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

8 *Supplement 189: Parametrical Blending Presentation State Storage*

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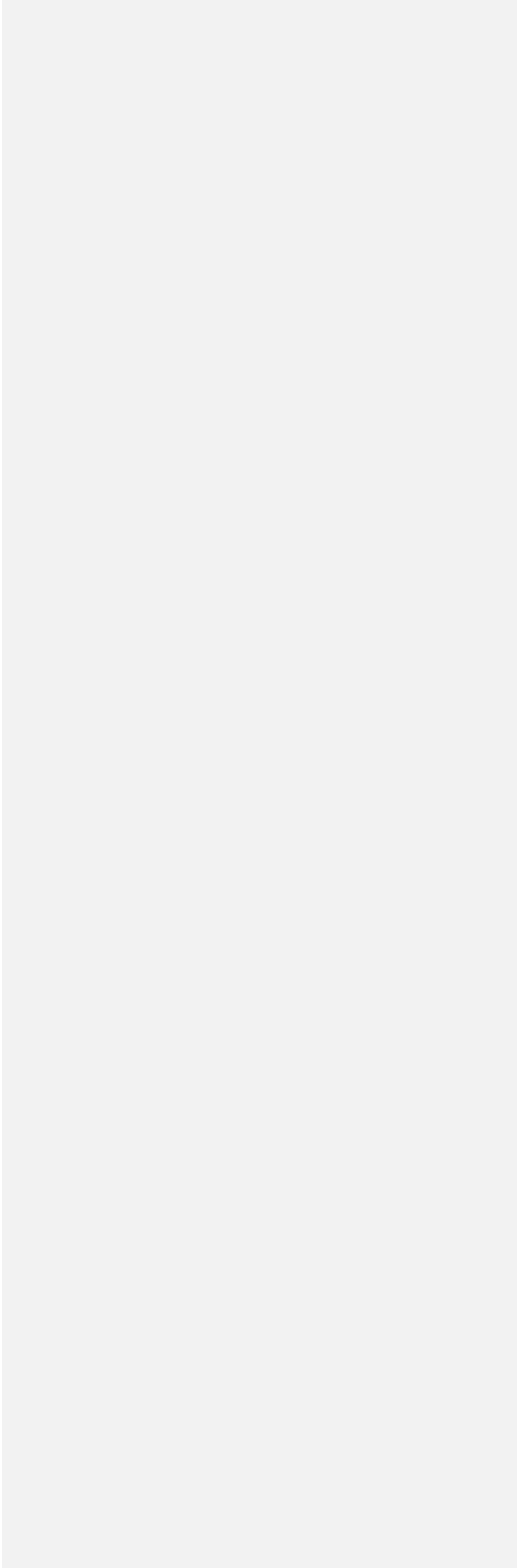
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DOCUMENT HISTORY

| Document Version | Date | Content |
|------------------|--------------|---|
| 01 | 17-Feb-2015 | Initial Draft |
| 04 | 05-May-2015 | Updated with more definitions and first set of parameters with specific values. |
| 06 | 21-July-2015 | Cleanup accepted items. |
| 07 | 15-Sept-2015 | Version after F2F, updated name and got supplement number (189) from WG06 |
| 08 | 13-Oct-2015 | Update for tcon, start to incorporate WG06 feedback |
| 09 | 14-Oct-2015 | Start of Blending object definition |
| 10 | 19-Nov-2015 | |
| 13 | 13-July-2016 | Update to remove Color and restrict introduction to content and no longer full overview of fMRI |
| 14 | 08-Sept-2016 | Update for PC discussion |
| 15 | 09-Sept-2016 | Update for PC discussion |
| 16 | 11-Sept2016 | Clean up before WG06 |

Scope and Field

Commented [CvWW1]: Check if this needs a change.

- 135 Parametric Maps can be used to store the quantification of a specific measurement. The
Parametric Blending Presentation State is defining the blending of the content of the different
Parametric Maps with optionally an anatomical image as underlay. This way showing the
measurements (like BOLD fMRI, Diffusion parameter maps, CT/MRI Perfusion parameter maps,
FDG PET map) in relation to the anatomical structure.
- 140 Currently there is no description on how to present a set of Parametric Maps to show
measurement results in a structured way together with the anatomical information.
The Supplement will define missing information that is needed to combine the different maps and
how to show these together. This way the user will be able to relate different items together.
Giving the opportunity to get a full overview instead of every single item in isolation.
- 145 Displayed Area and Graphic modules are present to allow the user to add graphical information
related to the blending operation. Like marking the Motor Cortex based on the parametric map.
The usage will be described by using an example of an fMRI study in a new chapter in PS 17 as
Informative Annex.
- 150 The usage of Color in the Parametric Map is added through CP 1584 and for the supplement it is
assumed that the structure and content will be accepted.

OPEN ISSUES

| | |
|---|---|
| 1 | If we have motion correction within the same Frame of Reference will it be allowed to use Spatial Registration to correct this as the movement is only captured after analysis? |
| 2 | |

155

CLOSED ISSUES

| | |
|---|---|
| 2 | The blending operation might also be used for other areas than the Functional MRI. Should we make it generic or focus on Functional MRI. The real world value mapping already makes it already generic in nature. Closed as name is now Parametric Blending Presentation State Blending. |
| | |
| | |
| | |

DICOM PS 3.2 Conformance

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

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

| UID Value | UID NAME | Category |
|------------|---|-----------------|
| ... | | |
| XXX | <u>Parametric Blending Presentation State Storage</u> | <u>Transfer</u> |
| ... | | |

DICOM PS 3.3: Information Object Definitions

165 **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

| IODs Modules | Parametric Blending |
|----------------------------------|--------------------------------|
| Patient | <u>M</u> |
| Specimen | <u>U</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 | M |
| Clinical Trial Series | <u>U</u> |
| Presn. Series | <u>M</u> |
| Frame of Reference | <u>M</u> |
| General Equipment | <u>M</u> |
| Enhanced General Equipment | <u>M</u> |
| Common Instance Reference | <u>M</u> |
| SOP Common | <u>M</u> |

Commented [CvWW2]: TODO fill in correct set of modules.

170

Item: Add in the following new section in Annex A

A.X PARAMETRIC BLENDING PRESENTATION STATE IOD

A.X.1 Parametric Blending Presentation State IOD Description

175 The Parametric Blending Presentation State Information Object Definition (IOD) specifies information that may be used to blend two or more sets of images that are referenced from within the IOD for the purpose of presentation (display).

It includes capabilities for specifying:

- 180 a. the output color space in PCS-Values
- b. possible thresholds to restrict shown area of a Parametric Map
- c. definition of Alpha levels for the different Parametric Maps

- d. selection of the area of the blended images to display and whether to rotate or flip it
- e. image and display relative annotations, including graphics, text and overlays

A.X.2 Parametric Blending Presentation State IOD Entity-Relationship Model

The E-R Model in Section A.1.2 depicts those components of the DICOM Information Model that directly reference the Parametric Blending Presentation State IOD.

A.X.3 Parametric Blending Presentation State IOD Module Table

Table A.X-1. Parametric Blending Presentation State IOD Modules

| IE | Module | Reference | Usage |
|--------------------|---|-----------|--|
| 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 |
| | Presentation Series | C.11.9 | M |
| | Clinical Trial Series | C.7.3.2 | U |
| Frame of Reference | Frame of Reference | C.7.4.1 | M |
| Equipment | General Equipment | C.7.5.1 | M |
| | Enhanced General Equipment | C.7.5.2 | M |
| Presentation State | Presentation State Identification | | M |
| | Parametric Blending Presentation State | C.11.x1 | M |
| | Parametric Blending Presentation State Display Module | C.11.x2 | M |
| | Displayed Area | C.10.4 | U |
| | Graphic Annotation | C.10.5 | U |
| | Spatial Transformation | C.10.6 | C - Required if rotation or flipping are to be applied |
| | Graphic Layer | C.10.7 | C - Required if Graphic Annotation Module is present |
| | Graphic Group | C.10.11 | U |
| | ICC Profile | C.11.15 | M |
| | SOP Common | C.12.1 | M |

Commented [CvWW3]: WG06: do we need to say anything on these or is it logical that they will be used on top of the blended result.

