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**Digital Imaging and Communications in Medicine (DICOM)**

*Supplement 154: Optical Surface Scanner Storage SOP Class*

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## Scope and Field

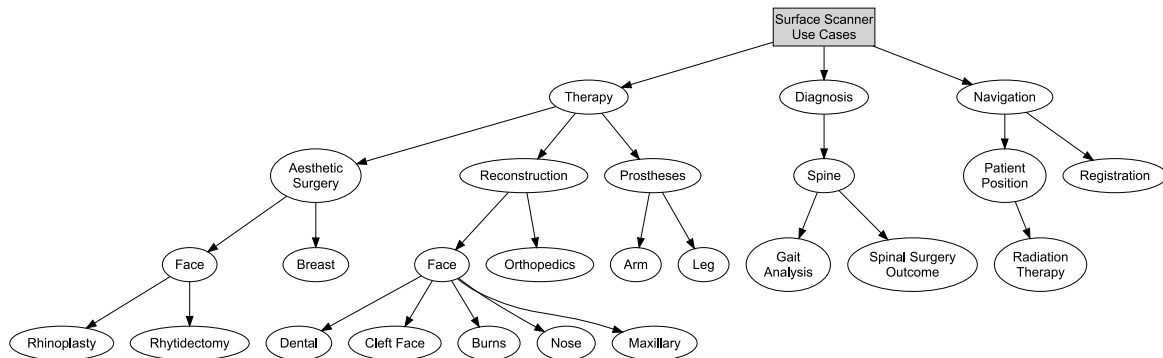
85 Since the use of optical surface scanners in medical applications is constantly rising, they should be represented by specific modality and device attributes in DICOM. This would allow the user to store the scanned surfaces on a PACS.

90 An optical surface scanner projects structured light (line(s) or complex pattern) on an object and takes a picture of the scene. A point cloud is calculated from the deviations of the projected pattern. Time of Flight cameras calculate the point cloud of the reflecting light's delay. Based on the point cloud, a 3D surface is calculated. Point clouds and surfaces are already part of the current DICOM Standard.

Optionally an additional camera on the scanner device is able to take colored high-resolution pictures to record textures of the object.

95 Available devices are able to store the scanned object either completely processed as a 3D object or as point cloud with texture. Therefore, two SOP classes are required.

There are a number of use cases that would benefit from the connection of a Surface Scanner to a PACS (see Figure 1):



**Figure 1: Tree-like structure of medical use cases for optical surface scanners.**

100 It is not possible to store colored 3D object using the Surface Segmentation IOD. UV mapping is used for applying potentially colored textures to 3D objects. To make UV mapping possible the supplement describes a way to assign textures to existing point clouds or 3D objects.

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110

**Changes to NEMA Standards Publication PS 3.2-2011**

**Digital Imaging and Communications in Medicine (DICOM)**

**Part 2: Conformance**

115

**Item: Add SOP Class to Table A.1-2**

**Table A.1-2  
UID VALUES**

<b>UID Value</b>	<b>UID NAME</b>	<b>Category</b>
...		
1.2.840.10008.5.1.4.1.1.68.1	Surface Scan Mesh Storage	Transfer
1.2.840.10008.5.1.4.1.1.68.2	Surface Scan Point Cloud Storage	Transfer
...		

**Changes to NEMA Standards Publication PS 3.3-2011**

**Digital Imaging and Communications in Medicine (DICOM)**

**Part 3: Information Object Definitions**

130

**Item: Add in Section A.1.4, rows and column to Table A.1-2**

**A.1.4 Overview of the Composite IOD Module Content**

<b>IODs Modules</b>	<b><u>Surface Scan Point Cloud</u></b>	<b><u>Surface Scan Mesh</u></b>
Patient	<u>M</u>	<u>M</u>
Specimen	<u>U</u>	<u>U</u>
Clinical Trial Subject	<u>U</u>	<u>U</u>
General Study	<u>M</u>	<u>M</u>
Patient Study	<u>U</u>	<u>U</u>
Clinical Trial Study	<u>U</u>	<u>U</u>
General Series	<u>M</u>	<u>M</u>
Clinical Trial Series	<u>U</u>	<u>U</u>
<b><u>Optical Surface Scanner Series</u></b>	<u>M</u>	<u>M</u>
General Equipment	<u>M</u>	<u>M</u>
Enhanced General Equipment	<u>M</u>	<u>M</u>
<b><u>Point Cloud</u></b>	<u>M</u>	
<b><u>Surface Mesh</u></b>		<u>M</u>
<b><u>UV Mapping</u></b>	<u>U</u>	<u>U</u>
<b><u>Scan Procedure</u></b>	<u>M</u>	<u>M</u>
SOP Common	<u>M</u>	<u>M</u>

135

**Item: Add in the following new section in Annex A**

**A.X SURFACE SCAN MESH INFORMATION OBJECT DEFINITION**

**A.X.1 Surface Scan Mesh IOD Description**

140 The Surface Scan Mesh IOD specifies a triangulated surface generated by an optical surface scanner or a 3D post-processing application. The Surface Scan Mesh IOD stores a surface including UV mapping and change history combined with device specific parameters.

**A.X.2 Surface Scan Mesh IOD Entity-Relationship Model**

145 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 Surface Scan Mesh IOD. Below the Series IE, only the Surface IE is used.



