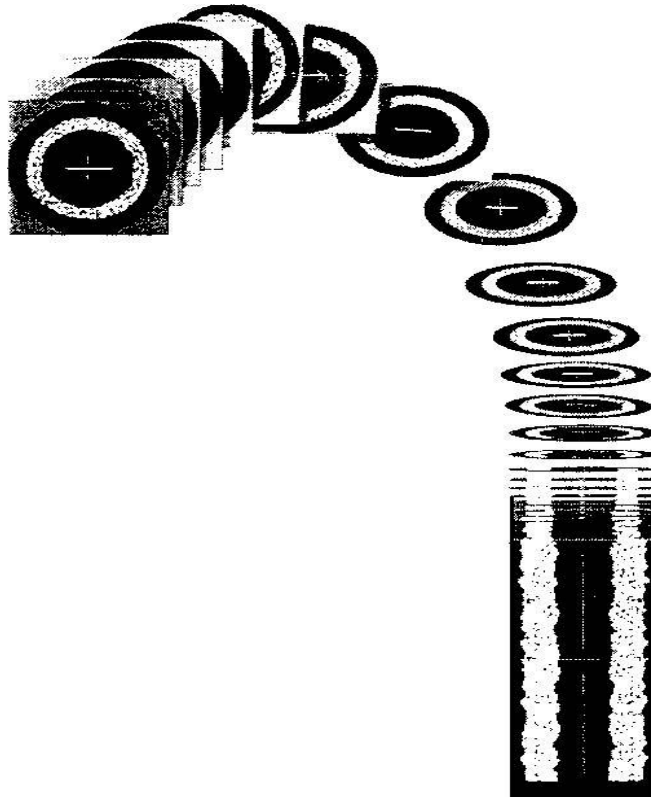


Figure X.3-2 - IVOCT Image with Horizontal Longitudinal View



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Figure X.3-3 - Longitudinal Reconstruction

Figure X.3-3 illustrates how the 2D cross-sectional frames are stacked along the catheter longitudinal axis. True geometric representation of the vessel morphology cannot be rendered, since only the Z position information is known. Position (X and Y) and rotation (X, Y and Z) information of the acquired cross-sectional frames is unknown.

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