Commented [CvWW4]: Common for all colors. Assuming at least one object will have color information

190 **Item: Add the following new sections in PS 3.3 C**

C.11.X1 Parametric Blending Presentation State Module

C.11.X1.1 Parametric Blending Presentation State Module Attributes

195 Table C.11.X1-1 contains Attributes that describe the identification of an optional set of grayscale images, one or more sets of parametric maps, optionally one or more sets of registration objects and the color and thresholds to be applied to them, for the purpose of blending.

Table C.11.X1-1. Parametric Blending Presentation State Module Attributes

| Attribute Name | Tag | Type | Attribute Description |
|---|-------------|------|---|
| Parametric Blending Sequence | (0070,xxx1) | 1 | <p>A Sequence of Items, one identifying an optional set of underlying images, and one or more identifying and describing transformations upon a set of superimposed parametric map images.</p> <p>At least one Item shall be included in this Sequence.</p> <p>If more than two items are present the order of the items is determining the order of blending where the last item will be blended last.</p> <p>The number of Items shall be the same as in the Referenced Series Sequence (0008,1115)</p> <p>See Section C.11.X1.1.1.</p> |
| >Parametric Blending Input Number | (0070,xxx2) | 1 | <p>Identification number of the input. Values shall be ordinal numbers starting from 1 and monotonically increasing by 1 within the Parametric Blending Presentation State instance.</p> |
| >Study Instance UID | (0020,000D) | 1 | <p>Unique identifier for the Study.</p> |
| >Series Instance UID | (0020,000E) | 1 | <p>Unique identifier of a Series that is part of the Study defined by the Study Instance UID (0020,000D)</p> |
| >Referenced Image Sequence | (0008,1140) | 1C | <p>The set of images comprising this input series. One or more items shall be included in this sequence.</p> <p>Required if a subset of the series is used.</p> |
| >>Include 'Image SOP Instance Reference Macro' Table 10-3 | | | |

| Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|---|
| >Referenced Spatial Registration Sequence | (0070,0404) | 1C | A reference to a Spatial Registration Instance that is used to register the referenced inputs. Only one item shall be included in this sequence. Required if the Frame of Reference UID (0020,0052) value of the Images referenced by the Referenced Image Sequence (0008,1140) of this item does not match the Frame of Reference UID (0020,0052) value of this Presentation State instance. May be present otherwise. |
| >>Include SOP Instance Reference Macro Table 10-11 | | | |
| >Include Table C.17-3 "Hierarchical SOP Instance Reference Macro Attributes" | | | |

Commented [CvWW5]: Rephrase to capture also full series

Commented [CvWW6]: Can be present if later on movement is detected and corrected.

Commented [CvWW7]: WG06: Should we add it here. Not seen in Volumetric PS

200

~~C.11.X1.1 Parametric Blending Presentation State Module Attributes~~

C.11.X1.1.1 Parametric Blending Sequence

The sets of images and any subset of the frames therein in the case of multi-frame images are identified by Study, Series, SOP Instance and Frame Number.

205 This module specifies no explicit relationship (such as pairing or ordering) between the sets of images and frames defined in the sequence elements. This module does not define how the images are spatially related, and what re-sampling, if any, needs to be performed before the images are blended for rendering.

Note

210 1. The images in the image sets may share the same Frame of Reference, in which case the rendering application can spatially relate the image sets based on their Image Position (Patient) (0020,0032) and Image Orientation (Patient) (0020,0037) Attributes.

Alternatively, Spatial Registration SOP Instance(s) may exist that relates either two or more different Frames of Reference, or two or more sets of images that share the same Frame of Reference.

215 Whilst the image sets may already be spatially co-registered and oriented in the same plane, or even be sampled at the same in-plane and between-plane resolution, this will frequently not be the case.

See PS3.4 for behavioral requirements that apply to Storage SOP Classes using this Module.

2. The underlying image for a superimposed Segmentation image need not be the source image for the segmentation.

Formatted: Font: Helvetica, 10 pt, Font color: Auto

220 2-3. If a spatial registration object is defined it shall be used for presentation and alignment of the data even if the Frame of Reference is the same. This as small corrections might have taken place during post-processing.

~~C.11.X1.1.2 Threshold Sequence Macro~~

~~The threshold is defining the values of the image that are used versus ignored.~~

225

Table C.11.X2.1-1
THRESHOLD SEQUENCE MACRO-ATTRIBUTES

| Attribute Name | Tag | Type | Attribute Description |
|----------------------------|-------------|------|---|
| Threshold Sequence | {xxx1,yyy1} | 2 | Threshold specification for the image Zero or more Items are permitted in this Sequence. |
| ➤ Threshold Value Sequence | {xxx1,yyy2} | 4 | Value(s) used as boundary for the threshold |
| ➤➤ Threshold Value | {xxx1,yyy4} | 4 | If the Threshold Type (xxx1,yyy3) is GREATER_OR_EQUAL, LESS_OR_EQUAL, GREATER_THAN, LESS_THAN or EQUAL only a single Item shall be included in this Sequence. If the Threshold Type (xxx1,yyy3) is RANGE_INCL or RANGE_EXCL , exactly two Items shall be included in this Sequence, the first of which is less than or equal to the second. |
| ➤ Threshold Type | {xxx1,yyy3} | 4 | Describes how the value(s) specified by the Threshold (xxx,yyy2) shall be used to determine the presence of the pixel value See C.11.X2.1. Enumerated Values: —RANGE_INCL —RANGE_EXCL —GREATER_OR_EQUAL —LESS_OR_EQUAL —GREATER_THAN —LESS_THAN —EQUAL |

Commented [CvWW8]: Is this the right type, zero elements means full range will be displayed.

Commented [CvWW9]: Better word needed

Commented [CvWW10]: Are these values enough and not too much, EQUAL present for integer bit maps.

C.11.X1.1.2.1 Threshold

The Threshold Type is defining the pixel values that shall be shown versus the ones that are ignored.
~~Values that are not conform the specified Threshold are dropped for the blending operation.~~

230

~~To describe a thresholding that consists of more than one range, multiple elements in the Threshold sequence need to be specified.~~

Commented [CvWW11]: Should we include a simple example?

When more than one item is specified in the Threshold Sequence (xxx,yyy1) the union of the different ranges shall be used to determine the presence of a pixel.

Commented [CvWW12]: Better word

235

The number of values in the Threshold Value Sequence (xxx,yyy2) is depending on the Threshold Type (xxx,yyy3).

Commented [CvWW13]: Create pipeline overview of where the Threshold is applied. The threshold will be on the stored pixel values. RWV will be the identity transformation as the stored values are the RWV. (is our current expectation in the fMRI case).

The use of the specified value(s) in the Threshold Value Sequence (xxx,yyy2) shall depend on the value of the Threshold Type (xxx,yyy3) as follows:

Commented [CvWW14]: Might be not needed as it is already part of the table.

240 ~~RANGE_INCL~~ the pixel value shall be used when the value lies between the specified values, or be equal to one of the specified values. Two items shall be present in the Threshold Value Sequence (xxxx,yyy2)

~~RANGE_EXCL~~ the pixel value shall be used when the value lies outside (i.e. not between) the specified values. Two items shall be present in the Threshold Value Sequence (xxxx,yyy2)

245 ~~GREATER_OR_EQUAL~~ the pixel value shall be used when the value is greater than or equal to the specified value. One item shall be present in the Threshold Value Sequence (xxxx,yyy2).

~~LESS_OR_EQUAL~~ the pixel value shall be used when the value is less than or equal to the specified value. One item shall be present in the Threshold Value Sequence (xxxx,yyy2).

250 ~~GREATER_THAN~~ the pixel value shall be used when the value is greater than the specified value. One item shall be present in the Threshold Value Sequence (xxxx,yyy2).

~~LESS_THAN~~ the pixel value shall be used when the value is less than the specified value. One item shall be present in the Threshold Value Sequence (xxxx,yyy2).

255 ~~EQUAL~~ the pixel value shall be used when the value is equal to the specified value. One item shall be present in the Threshold Value Sequence (xxxx,yyy2).