**A.X.3 Surface Scan Mesh IOD Module Table**

**Table A.X-1  
SURFACE SCAN MESH IOD MODULES**

<b>IE</b>	<b>Module</b>	<b>Reference</b>	<b>Usage</b>
Patient	Patient	C.7.1.1	M
	Specimen	C.7.1.2	U
	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
	Optical Surface Scanner Series	C.8.X.1	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Surface	Surface Mesh	C.27.1	M
	UV Mapping	C.27.Y	U
	Scan Procedure	C.8.X.2	M
	SOP Common	C.12.1	M

150 **A.Y SURFACE SCAN POINT CLOUD INFORMATION OBJECT DEFINITION**

**A.Y.1 Surface Scan Point Cloud IOD Description**

The Surface Scan Point Cloud IOD specifies a point cloud generated by an optical surface scanner. Multiple Point Clouds within the same series shall be from the same anatomical region, but they do not need to be in the same coordinate system.

155 **A.Y.2 Surface Scan Point Cloud 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 Surface Scan Point Cloud IOD. Below the Series IE, only the Surface IE is used.

**A.Y.3 Surface Scan Point Cloud IOD Module Table**

160

**Table A.Y-1  
SURFACE SCAN POINT CLOUD IOD MODULES**

<b>IE</b>	<b>Module</b>	<b>Reference</b>	<b>Usage</b>
Patient	Patient	C.7.1.1	M
	Specimen	C.7.1.2	U
	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
	Optical Surface Scanner Series	C.8.X.1	M
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Surface	Point Cloud	C.27.X	M
	UV Mapping	C.27.Y	U
	Scan Procedure	C.8.X.2	M
	SOP Common	C.12.1	M

**Item: Modify sections C.7.3.1.1.1**

**C.7.3.1.1.1 Modality**

165 OSS = Optical Surface Scan

**Item: Add in the following new sections in C**

**C.8.X Optical Surface Scanner Modules**

170 This Section describes Optical Surface Scanner Modules. These Modules contain Attributes that are specific to Optical Surface Scanner scans.

**C.8.X.1 Optical Surface Scanner Series Module**

175 Table C.8.X-1 contains IOD Attributes that describe an optical surface scan series performed on the patient.

**Table C.8.X-1  
OPTICAL SURFACE SCANNER 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: OSS See section C.7.3.1.1.1 for further explanation.
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). Only a single Item shall be included in this sequence. Required if the Modality Performed Procedure Step SOP Class, General

			Purpose Performed Procedure Step SOP Class is supported.
<i>&gt;Include SOP Instance Reference Macro Table 10-11</i>			
Referenced Surface Data Sequence	(xxxx,yy13)	2	Lists the predecessor surfaces and/or point clouds instances. Zero or more Items shall be included in this sequence.
<i>&gt;Include 'SOP Instance Reference Macro' Table 10-11</i>			

**C.8.X.2 Scan Procedure Module**

180 Table C.8.X-2 specifies the Attributes of the Scan Procedure Module.

**Table C.8.X-2  
SCAN PROCEDURE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Surface Scan Acquisition Type Code Sequence	(0080,0001)	1	Specify the type of acquisition method. For evaluation of the characteristics or quality of the data. Only a single Item shall be permitted in this sequence.
<i>&gt;Include 'Code Sequence Macro' Table 8.8-1</i>			Baseline CID 8201
Surface Scan Mode Code Sequence	(0080,0002)	2	Used scan mode. Zero or more Items shall be included in this sequence.
<i>&gt;Include 'Code Sequence Macro' Table 8.8-1</i>			Baseline CID 8202
Registration Method Code Sequence	(0080,0003)	1C	Method for registering multiple shots. Required if the IOD stores data which has been derived from multiple shots. Only a single Item shall be permitted in this sequence.
<i>&gt;Include 'Code Sequence Macro' Table 8.8-1</i>			Baseline CID 8203
Instance Number	(0020,0013)	1	A number that identifies this shot. Shall start at 1 and monotonically increase by 1 within a single acquisition.
Acquisition Number	(0020,0012)	1	A number identifying the single continuous gathering of data over a period of time that resulted in this instance.
Acquisition DateTime	(0008,002A)	1	The date and time that the acquisition of data that resulted in this instance started.
Shot Duration Time	(0080,0004)	1	The time in seconds from the start of this shot until the end of this shot.
Shot Offset Time	(0080,0005)	3	The time in seconds from the Acquisition Date Time to the start of this shot.

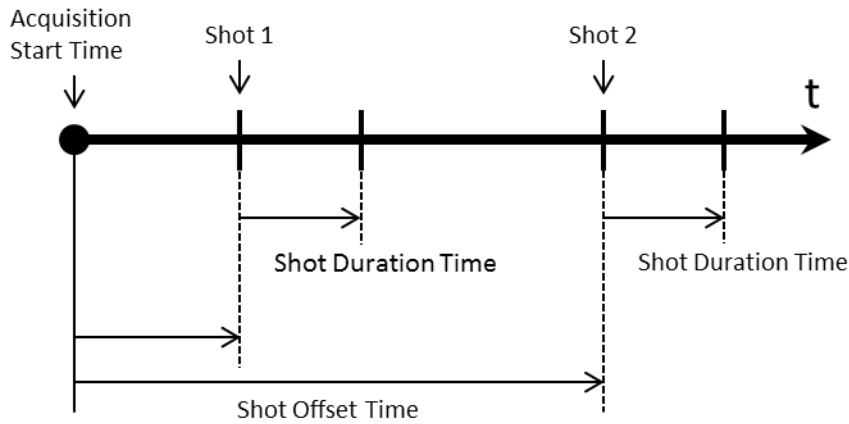
**C.8.X.2.1 Scan Procedure Attribute Descriptions**

185 **C.8.X.2.1.1 Shot Duration Time and Shot Offset Time**

Figure C.8.X.2-1 depicts the usages of some of the attributes of the Scan Procedure Module.