260 **C.11.x2. Parametric Blending Presentation State Display Module**

| Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|---|
| Pixel Presentation | (0008,9205) | 1 | Grayscale or color space of the Presentation State output. Enumerated Values: TRUE_COLOR Output consists of PCS-Values |
| Presentation State Classification Component Sequence | (0070,1801) | 2C | Sequence of classification components in which the order of items is significant. Each classification component converts one input into a single RGB output. Two or more items shall be included in this sequence. See C.11.x8.2. Required if Pixel Presentation (0008,9205) has a value of TRUE_COLOR. |
| > Include Tabel C.11., Presentation State Classification Component Identification Macro Attributes | | | |

Commented [CvWW15]: WG06 Can this be reused or do we need a new one?

Commented [CvWW16]: Need structure that captures a recursive set.
Seq:
>Set "1",
>> 1
>> 2
>> 3
>Set "2"
>> 4
>> 5
Alpha is needed on each level:
Equally distribution when two or more are combined.
Alpha (and 1- Alpha) value when two are combined
Result would be three sequence items:
Blending 1,2 and 3 with result number 6
Blending 4 and 5 with result number 7
Blending 6 and 7

265 **C.11.x3. Presentation State Classification Component Identification Module-Macro**

| Attribute Name | Tag | Type | Attribute Description |
|---|-------------|------|---|
| Presentation State Classification Component Identification Sequence | (0070,xxx9) | 2C | Sequence of classification components in which the order of items is significant. Each classification component converts one input into a single RGB output. One or more items shall be included in this sequence. See C.11.x8.2. Required if Pixel Presentation (0008,9205) has a value of TRUE_COLOR. |
| >Parametric Blending Input Number | (0070,xxx2) | 1 | Identification number of the input series to which the Blending information must be applied. Required if (0070,1801) is not present in this sequence item |
| >Include Tabel C.11.X2.1-1 'Threshold Sequence Macro Attributes' | | | |
| Alpha Value | (0028,xxx8) | 1C | Specifies opacity value for the visible pixels of the sets created in the Required if Blending mode is equal to FOREGROUND_PRIORITY |
| Blending Mode | (0028,xxx9) | 1 | Specifies the way the result sets need to be blended: Enumerated values: EQUALLY FOREGROUND_PRIORITY See section C.11.x2.1 |
| Parametric Blending Input Number | (0070,xxx2) | 1C | Identification of the result as input for a subsequent blending operation. Required if the result is used for further Blending |

Commented [CvWW17]: Equally means all sets get the same level of alpha for the visible voxels (example)
Foreground means the second sequence item result is on top of the first with opacity level defined by Alpha value, for transparent voxels the alpha of the foreground will be 0 per definition

Commented [CvWW18R17]: Is this pixels or should it be voxels?

Commented [CvWW19]: This is called input number as it shall contain the number that will be used as input in a later step. Do we use it that way or will it have a different name.

Commented [CvWW20]: TODO start here. Mostly copy from Volumetric PS how to use these components.

Commented [CvWW21]: Create picture of the steps.

Commented [CvWW22]: Can Padding be different for the different images?

C.11.x3.1 Blending Mode

~~Blending Mode (0028,xxx9) describes the method for weighting the different input images during the blending operation.~~

~~EQUALLY means all input images get the same level of alpha for the visible voxels~~

~~This means that if 3 input images are merged in and all three have a visible voxel the Alpha Value will be 0.33, whereas it will be 0.5 if one of the voxels is not visible through Thresholding~~

~~FOREGROUND_PRIORITY means the second sequence item result is on top of the first with opacity level defined by Alpha Value (0028,xxx8), for non visible voxels of the foreground the alpha value will be 0 per definition and background images will be used.~~

~~Visible voxels are voxels that are not having a padding value and are within the threshold range.~~

270

275

C.11.X1.1.2 Threshold Sequence Macro

The threshold is defining the values of the image that are used versus ignored.

280

**Table C.11.X2.1-1
THRESHOLD SEQUENCE MACRO ATTRIBUTES**

| <u>Attribute Name</u> | <u>Tag</u> | <u>Type</u> | <u>Attribute Description</u> |
|-------------------------------------|--------------------|-------------|--|
| <u>Threshold Sequence</u> | <u>(xxx1.yyy1)</u> | <u>2</u> | <u>Threshold specification for the image</u> <u>Zero or more Items are permitted in this</u> <u>Sequence.</u> |
| <u>>Threshold Value Sequence</u> | <u>(xxx1.yyy2)</u> | <u>1</u> | <u>Value(s) used as boundary for the threshold</u> |
| <u>>>Threshold Value</u> | <u>(xxx1.yyy4)</u> | <u>1</u> | <u>If the Threshold Type (xxx1.yyy3) is</u> <u>GREATER OR EQUAL, LESS OR EQUAL,</u> <u>GREATER THAN, LESS THAN or EQUAL,</u> <u>only a single Item shall be included in this</u> <u>Sequence.</u> <u>If the Threshold Type (xxx1.yyy3) is</u> <u>RANGE INCL or RANGE_EXCL, exactly two</u> <u>Items shall be included in this Sequence, the</u> <u>first of which is less than or equal to the</u> <u>second.</u> |
| <u>>Threshold Type</u> | <u>(xxx1.yyy3)</u> | <u>1</u> | <u>Describes how the value(s) specified by the</u> <u>Threshold (xxx1.yyy2) shall be used to</u> <u>determine the presence of the pixel value</u> <u>See C.11.X2.1.</u> <u>Enumerated Values:</u> <u>RANGE_INCL</u> <u>RANGE_EXCL</u> <u>GREATER_OR_EQUAL</u> <u>LESS_OR_EQUAL</u> <u>GREATER_THAN</u> <u>LESS_THAN</u> <u>EQUAL</u> |

Commented [CvWW23]: Is this the right type, zero elements means full range will be displayed.

Commented [CvWW24]: Better word needed

Commented [CvWW25]: Are these values enough and not too much, EQUAL present for integer bit maps.

C.11.X1.1.2.1 Threshold

The Threshold Type is defining the pixel values that shall be shown versus the ones that are ignored.
Values that are not conform the specified Threshold are dropped for the blending operation.

285

To describe a thresholding that consists of more than one range, multiple elements in the Threshold sequence need to be specified.

Commented [CvWW26]: Should we include a simple example?

When more than one item is specified in the Threshold Sequence (xxx1.yyy1) the union of the different ranges shall be used to determine the presence of a pixel.

Commented [CvWW27]: Better word

The number of values in the Threshold Value Sequence (xxx1.yyy2) is depending on the Threshold Type (xxx1.yyy3).

290

Commented [CvWW28]: Create pipeline overview of where the Threshold is applied. The threshold will be on the stored pixel values. RWV will be the identity transformation as the stored values are the RWV. (is our current expectation in the fMRI case).

The use of the specified value(s) in the Threshold Value Sequence (xxxx.yyy2) shall depend on the value of the Threshold Type (xxxx.yyy3) as follows:

| | | |
|-----|-------------------------|---|
| 295 | <u>RANGE_INCL</u> | <u>the pixel value shall be used when the value lies between the specified values, or be equal to one of the specified values. Two items shall be present in the Threshold Value Sequence (xxxx.yyy2)</u> |
| | <u>RANGE_EXCL</u> | <u>the pixel value shall be used when the value lies outside (i.e. not between) the specified values. Two items shall be present in the Threshold Value Sequence (xxxx.yyy2)</u> |
| 300 | <u>GREATER_OR_EQUAL</u> | <u>the pixel value shall be used when the value is greater than or equal to the specified value. One item shall be present in the Threshold Value Sequence (xxxx.yyy2).</u> |
| | <u>LESS_OR_EQUAL</u> | <u>the pixel value shall be used when the value is less than or equal to the specified value. One item shall be present in the Threshold Value Sequence (xxxx.yyy2).</u> |
| 305 | <u>GREATER_THAN</u> | <u>the pixel value shall be used when the value is greater than the specified value. One item shall be present in the Threshold Value Sequence (xxxx.yyy2).</u> |
| | <u>LESS_THAN</u> | <u>the pixel value shall be used when the value is less than the specified value. One item shall be present in the Threshold Value Sequence (xxxx.yyy2).</u> |
| 310 | <u>EQUAL</u> | <u>the pixel value shall be used when the value is equal to the specified value. One item shall be present in the Threshold Value Sequence (xxxx.yyy2).</u> |

Commented [CvWW29]: Might be not needed as it is already part of the table.

C.11.x3.1 Blending Mode

Blending Mode (0028.xxx9) describes the method for weighting the different input images during the blending operation.

EQUALLY means all input images get the same level of alpha for the visible voxels

320 This means that if 3 input images are merged in and all three have a visible voxel the Alpha Value will be 0.33, whereas it will be 0.5 if one of the voxels is not visible through Thresholding

BACKGROUND PRIORITY means the second sequence item result is on top of the first with opacity level defined by Alpha Value (0028.xxx8), for non-visible voxels of the foreground the alpha value will be 0 per definition and background images will be used.

325 Visible voxels are voxels that are not having a padding value and are within the threshold range.

Commented [CvWW30]: TODO start here. Mostly copy from Volumetric PS how to use these components.

Commented [CvWW31]: Create picture of the steps.

Commented [CvWW32]: Can Padding be different for the different images?

DICOM PS3.4: Service Class Specifications

Amend DICOM PS 3.4 Annex B.5 Standard SOP Classes as follows:

330

Table B.5-1. Standard SOP Classes

| SOP Class Name | SOP Class UID | IOD Specification (defined in PS3.3) |
|---|-------------------------------------|---|
| ... | ... | ... |
| XA/XRF Grayscale Softcopy Presentation State Storage | 1.2.840.10008.5.1.4.1.1.11.5 | XA/XRF Grayscale Softcopy Presentation State IOD |
| <u>Parametric Blending Presentation State Storage</u> | <u>1.2.840.10008.5.1.4.1.1.11.x</u> | <u>Parametric Blending Presentation State IOD</u> |
| ... | ... | ... |

Amend DICOM PS 3.4 Annex I.4 Media Storage Standard SOP Classes as follows:

335

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

| SOP Class Name | SOP Class UID | IOD Specification (defined in PS3.3) |
|---|-------------------------------------|---|
| ... | ... | ... |
| XA/XRF Grayscale Softcopy Presentation State Storage | 1.2.840.10008.5.1.4.1.1.11.5 | XA/XRF Grayscale Softcopy Presentation State IOD |
| <u>Parametric Blending Presentation State Storage</u> | <u>1.2.840.10008.5.1.4.1.1.11.x</u> | <u>Parametric Blending Presentation State IOD</u> |
| ... | ... | ... |

DICOM PS 3.6: Data Dictionary

340

Amend DICOM PS 3.6 – Data Dictionary – Section 6 Registry of DICOM Data Elements as follows:

Table 6-1. Registry of DICOM Data Elements

| Tag | Name | Keyword | VR | VM | |
|--------------------|---|--------------------------------------|-----------|----------|--|
| <u>(0070,xxx1)</u> | <u>Parametric Blending Sequence</u> | <u>ParametricBlendingSequence</u> | <u>SQ</u> | <u>1</u> | |
| <u>(0070,xxx2)</u> | <u>Parametric Blending Input Number</u> | <u>ParametricBlendingInputNumber</u> | <u>IS</u> | <u>1</u> | |
| <u>(xxx1,yyy1)</u> | <u>Threshold Sequence</u> | <u>ThresholdSequence</u> | <u>SQ</u> | <u>1</u> | |
| <u>(xxx1,yyy2)</u> | <u>Threshold Value Sequence</u> | <u>ThresholdValueSequence</u> | <u>SQ</u> | <u>1</u> | |
| <u>(xxx1,yyy3)</u> | <u>Threshold Type</u> | <u>ThresholdType</u> | <u>CS</u> | <u>1</u> | |
| <u>(xxx1,yyy4)</u> | <u>Threshold Value</u> | <u>ThresholdValue</u> | <u>FD</u> | <u>1</u> | |

Commented [CvWW33]: TODO update to latest elements

Commented [CvWW34]: DO we need more depending on the type of bitmap?

345

DICOM PS 3.15: Security and System Management Profiles

Amend: C.2 Creator RSA Digital Signature Profile:

...

aa. any attributes of the Enhanced Mammography Image module that are present

xx. any attributes of the ~~Tractography Results~~ module that are present

350 might need to add row here

Commented [CvWW35]: Might need to add this

Commented [CvWW36]: TODO, check if we created something that needs to be added here.

DICOM PS 3.16: ~~Content Mapping Resource~~

Commented [CvWW37]: Anything we have for this ?

Item: Add in Section B DCMR Context Groups (Normative)

355

DICOM PS 3.17: Explanatory Information

Item: Add the following Section

XX ~~Functional MRI S~~Parametric Blending Presentation State Storage Encoding Example (Informative)

360 This section illustrates the usage of the Parametric Blending Presentation State for a functional MRI study.

XX.1 Introduction

365 Quantitative imaging provides measurements of physical properties, in vivo and non-invasively, for research and clinical practice. DICOM support for parametric maps provides a structure for organizing these results as an extension of the already widely-used imaging standard. The addition of color LUT support for parametric maps bridges the gap between data handling and visualization.

370 An example of quantitative imaging in clinical practice today is the use of MRI, PET and other modalities in brain mapping for diagnostic assessment in pre-treatment planning for tumor, epilepsy, arterio-venous malformations (AVMs) and other conditions. MR Diffusion tensor imaging (DTI) results in fractional anisotropy (FA) and other parametric maps highlighting white matter structures. Task-based functional MRI (fMRI) highlights specific areas of eloquent cortex (gray matter) as expressed in statistical activation maps. Other parameters and modalities including perfusion, MR spectroscopy, and PET are often employed to locate and characterize lesions by means of their hyper- and hypo-metabolism and – perfusion in parametric maps.

375 The visualization of multiple parametric maps and sources of anatomical information in the same space requires the tools to highlight areas of interest (and hide irrelevant areas) in parametric maps. Two important tools provided in this supplement are thresholding of parametric maps by their real-world values, and blending of multiple image data sets in a single view. A task-based Functional MRI study is used to correlate specific activities to area's in the brain that are used during the specific activity.–

380 A full Functional MRI (fMRI) study consists of several steps. The full workflow is shown in fig XX.1-1.

Figure XX.1-1. Workflow overview of typical fMRI study

385 XX.4 Post-Acquisition Data Processing

390 During the Post-Acquisition Data Processing the acquired data is processed and analyzed to find the correlation for each voxel with the stimuli given over time. First step can be motion correction to remove small movements of the patient during the acquisition. Second step would be to determine for each voxel in the image volume the signal change corresponding to activation (e.g. BOLD signal change as a percentage of baseline). Based on this set of values of the voxel a statistical activation value is determined using statistical methods. The result is a volume (r*c*s voxels) representing the statistical activation map. The value of the voxel is an indication to how much the voxel is activated during the given stimuli.

Commented [CvWW38]: Do we keep this as an example of usage of Parametric map. If so would like to get out all surrounding information and focus on the Maps and usage.

Commented [CvWW39]: Check if this is needed throughout the document.

Commented [CvWW40]: Also the capturing of who did what during the whole procedure. How does this fit into the data stream.

Commented [CvWW41]: Think about adding paradigm system. Including SR log of given events.