The Shot Offset Time is the time required for the detection of focus points and exposure time settings.

The Shot Duration Time is the time required to acquire a surface from the scanned object.



190

**Figure C.8.X.2-1 – Timing attributes Illustration**

**C.27.X Point Cloud Module**

Table C.27.X-1 specifies the Attributes of the Point Cloud Module.

195

**Table C.27.X-1  
POINT CLOUD MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Surface Points Sequence	(0066,0011)	1	The point positions representing vertices of the surface. Only one item shall be permitted in the sequence.
<i>&gt;Include 'Points Macro' Table C.27-2</i>			
Surface Point Presentation Value Data	(0080,0006)	3	Contains a vector of P-Values to assign a gray value to each point. The number of values shall be equal to the value of the Number Of Surface Points Attribute (0066,0015) in the Points Macro. Each value shall correspond to the respective point in the Point Coordinates Data (0066,0016).

Surface Point Color CIE Lab Value Data	(0080,0007)	3	<p>Contains a vector of color triplets to assign colors to each point.</p> <p>The number of triplets shall be equal to the value of the Number Of Surface Points Attribute (0066,0015) in the Points Macro.</p> <p>The units are PCS-Values, and the value is encoded as CIE Lab. See C.10.7.1.1.</p> <p>Each triplet shall correspond to the respective point in the Point Coordinates Data (0066,0016).</p>
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**C.27.Y UV Mapping Module**

Table C.27.Y-1 specifies the Attributes of the UV Mapping Module.

200

**Table C.27.Y-1  
UV MAPPING MODULE ATTRIBUTES**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
UV Mapping Sequence	(0080,0008)	1	<p>Maps each point of the Surface Points Sequence (0066,0011) in the Point Cloud Module or the Surface Mesh Module to the coordinates of a VL Photographic Image Instance.</p> <p>One or more Items shall be included in this Sequence.</p>
>Texture Label	(0080,0009)	1	<p>Contains a label that uniquely identifies this UV map to distinguish it from other items in the sequence.</p>
>U Value Data	(0080,0010)	1	<p>Contains a vector of column offsets. Each value is normalized to the range of 0.0 to 1.0 pointing in the pixel data of the referenced textures sequence image. Each value shall correspond to the respective point in the Point Coordinates Data (0066,0016).</p> <p>The number of values must be equal to the number of points of the Point Cloud or the Surface Mesh.</p>
>V Value Data	(0080,0011)	1	<p>Contains a vector of row offsets. Each value is normalized to the range of 0.0 to 1.0 pointing in the pixel data of the referenced textures sequence image. Each value shall correspond to the respective point in the Point Coordinates Data (0066,0016).</p> <p>The number of values must be equal to the number of points of the Point Cloud or the Surface Mesh.</p>

>Referenced Textures Sequence	(0080,0012)	1	The image that is being mapped to the point cloud or the surface mesh. Only one item shall be permitted in the Sequence.
>>Include 'Referenced Instances And Access Macro' Table 10-3b			

**C.27.Y.1 UV Mapping Attribute Discription**

**C.27.Y.1.1 U Value Data and V Value Data**

- 205 UV texturing allows a 3D object to be colored with the color from a 2D image. The 2D image therefore is called texture map. During the UV mapping process pixels from the 2D image are assigned to each point in the point cloud or the surface mesh of the object. The 2D image shall fully cover the space of the scanned object. If more than one texture with different resolutions or different exposures is required separate SOP Instances shall be created.
- 210 The term U and V is used because X, Y and Z are already assigned to the coordinates of the points of the scanned object.

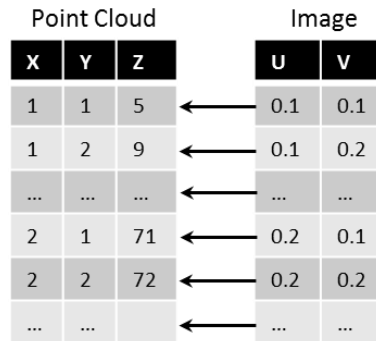


Figure C.27.Y.1.1-1 Example of mapping textures to point coordinates.

Add to PS 3.3 Annex F:

215

**Table F.3-3**  
**DIRECTORY INFORMATION MODULE**

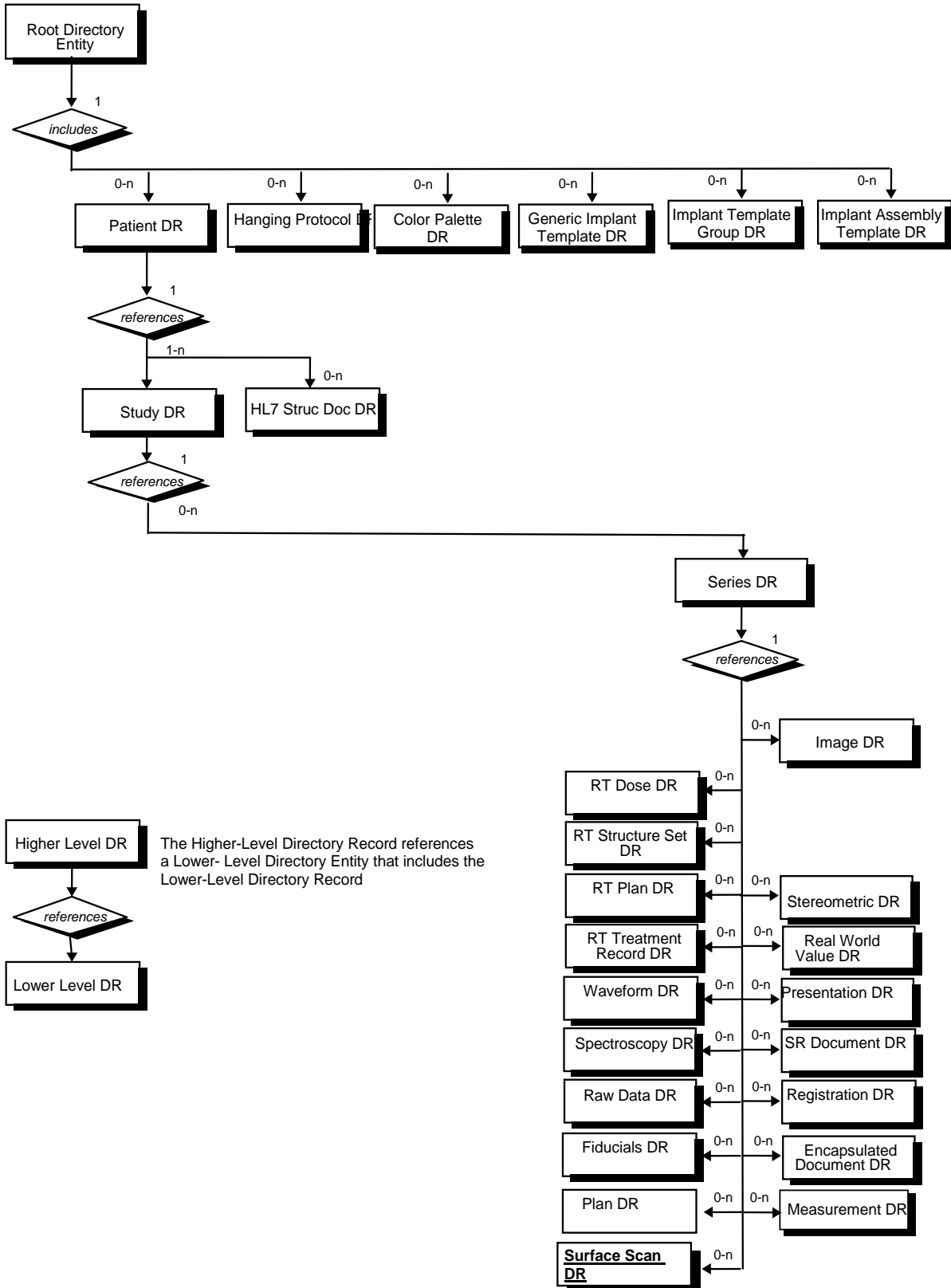
Attribute Name	Tag	Type	Attribute Description
>Directory Record Type	(0004,1430)	1C	... Enumerated Values (see Section F.5): ... <b><u>SURFACE SCAN</u></b>

220

**Table F.4-1**  
**RELATIONSHIP BETWEEN DIRECTORY RECORDS**

Directory Record Type	Section	Directory Record Types which may be included in the next lower-level directory Entity
...	...	...
<b><u>SURFACE SCAN</u></b>	<b><u>F.5.X</u></b>	<b><u>PRIVATE</u></b>

**Update Figure F.4-1 Basic Directory IOD Information Model: add Surface Scan DR**





225

**Add Directory Record to F.5:**

**F.5.X Surface Scan Mesh directory record definition**

230

The Directory Record is based on the specification of Section F.3. It is identified by a Directory Record Type of Value "SURFACE SCAN ". Table F.5-X lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Surface Scan IE of the Surface Scan Mesh and Surface Scan Point Cloud IODs. This Directory Record shall be used to reference a Surface Scan Mesh SOP Instance. This type of Directory Record may reference a Lower-Level Directory Entity that includes one or more Directory Records as defined in Table F.4-1.

235

**Table F.5-X  
SURFACE SCAN KEYS**

<b>Key</b>	<b>Tag</b>	<b>Type</b>	<b>Attribute Description</b>
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used in one of the keys.
Content Date	(0008,0023)	1	The date the content creation started.
Content Time	(0008,0033)	1	The time the content creation started.
Any other Attribute of the Surface Scan IE Modules		3	

Note: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table F.3-3), it is not duplicated in this list of keys.

240

245

**Changes to NEMA Standards Publication PS 3.4-2011**

**Digital Imaging and Communications in Medicine (DICOM)**

250

**Part 4: Service Class Specifications**

**Item: Add the following to Table B.5-1**

**B.5 STANDARD SOP CLASSES**

255

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

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
...	...	...
Surface Scan Mesh Storage	1.2.840.10008.5.1.4.1.1.68.1	Surface Scan Mesh
Surface Scan Point Cloud Storage	1.2.840.10008.5.1.4.1.1.68.2	Surface Scan Point Cloud
...	...	...