395 ~~The Statistical Activation Map is typically shown using a threshold and an anatomical image series. With the threshold the voxel values that are displayed are selected. Together with a color scale for the statistical activation values a color overlay is created. A typical example is shown in figure XX.4-1.~~

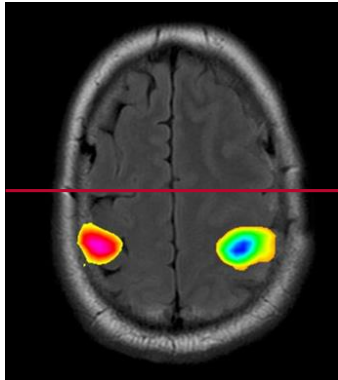


Figure XX.4-1 Sample Blending of Enhanced MR image and Statistical Activation Map image

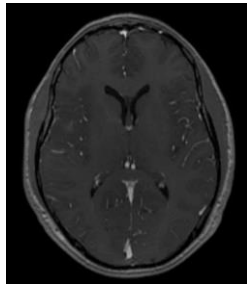
~~XX.5 Interpretation and Results Distribution.~~

400 ~~During the interpretation and distribution the physician can interpret and distribution the physician can adjust the threshold originally defined during the post-processing phase. It will result in a larger of smaller relevant area that will be shown in the overlay.~~

XX.2 Example (Informative)

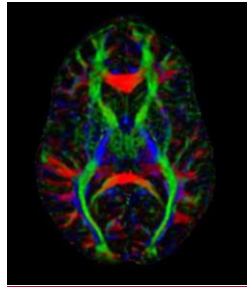
405 The example describes the blending of five series:

Series 1 the anatomical series which is stored as single volume in an Enhanced MR Image object having no Color LUT attached.

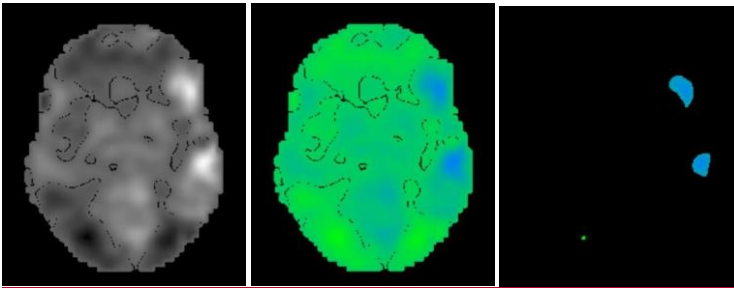


410 Series 2 the DTI series which is stored as an Enhanced MR Color Image object, means that no RGB transformation is needed. Will be displayed at 30% opacity.

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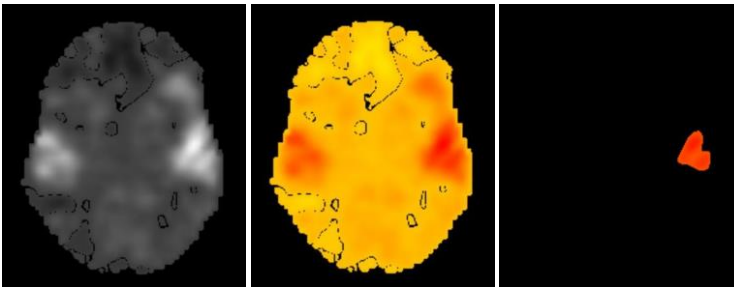
Series 3 is Reading task captured in a Parametric Map with Color LUT Winter attached to it. Will be displayed with threshold range 6% to 50%. Opacity will be equal divided with the other two task maps.



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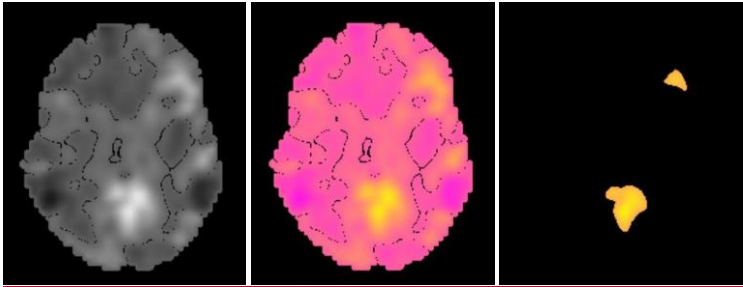
415 Series 4 is Listening task captured in a Parametric Map with Color LUT Fall attached to it. Will be displayed with threshold range 9% to 60%. Opacity will be equal divided with the other two task maps.



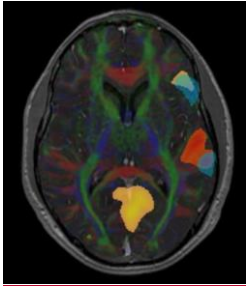
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420 Series 5 is Silent Word Generation task captured in a Parametric Map with Color LUT Spring attached to it. Will be displayed with threshold range 7% to 75%. Opacity will be equal divided with the other two task maps.

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Final result

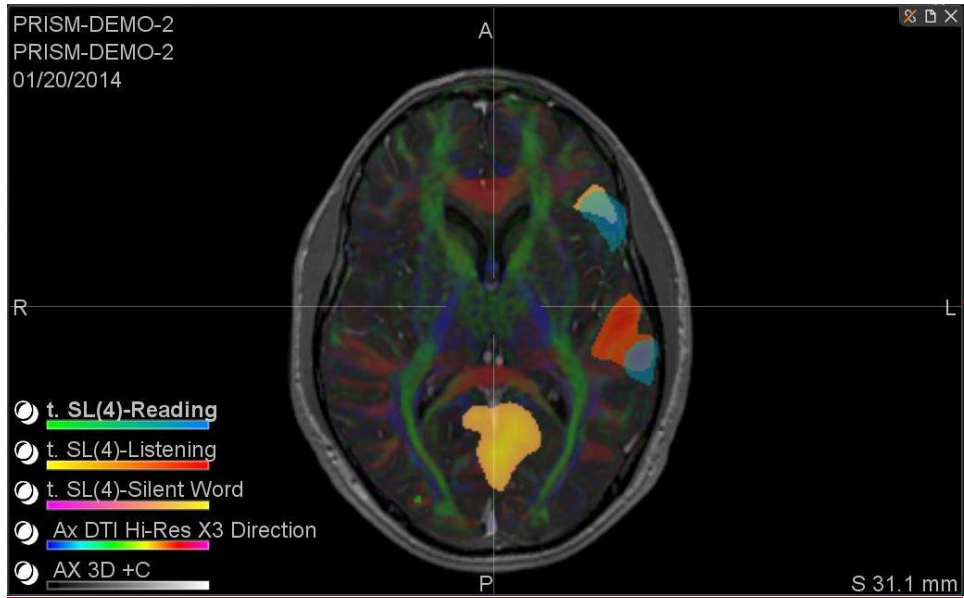


Final result with information on patient and different layers. Which is not described in the object but would be application specific behavior.

425

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XX.6 Application Cases

XX.6.1 Case #1: Description of use case

430 ~~As example for the objects created and there specific content we use the use case of a patient up for surgery and for this it is needed to identify the motor strip and determine language lateralization.~~

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Commented [CvWW42]: Describe Use case

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435 ~~Procedure order delivers the plan for the Acquisition where a paradigm is created which will be acquired with only 5 volumes. The acquired anatomical dataset will be stored in one Enhanced MR object (could be a set of Classic objects), and a derived Parametric Map with a double threshold range (positive and negative) for the motor strip and a derived Parametric map with a positive threshold for the language lateralization.~~

Commented [CvWW43]: Describe full examination and which datasets are used for the example.

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440 ~~Showing the main content of the Enhanced object related to the fMRI acquisition, which are the important parameters.~~

~~XX.6.1.1 User scenario~~

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~~XX.6.1.2 Encoding outline~~

445

~~XX.36.1.3 Encoding exempleng details (Informative)~~

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| <u>Attribute Name</u> | <u>Tag</u> | <u>Value</u> | <u>Comment</u> |
|---|--------------------|---|---|
| <u>Parametric Blending Sequence</u> | <u>(0070,xxx1)</u> | | |
| <u>Sequence Item 1</u> | | | <u>Identifies Anatomical Series, no sub</u> <u>of series or registration</u> |
| <u>>Parametric Blending Input Number</u> | <u>(0070,xxx2)</u> | <u>"1"</u> | |
| <u>>Study Instance UID</u> | <u>(0020.000D)</u> | <u>"1.3.46.670589.11.3"</u> | |
| <u>>Series Instance UID</u> | <u>(0020.000E)</u> | <u>"1.3.46.670589.11.3.4</u> <u>5"</u> | |
| <u>End Sequence item 1</u> | | | |

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| <u>Attribute Name</u> | <u>Tag</u> | <u>Value</u> | <u>Comment</u> |
|---|-------------|----------------------------|---|
| Sequence Item 2 | | | Identifies DTI Series, no subset of series is used, no registration present |
| >Parametric Blending Input Number | (0070,xxx2) | "2" | |
| >Study Instance UID | (0020,000D) | "1.3.46.670589.11.3" | |
| >Series Instance UID | (0020,000E) | "1.3.46.670589.11.3.49" | - |
| End Sequence item 2 | | | |
| Sequence Item 3 | | | Identifies first Parametric map, no registration |
| >Parametric Blending Input Number | (0070,xxx2) | "3" | |
| >Study Instance UID | (0020,000D) | "1.3.46.670589.11.3" | |
| >Series Instance UID | (0020,000E) | "1.3.46.670589.11.3.56" | - |
| End Sequence item 3 | | | |
| Sequence Item 4 | | | Identifies second Parametric map, no registration |
| >Parametric Blending Input Number | (0070,xxx2) | "3" | |
| >Study Instance UID | (0020,000D) | "1.3.46.670589.11.3" | |
| >Series Instance UID | (0020,000E) | "1.3.46.670589.11.3.58" | - |
| End Sequence item 4 | | | |
| Sequence Item 5 | | | Identifies third Parametric map with registration |
| >Parametric Blending Input Number | (0070,xxx2) | "3" | |
| >Study Instance UID | (0020,000D) | "1.3.46.670589.11.3" | |
| >Series Instance UID | (0020,000E) | "1.3.46.670589.11.3.59" | - |
| >Referenced Spatial Registration Sequence | (0070,0404) | | |
| >> | | "1.3.46.670589.11.3.59.43" | Registration object for this series |
| End Sequence item 5 | | | |
| Pixel Presentation | (0008,9205) | "TRUE_COLOR" | |

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| <u>Attribute Name</u> | <u>Tag</u> | <u>Value</u> | <u>Comment</u> |
|--|--------------------|----------------------------|--|
| <u>Presentation State Classification Component Sequence</u> | <u>(0070,1801)</u> | | |
| Sequence Item 1 | | | |
| > <u>Presentation State Classification Component Identification Sequence</u> | <u>(0070,xxx9)</u> | | |
| > Sequence Item 1-1 | | | <u>Anatomical series, no threshold</u> |
| >> <u>Parametric Blending Input Number</u> | <u>(0070,xxx2)</u> | <u>"1"</u> | |
| > End Sequence Item 1-1 | | | |
| > Sequence Item 1-2 | | | <u>DTI series, no threshold</u> |
| >> <u>Parametric Blending Input Number</u> | <u>(0070,xxx2)</u> | <u>"2"</u> | |
| > End Sequence Item 1-2 | | | |
| <u>Alpha Value</u> | <u>(0028,xxx8)</u> | <u>0.3</u> | |
| <u>Blending Mode</u> | <u>(0028,xxx9)</u> | <u>BACKGROUND_PRIORITY</u> | |
| <u>Parametric Blending Input Number</u> | <u>(0070,xxx2)</u> | <u>"6"</u> | <u>Output is used for later Blending</u> |
| End Sequence item 1 | | | |
| Sequence Item 2 | | | |
| > <u>Presentation State Classification Component Identification Sequence</u> | <u>(0070,xxx9)</u> | | |
| > Sequence Item 2-1 | | | <u>Parametric series 1</u> |
| >> <u>Parametric Blending Input Number</u> | <u>(0070,xxx2)</u> | <u>"3"</u> | |
| >> <u>Threshold Sequence</u> | <u>(xxx1,yyy1)</u> | | |
| >> Sequence Item 2-1-1 | | | |
| >> <u>Threshold Value Sequence</u> | <u>(xxx1,yyy2)</u> | | |
| >>> Sequence Item 2-1-1-1 | | | |
| >>> <u>Threshold Value</u> | <u>(xxx1,yyy4)</u> | <u>6</u> | |
| >>> End Sequence Item 2-1-1-1 | | | |
| >>> Sequence Item 2-1-1-2 | | | |
| >>> <u>Threshold Value</u> | <u>(xxx1,yyy4)</u> | <u>50</u> | |

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Commented [CvWW44]: This is called input number as it shall contain the number that will be used as an input in a later step. Do we use it that way or will it have a different name.

| <u>Attribute Name</u> | <u>Tag</u> | <u>Value</u> | <u>Comment</u> |
|-------------------------------------|-------------|--------------|---------------------|
| >>> End Sequence Item 2-1-1-2 | | | |
| >>Threshold Type | (xxx1.yyy3) | RANGE_INCL | |
| >> End Sequence Item 2-1-1 | | | |
| > End Sequence Item 2-1 | | | |
| > Sequence Item 2-2 | | | Parametric series 2 |
| >> Parametric Blending Input Number | (0070.xxx2) | "4" | |
| >> Threshold Sequence | (xxx1.yyy1) | | |
| >> Sequence Item 2-2-1 | | | |
| >> Threshold Value Sequence | (xxx1.yyy2) | | |
| >>> Sequence Item 2-2-1-1 | | | |
| >>> Threshold Value | (xxx1.yyy4) | 9 | |
| >>> End Sequence Item 2-2-1-1 | | | |
| >>> Sequence Item 2-2-1-2 | | | |
| >>> Threshold Value | (xxx1.yyy4) | 60 | |
| >>> End Sequence Item 2-2-1-2 | | | |
| >>Threshold Type | (xxx1.yyy3) | RANGE_INCL | |
| >> End Sequence Item 2-2-1 | | | |
| > End Sequence Item 2-2 | | | |
| > Sequence Item 2-3 | | | Parametric series 3 |
| >> Parametric Blending Input Number | (0070.xxx2) | "5" | |
| >> Threshold Sequence | (xxx1.yyy1) | | |
| >> Sequence Item 2-3-1 | | | |
| >> Threshold Value Sequence | (xxx1.yyy2) | | |
| >>> Sequence Item 2-3-1-1 | | | |
| >>> Threshold Value | (xxx1.yyy4) | Z | |
| >>> End Sequence Item 2-3-1-1 | | | |
| >>> Sequence Item 2-3-1-2 | | | |
| >>> Threshold Value | (xxx1.yyy4) | 75 | |
| >>> End Sequence Item 2-3-1-2 | | | |
| >>Threshold Type | (xxx1.yyy3) | RANGE_INCL | |

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| <u>Attribute Name</u> | <u>Tag</u> | <u>Value</u> | <u>Comment</u> |
|---|-------------|--------------|--|
| >> End Sequence Item 2-3-1 | | | |
| > End Sequence Item 2-3 | | | |
| Blending Mode | (0028,xxx9) | EQUALLY | |
| Parametric Blending Input Number | (0070,xxx2) | "7" | Output is used for later Blending |
| End Sequence item 2 | | | |
| Sequence Item 3 | | | |
| > Presentation State Classification Component Identification Sequence | (0070,xxx9) | | |
| > Sequence Item 3-1 | | | Output first blending operation, no threshold |
| >> Parametric Blending Input Number | (0070,xxx2) | "6" | |
| > End Sequence Item 3-1 | | | |
| > Sequence Item 3-2 | | | Output second blending operation, no threshold |
| >> Parametric Blending Input Number | (0070,xxx2) | "7" | |
| > End Sequence Item 3-2 | | | |
| Blending Mode | (0028,xxx9) | EQUALLY | |
| End Sequence item 3 | | | |

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Commented [CvWW45]: This is called input number as it shall contain the number that will be used as an input in a later step. Do we use it that way or will it have a different name.

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450 **XX.6.1.3.1 Enhanced MR Image IOD**

455 **XX.6.1.3.1.3 Frame of Reference**

| <u>Attribute Name</u> | <u>Tag</u> | <u>Type</u> | <u>Attribute Description</u> |
|------------------------|-------------|-------------|---|
| Frame of Reference UID | (0020,0052) | 4 | Uniquely identifies the frame of reference for a Series. See Section C.7.4.1 for further explanation. |

Commented [CvWW46]: Needs to be part of the example to create the connection to the Parametric map and Blending object.