**Item: Add the following to Table I.4-1**

260

**I.4 MEDIA STORAGE STANDARD SOP CLASSES**

**Table I.4-1  
 Media Storage Standard SOP Classes**

SOP Class Name	SOP Class UID	IOD Specification (defined in PS 3.3)
...	...	...
Surface Scan Mesh Storage	1.2.840.10008.5.1.4.1.1.68.1	Surface Scan Mesh
Surface Scan Point Cloud Storage	1.2.840.10008.5.1.4.1.1.68.2	Surface Scan Point Cloud
...	...	...

265

270

**Changes to NEMA Standards Publication PS 3.6-2011**

**Digital Imaging and Communications in Medicine (DICOM)**

**Part 6: Data Dictionary**

275

**Item: Add or the following Data Elements to Part 6 Section 6:**

### Registry of DICOM data elements

Tag	Name	Keyword	VR	VM
(0080,0001)	Surface Scan Acquisition Type Code Sequence	SurfaceScanAcquisitionTypeCodeSequence	SQ	1
(0080,0002)	Surface Scan Mode Code Sequence	SurfaceScanModeCodeSequence	SQ	1
(0080,0003)	Registration Method Code Sequence	RegistrationMethodCodeSequence	SQ	1
(0080,0004)	Shot Duration Time	ShotDurationTime	FD	1
(0080,0005)	Shot Offset Time	ShotOffsetTime	FD	1
(0080,0006)	Surface Point Presentation Value Data	SurfacePointPresentationValueData	US	1-n
(0080,0007)	Surface Point Color CIELab Value Data	SurfacePointColorCIELabValueData	US	3-3n
(0080,0008)	UV Mapping Sequence	UVMappingSequence	SQ	1
(0080,0009)	Texture Label	TextureLabel	SH	1
(0080,0010)	U Value Data	UValueData	OF	1-n
(0080,0011)	V Value Data	VValueData	OF	1-n
(0080,0012)	Referenced Texture Sequence	ReferencedTextureSequence	SQ	1
(0080,0013)	Referenced Surface Data Sequence	ReferencedSurfaceDataSequence	SQ	1

**Item: Add the following UIDs to Part 6 Annex A:**

### Annex A Registry of DICOM unique identifiers (UID) (Normative)

280

**Table A-1  
UID VALUES**

UID Value	UID NAME	UID TYPE	Part
...	...	...	...
1.2.840.10008.5.1.4.1.1.68.1	Surface Scan Mesh Storage	SOP Class	PS 3.4
1.2.840.10008.5.1.4.1.1.68.2	Surface Scan Point Cloud Storage	SOP Class	PS 3.4
...	...	...	...

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

285

<b>Context UID</b>	<b>Context Identifier</b>	<b>Context Group Name</b>
1.2.840.10008.6.1.953	8201	Surface Scan Acquisition Types
1.2.840.10008.6.1.954	8202	Surface Scan Mode Types
1.2.840.10008.6.1.956	8203	Surface Scan Registration Method Types

290

**Changes to NEMA Standards Publication PS 3.15-2011**

295

**Digital Imaging and Communications in Medicine (DICOM)**

**Part 15: Security and Systems Management Profiles**

<b>Item: Add to Section C2 and C3</b>
---------------------------------------

300 **C.2 CREATOR RSA DIGITAL SIGNATURE PROFILE**

...

- a. the SOP Class and Instance UIDs
- b. the SOP Creation Date and Time, if present
- c. the Study and Series Instance UIDs
- 305 d. any attributes of the General Equipment module that are present
- e. any attributes of the Overlay Plane, Curve or Graphic Annotation modules that are present
- f. any attributes of the General Image and Image Pixel modules that are present
- 310 g. any attributes of the SR Document General and SR Document Content modules that are present
- h. any attributes of the Waveform and Waveform Annotation modules that are present
- i. any attributes of the Multi-frame Functional Groups module that are present
- j. any attributes of the Enhanced MR Image module that are present
- k. any attributes of the MR Spectroscopy modules that are present
- 315 l. any attributes of the Raw Data module that are present
- m. any attributes of the Enhanced CT Image module that are present
- n. any attributes of the Enhanced XA/XRF Image module that are present
- o. any attributes of the Segmentation Image module that are present
- p. any attributes of the Encapsulated Document module that are present
- 320 q. any attributes of the X-Ray 3D Image module that are present
- r. any attributes of the Enhanced PET Image module that are present
- s. any attributes of the Enhanced US Image module that are present
- t. any attributes of the Surface Segmentation module that are present
- u. any attributes of the Surface Mesh Module that are present
- 325 v. any attributes of the Structured Display, Structured Display Annotation, and Structured Display Image Box modules that are present
- w. any Attributes of the Implant Template module that are present
- x. any Attributes of the Implant Assembly Template module that are present
- y. any Attributes of the Implant Template Group module that are present
- 330 z. **any attributes of the Point Cloud Module that are present**

**C.3 AUTHORIZATION RSA DIGITAL SIGNATURE PROFILE**

...