XX.6.1.3.1.3 Synchronization

Table C.7-7. Synchronization Module Attributes

460

| Attribute Name | Tag | Type | Attribute Description |
|-------------------------------|-------------|------|---|
| Synchronization Trigger | (0018,106A) | 1 | Data acquisition synchronization with external equipment. Enumerated Values: SOURCE — this equipment provides synchronization channel or trigger to other equipment EXTERNAL — this equipment receives synchronization channel or trigger from other equipment PASSTHRU — this equipment receives synchronization channel or trigger and forwards it NO TRIGGER — data acquisition not synchronized by common channel or trigger |
| Acquisition Time Synchronized | (0018,1800) | 1 | Acquisition DateTime (0008,002A) synchronized with external time reference. Enumerated Values: Y — N — See Section C.7.4.2.1.4 |
| Time Source | (0018,1801) | 3 | ID of equipment or system providing time reference |
| Time Distribution Protocol | (0018,1802) | 3 | Method of time distribution used to synchronize this equipment. Enumerated Values: NTP — Network Time Protocol IRIG — Inter Range Instrumentation Group GPS — Global Positioning System SNTP — Simple Network Time Protocol PTP — IEEE 1588 Precision Time Protocol |
| NTP Source Address | (0018,1803) | 3 | IP Address of NTP, SNTP, or PTP time source. IPv4 address shall be in dotted decimal (e.g., 192.168.1.1). The IPv6 address shall be in colon-separated hexadecimal (e.g., 12:34:56:78:9a:bc:de:f0). Note Identity of this value in two instances acquired contemporaneously implies a common time base. The NTP Source Address might not persist over time. |

Commented [CvWW47]: Is there a common way for this that we can recommend a value?

Commented [CvWW47]: Is there a common way for this that we can recommend a value?

Commented [CvWW48]: Expect Y will be recommended

Commented [CvWW48]: Expect Y will be recommended

Commented [CvWW49]: Preferred

Commented [CvWW49]: Preferred

Commented [CvWW50]: Recommend to fill in.

Commented [CvWW50]: Recommend to fill in.

XX.6.1.3.1.3 Multi-frame Functional Groups

| Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|---|
| Shared Functional Groups Sequence | (5200,9229) | 4 | <p>Sequence that contains the Functional Group Macros that are shared for all frames in this SOP Instance and Concatenation.</p> <p>Note</p> <p>The contents of this sequence are the same in all SOP Instances that comprise a Concatenation.</p> <p>Only a single Item shall be included in this sequence.</p> <p>See Section C.7.6.16.1.1 for further explanation.</p> |
| <p>>Include one or more Functional Group Macros that are shared by all frames. The selected Functional Group Macros shall not be present in the Per-frame Functional Groups Sequence (5200,9230).</p> | | | <p>For each IOD that includes this module, a table is defined in which the permitted Functional Group Macros and their usage is specified.</p> <p>The Item may be empty if the requirements for inclusion of the Functional Groups are not satisfied.</p> |
| Per-frame Functional Groups Sequence | (5200,9230) | 1 | <p>Sequence that contains the Functional Group Sequence Attributes corresponding to each frame of the Multi-frame Image. The first Item corresponds with the first frame, and so on.</p> <p>One or more Items shall be included in this sequence. The number of Items shall be the same as the number of frames in the Multi-frame image. See Section C.7.6.16.1.2 for further explanation.</p> |
| <p>>Include one or more Functional Group Macros.</p> | | | <p>For each IOD that includes this module, a table is defined in which the permitted Functional Group Macros and their usage is specified.</p> <p>An Item may be empty if the requirements for inclusion of the Functional Groups for the corresponding frame are not satisfied.</p> |
| | | | |

Commented [CvWW51]: Not sure yet if we will have a specific preference for groups in the sequence.

Commented [CvWW51]: Not sure yet if we will have a specific preference for groups in the sequence.

XX.6.1.3.1.3 Multi-frame Dimension

| Attribute Name | Tag | Type | Attribute Description |
|-----------------------------------|-------------|------|--|
| Dimension Organization Sequence | (0020,9221) | 4 | Sequence that lists the Dimension Organization UIDs referenced by the containing SOP Instance. See Section C.7.6.17.2 for further explanation. One or more Items shall be included in this Sequence. |
| >Dimension Organization UID | (0020,9164) | 1 | Uniquely identifies a set of dimensions referenced within the containing SOP Instance. See Section C.7.6.17.2 for further explanation. |
| Dimension Organization Type | (0020,9311) | 3 | Dimension organization of the instance. Defined Terms: 3D Spatial Multi-frame image of equally spaced parallel planes (3D volume set) 3D_TEMPORAL Temporal loop of equally spaced parallel plane 3D volume sets. |
| Dimension Index Sequence | (0020,9222) | 1 | Identifies the sequence containing the indices used to specify the dimension of the multi-frame object. One or more Items shall be included in this sequence. |
| >Dimension Index Pointer | (0020,9165) | 1 | Contains the Data Element Tag that is used to identify the Attribute connected with the index. See Section C.7.6.17.1 for further explanation. |
| >Dimension Index Private Creator | (0020,9213) | 1C | Only important when private tags are used |
| >Functional Group Pointer | (0020,9167) | 1C | Contains the Data Element Tag of the Functional Group Sequence that contains the Attribute that is referenced by the Dimension Index Pointer (0020,9165). See Section C.7.6.17.1 for further explanation. Required if the value of Dimension Index Pointer (0020,9165) is the Data Element Tag of an Attribute that is contained within a Functional Group Sequence. |
| >Functional Group Private Creator | (0020,9238) | 1C | Only important when private tags are used |
| >Dimension Organization UID | (0020,9164) | 1C | Uniquely identifies a set of dimensions referenced within the containing SOP Instance. In particular the dimension described by this sequence item is associated with this Dimension Organization UID. See Section C.7.6.17.2 for further explanation. Required if the value of Dimension Organization Sequence (0020,9221) contains Items |
| >Dimension Description Label | (0020,9421) | 3 | Free text description that explains the meaning of the dimension. |

Commented [CvWW52]: Here we will specify the specific parameters that will be used in the scan. This will be temporal position and stack and in-stack position. What will be the order.

Commented [CvWW52]: Here we will specify the specific parameters that will be used in the scan. This will be temporal position and stack and in-stack position. What will be the order.

XX.6.1.3.1.3 Enhanced MR Image

| Attribute Name | Tag | Type | Attribute Description |
|---|-------------|------|---|
| <i>Include Table C.8-83 "MR Image and Spectroscopy Instance Macro Attributes"</i> | | | |
| Image Type | (0008,0008) | 1 | Image characteristics. See Section C.8.16.1 and Section C.8.13.1.1.1. |
| <i>Include Table C.8-131 "Common CT/MR Image Description Macro Attributes"</i> | | | |
| <i>Include Table C.8-84 "MR Image Description Macro Attributes"</i> | | | |
| Samples per Pixel | (0028,0002) | 4 | Number of samples (planes) in this image. For Enumerated Values See Section C.8.13.1.1.2. |
| Photometric Interpretation | (0028,0004) | 4 | Specifies the intended interpretation of the pixel data. Enumerated Values are specified in the that invokes this Module. See Section C.7.6.3 for definition of this term. |
| Bits Allocated | (0028,0100) | 4 | Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. For Enumerated Values See Section C.8.13.1.1.2. |
| Bits Stored | (0028,0101) | 4 | Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. For Enumerated Values See Section C.8.13.1.1.2. |
| High Bit | (0028,0102) | 4 | Most significant bit for pixel sample data. Each sample shall have the same high bit. Shall be one less than the value in Bits Stored (0028,0101). |
| **** | | | |
| Lossy Image Compression | (0028,2110) | 4C | Specifies whether an Image has undergone lossy compression (at a point in its lifetime). Enumerated Values: 00 Image has NOT been subjected to lossy compression. 01 Image has been subjected to lossy compression. Once this value has been set to 01 it shall not be reset. See Section C.7.6.1.1.5. Required if SOP Class UID is not "1.2.840.10008.5.1.4.1.1.4.4" (Legacy Converted). May be present otherwise. |

Commented [CvWW53]: Look for the correct values.