- a. the SOP Class and Instance UIDs
- 335 b. the Study and Series Instance UIDs
- c. any attributes whose Values are verifiable by the technician or physician (e.g., their Values are displayed to the technician or physician)
- d. any attributes of the Overlay Plane, Curve or Graphic Annotation modules that are present



- 340 e. any attributes of the General Image and Image Pixel modules that are present
- f. any attributes of the SR Document General and SR Document Content modules that are present
- g. any attributes of the Waveform and Waveform Annotation modules that are present
- h. any attributes of the Multi-frame Functional Groups module that are present
- 345 i. any attributes of the Enhanced MR Image module that are present
- j. any attributes of the MR Spectroscopy modules that are present
- k. any attributes of the Raw Data module that are present
- l. any attributes of the Enhanced CT Image module that are present
- m. any attributes of the Enhanced XA/XRF Image module that are present
- 350 n. any attributes of the Segmentation Image module that are present
- o. any attributes of the Encapsulated Document module that are present
- p. any attributes of the X-Ray 3D Image module that are present
- q. any attributes of the Enhanced PET Image module that are present
- r. any attributes of the Enhanced US Image module that are present
- 355 s. any attributes of the Surface Segmentation module that are present
- t. any attributes of the Surface Mesh Module that are present
- u. any attributes of the Structured Display, Structured Display Annotation, and Structured Display Image Box modules that are present
- v. any Attributes of the Implant Template module that are present
- 360 w. any Attributes of the Implant Assembly Template module that are present
- x. any Attributes of the Implant Template Group module that are present
- y. any attributes of the Point Cloud Module that are present**

365

**Changes to NEMA Standards Publication PS 3.16-2011**

370

**Digital Imaging and Communications in Medicine (DICOM)**

**Part 16: Content Mapping Resource**

Item: Add following to Annex B

375

**Context ID 29**  
**Acquisition Modality**  
Type: Extensible      Version: 2014060920121129

Coding Scheme Designator	Code Value	Code Meaning
...	...	...
<u>DCM</u>	<u>OSS</u>	<u>Optical Surface Scanner</u>
...	...	...

**CID 8201      SURFACE SCAN ACQUISITION TYPES**

380

**Context ID 8201**  
**Surface Scan Acquisition Types**  
Type: Extensible      Version: 20121129

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	114201	Time of flight
DCM	114202	Interferometry
DCM	114203	Laser scanning
DCM	114204	Pattern projection
DCM	114205	Shape from shading
DCM	114206	Shape from motion
DCM	114207	Confocal imaging
DCM	114208	Point Cloud Algorithmic

**CID 8202      SURFACE SCAN MODE TYPES**

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**CID 8202**  
**Surface Scan Mode Types**  
Type: Extensible      Version: 20121129

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	114209	Turntable Scan Method
DCM	114210	High resolution
DCM	114211	Fast mode
DCM	114216	Checkerboard

**CID 8603      SURFACE SCAN REGISTRATION METHOD TYPES**

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**CID 8603**  
**Surface Scan Registration Method Types**  
Type: Extensible      Version: 20121129

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	114213	Iterative Closest Point
DCM	125022	Fiducial Alignment
DCM	114215	Freehand

**Item: Add the following entries to the table in Annex D.**

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**DICOM Code Definitions**

Code Value	Code Meaning	Definition	Notes
...	...	...	...
114201	Time of flight	Measures the time-of-flight of a light signal between the camera and the subject for each point of the image.	
114202	Interferometry	Interferometry is a family of techniques in which waves are superimposed in order to extract depth information about the scanned object.	
114203	Laser scanning	Laser scanning describes the general method to sample or scan a surface using laser technology.	
114204	Pattern projection	Projecting a narrow band of light onto a three-dimensionally shaped surface produces a line of illumination that appears distorted from other perspectives than that of the projector. It can be used for an exact geometric reconstruction of the surface shape.	
114205	Shape from shading	A technique for estimating the surface normal of an object by observing that object under different lighting conditions.	
114206	Shape from motion	A technique for estimating the surface normal of an object by observing that object under different motions.	
114207	Confocal imaging	An optical imaging technique used to increase optical resolution and contrast of a micrograph by using point illumination and a spatial pinhole to eliminate out-of-focus light in specimens that are thicker than the focal plane. It enables the reconstruction of 3D structures from the obtained images.	
114208	Point Cloud Algorithmic	Point cloud that was calculated by an algorithm.	
114209	Turntable Scan Method	Scanning the object from different views by placing it on a rotating table	
114210	High resolution	Higher resolution with a longer acquisition time	

114211	Fast mode	Lower resolution with a shorter acquisition time	
114213	Iterative Closest Point	An algorithm employed to minimize the difference between two clouds of points. It iteratively revises the transformation (translation, rotation) needed to minimize the distance between the points of two point clouds.	
114215	Freehand	Human controlled minimization of the distance between the points of two point clouds.	
114216	Checkerboard	Scanning the object from different views by placing it in front of a checkerboard pattern.	

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**Changes to NEMA Standards Publication PS 3.17-2011**

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**Digital Imaging and Communications in Medicine (DICOM)**

**Part 17: Explanatory Information**

Item: Add following Section to PS 3.17

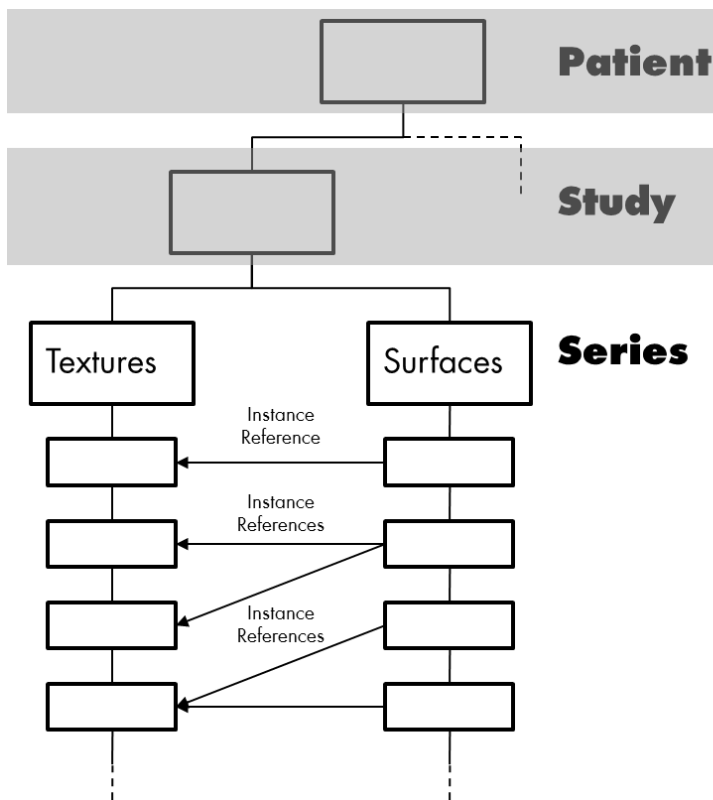
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## X Optical Surface Scan

### X.1 GENERAL INFORMATION

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When supporting textures within one acquisition process multiple series are generated. There is one Series containing the Surfaces and another containing the textures. References are used to link Instances in different series together.

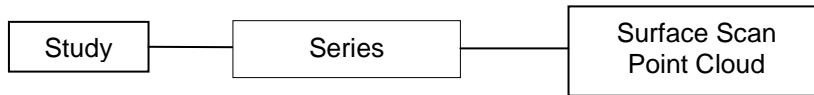


### X.2 ONE SINGLE SHOT WITHOUT TEXTURE ACQUISITION AS POINT CLOUD

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Use cases: A single surface record of a patient is made, for example teeth, nose, or breast. If third party software does the post-processing only the point cloud needs to be stored.

The Surface Scan Point Cloud instance will be used because a point cloud is stored. A study with a single series is created.

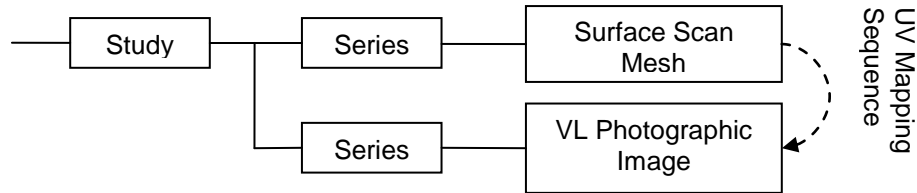


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### X.3 ONE SINGLE SHOT WITH TEXTURE ACQUISITION AS MESH

Use cases: A scanner device providing triangulated objects with textures, e.g. for documentation of burns or virtual autopsy.

430 The Surface Scan Mesh instance will be used because a triangulated object is stored. A study with two series will be created. One series contains a Surface Mesh instance and the other series a VL Photographic Image instance. The latter stores the texture, which is mapped on the surface mesh and is linked to the Surface Scan Mesh instance via the UV Mapping Sequence (0080,0008).

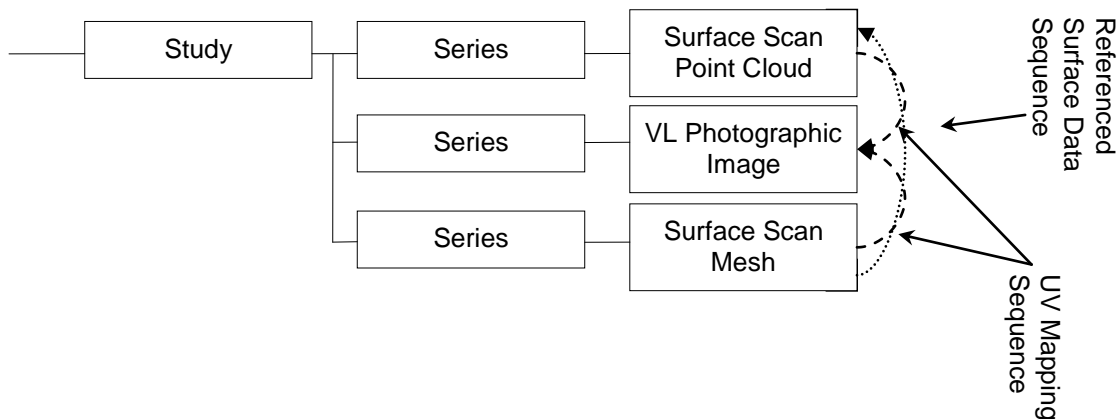


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### X.4 STORING MODIFIED POINT CLOUD WITH TEXTURE AS MESH

Use cases: The surface of a textured object has been modified, for example artifacts have been manually removed after the study or surgery. The new result is stored.

440 In the study of the origin Surface Scan Point Cloud instance a Surface Scan Mesh instance is created in its own series containing the modified mesh. The Referenced Surface Data Sequence (0080,0013) will be used to reference the original instance. The mesh as well as the point cloud points to the texture using the Referenced Surface Data Sequence (0080,0012).



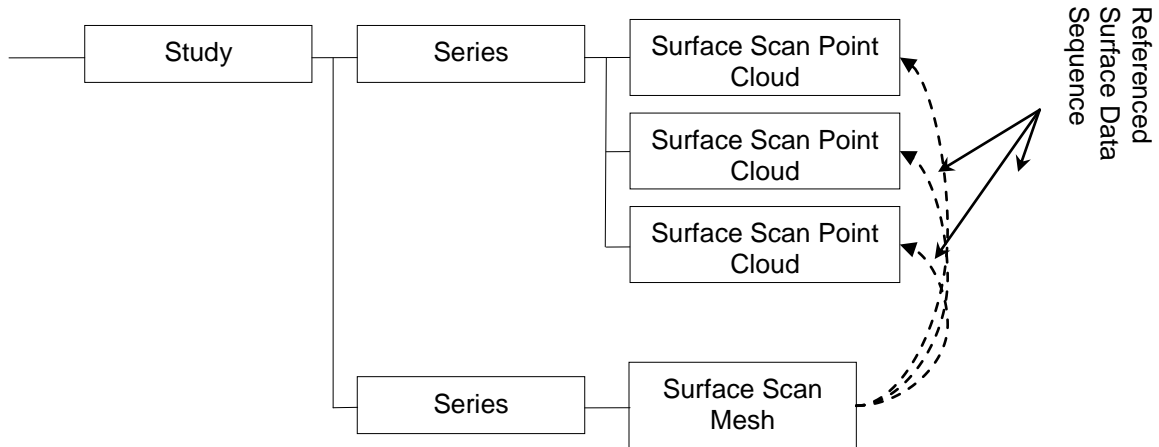


445 **X.5 MULTISHOT WITHOUT TEXTURE AS POINT CLOUDS AND MERGED MESH**

Use-case: Objects, which need to be scanned from multiple points of view, such as the nose.

After the acquired point clouds have been merged by a post-processing software application, the calculated surface mesh is stored in the same study in a new series. The Referenced Surface Data Sequence (0080,0013) points to all origin Surface Scan Point Cloud instances that have been used for reconstruction. The Registration Method Code Sequence (0080,0003) is used to indicate that multiple point clouds have been merged.

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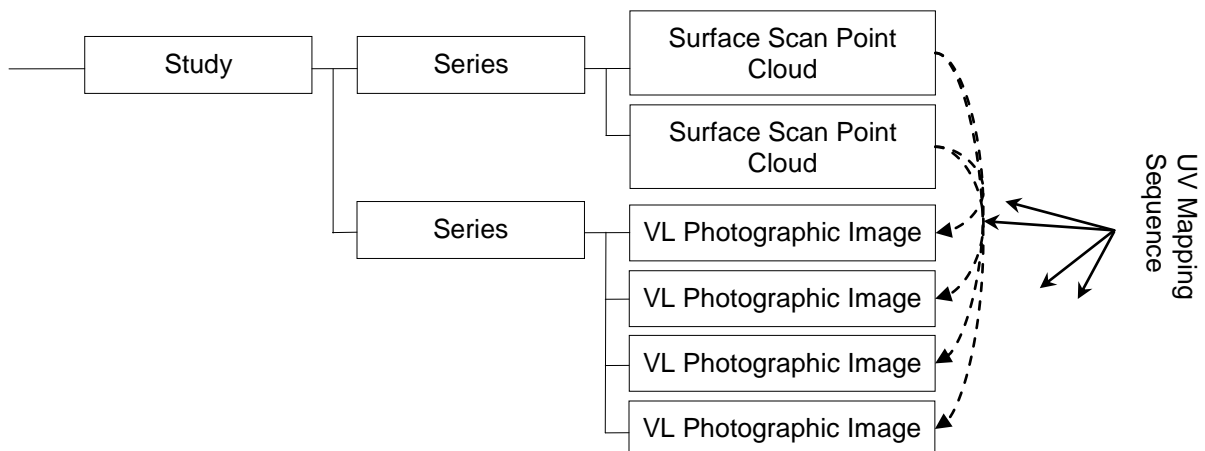
**X.6 MULTISHOT WITH TWO TEXTURE PER POINT CLOUD**

455 Use-case: In the application field of dental procedures some products support switching between two different textures for the same surface.

In this case a number of VL Photographic Image instances are stored in the same series.

The UV Mapping Sequence (0080,0008) is used to associate the VL Photographic Image instances with the Surface Scan Point Cloud instance. The Texture Label (0080,0009) is used to identify the textures of one point cloud.

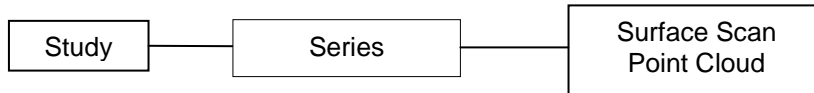
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### X.7 USING COLORED VERTICES INSTEAD OF TEXTURE

465 Use-case: A single surface record of a patient is made, for example teeth, nose, or breast. If third party software does the post-processing only the point cloud needs to be stored. Gray or color values can be assigned to each point in the point cloud.

470 The point cloud is stored in a Surface Scan Point Cloud instance. A study with a single series is created. One or both of the attributes Surface Point Presentation Value Data (0080,0006), or Surface Point Color CIE Lab Value Data (0080,0007) may be used to assign gray or color values to each point in the point cloud.



### X.8 4D SURFACE DATA ANALYSIS

475 Use-case: To replay a sequence of multiple 3D shots of different facial expressions of a patient before facial surgeries such as facial transplantation.

A time stamp for each shot is stored in the Acquisition DateTime attribute (0008,002A).

### X.9 REFERENCING A TEXTURE FROM ANOTHER SERIES

Use-case: A texture from another series must be applied to a point cloud.

480 The Referenced Instances And Access Macro is used within the Referenced Textures Sequence (0080,0012) to reference a VL Photographic Image instance from a different study.