Commented [CvWW53]: Look for the correct values.

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Commented [CvWW54]: Changed as per CP 1476.

Commented [CvWW55]: Will be 1

Commented [CvWW55]: Will be 1

Commented [CvWW56]: MONOCHROME2

Commented [CvWW56]: MONOCHROME2

Commented [CvWW57]: Don't allow 8 bit data, minimal shall be 12.

Commented [CvWW57]: Don't allow 8 bit data, minimal shall be 12.

Commented [CvWW58]: Shall be 00

Commented [CvWW58]: Shall be 00

| Attribute Name | Tag | Type | Attribute Description |
|--|-----|------|--------------------------|
| | | | |
| >Include Table C.7.11b "Image Pixel Macro Attributes" | | | See Section C.7.6.1.1.6. |
| [Include Table 10.25 "Optional View and Slice Progression Direction Macro Attributes"] | | | |

Commented [CvWW59]: Check content. WC

XX.6.1.3.1.3 SOP Common

Table C.8-xx. Functional MR Macro Attributes

Commented [CvWW60]: Pending acceptance of CP 1476.

470

| Attribute Name | Tag | Type | Attribute Description |
|-------------------------|-------------|------|--|
| Functional MR Sequence | {0018,xx01} | 4 | Identifies the Functional parameters of this frame. Only a single Item shall be included in this Sequence. |
| > Settling Phase Frame | {0020,xx01} | 1C | Identifies if the frame is part of a Functional MR settling phase. All frames with the same combination of Stack ID (0020,9056) and Temporal Position Index (0020,9128) shall have the same value. Enumerated Values: YES NO Required if Functional Settling Phase Frames Present (0018,xx02) is YES |
| > Functional Sync Pulse | {0018,xx03} | 4 | The date and time of the Functional Sync Pulse for this frame. See Section C.8.13.5.x.1 |

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| XX.6.1.3.1.3 SOP Common Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|---|
| SOP Class UID | {0008,0016} | 4 | Uniquely identifies the SOP Class. See Section C.12.1.1.1 for further explanation. See also PS3.4. |
| SOP Instance UID | {0008,0018} | 4 | Uniquely identifies the SOP Instance. See Section C.12.1.1.1 for further explanation. See also PS3.4. |

Commented [CvWW61]: Leave in for reference purposes from the Parametric map and the Blending object.

| XX.6.1.3.1.3 SOP Common Attribute Name | Tag | Type | Attribute Description |
|--|-----|------|-----------------------|
| ... | | | |

475

XX.6.1.3.2 Parametric Map IOD

Commented [CvWW62]: TODO add Functional MR Macro usage, Functional MR Sequence.

XX.6.1.3.2.1 General Series

| 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. See Section C.7.3.1.1.1 for Defined Terms. |
| ... | | | |
| Protocol Name | (0018,1030) | 3 | User-defined description of the conditions under which the Series was performed. Note This attribute conveys series-specific protocol identification and may or may not be identical to the one presented in the Performed Protocol Code Sequence (0040,0260). |
| ... | | | |
| Related Series Sequence | (0008,1250) | 3 | Identification of Series significantly related to this Series. One or more Items are permitted in this Sequence. Note 1. For example, for a combined CT and PET acquisition, the CT images and PET images would be in separate series that could cross-reference each other with multiple purpose-of-reference codes meaning same anatomy, simultaneously acquired and same indication. 2. The related series may have different Frames of Reference and hence require some sort of registration before spatial coordinates can be directly compared. 3. This attribute is not intended for conveying localizer reference information, for which Referenced Image Sequence (0008,1140) should be used. |
| >Study Instance UID | (0020,000D) | 4 | Instance UID of Study to which the related Series belongs |

Commented [CvWW63]: Will be MR

Commented [CvWW64]: Question: This can to be the same as the original series or the processing protocol. **Check with David on thoughts on this. WC**

Commented [CvWW65]: TODO: Make explicit reference to the related Image series and Blending object.

| Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|--|
| >Series Instance UID | {0020,000E} | 1 | Instance UID of Related Series |
| >Purpose of Reference Code Sequence | {0040,A170} | 2 | Describes the purpose for which the reference is made. Zero or more Items shall be included in this sequence. When absent, implies that the reason for the reference is unknown. |
| >>Include Table 8.8-1 "Code Sequence Macro Attributes" | | | Defined CID 7210 "Related Series Purposes of Referer |
| --- | | | |

Commented [CvWW66]: The original scan objects and if defined the Blending object(s) will be specified here. Question: Would adding the Blending object reference later need a new UID for the object. **Check!!**

Commented [CvWW67]: Continue here !!!!

Commented [CvWW68]: Extend 7210 to cover Parametric map and Blending operation.

480 **XX.6.1.3.2.3 Parametric Series**

| Attribute Name | Tag | Type | Attribute Description |
|----------------|-------------|------|--|
| Modality | {0008,0060} | 4 | Modality Type Note 1. It is expected that the majority of Parametric Maps will use the appropriate value for the acquisition modality, e.g. "MR", and so no specific Defined Terms or Enumerated Values are specified here. 2. If the image is derived from multiple modalities, then a value of "OT" is appropriate. |
| Series Number | {0020,0011} | 4 | A number that identifies this Series |

Commented [CvWW69]: This will be MR

Commented [CvWW70]: Anything about this?

XX.6.1.3.2.3 Frame of Reference

| Attribute Name | Tag | Type | Attribute Description |
|------------------------|-------------|------|--|
| Frame of Reference UID | {0020,0052} | 4 | Uniquely identifies the frame of reference for a Series. See Section C.7.4. for further explanation. |

Commented [CvWW71]: Shall be the same as the value of the related image series
Question: can this ever be different, is derived from a series and as such should have the same?

485 **XX.6.1.3.2.3 Floating Point Image Pixel**

| Attribute Name | Tag | Type | Attribute Description |
|----------------------------|-------------|------|--|
| Samples per Pixel | {0028,0002} | 4 | Number of samples (planes) in this image. See Section C.7.6.3.1.1 for further explanation. |
| Photometric Interpretation | {0028,0004} | 4 | Specifies the intended interpretation of the pixel data. |

Commented [CvWW72]: Is Floating point enough or should we go for the Double Floating point.

Commented [CvWW73]: Depends on outcome with WG06.

Commented [CvWW74]: Will it always be floating or double that we should use?

| Attribute Name | Tag | Type | Attribute Description |
|---------------------------------|-------------|------|--|
| | | | Enumerated Values: MONOCHROME2 |
| Rows | (0028,0010) | 4 | Number of rows in the image. |
| Columns | (0028,0011) | 4 | Number of columns in the image. |
| Bits Allocated | (0028,0100) | 4 | Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See PS3.5 for further explanation. Enumerated Values: 32 |
| Float Pixel Data | (7FE0,0008) | 1 | A data stream of the pixel samples that comprise the image. The order of pixels sent for each image plane is left to right, top to bottom, i.e., the upper left pixel (labeled 1,1) is sent first followed by the remainder of row 1, followed by the first pixel of row 2 (labeled 2,1) then the remainder of row 2 and so on. |
| Pixel Aspect Ratio | (0028,0034) | 1C | Ratio of the vertical size and horizontal size of the pixels in the image specified by a pair of integer values where the first value is the vertical pixel size, and the second value is the horizontal pixel size. Required if the aspect ratio values do not have a ratio of 1:1 and the physical pixel spacing is not specified by Pixel Spacing (0028,0030), or Imager Pixel Spacing (0048,1164) or Nominal Scanned Pixel Spacing (0048,2040), either for the entire image or per frame in a Functional Group Macro. See Section C.7.6.3.1.7. |
| Float Pixel Padding Value | (0028,0122) | 3 | One limit (inclusive) of a range of pixel values used in an image to pad to rectangular format or to signal background that may be suppressed. |
| Float Pixel Padding Range Limit | (0028,0124) | 1C | Pixel value that represents one limit (inclusive) of a range of padding values used together with Float Pixel Padding Value (0028,0122). Required if Float Pixel Padding Value (0028,0122) is present. Note 1. If only a single padding value rather than a range is required, then both Float Pixel Padding Value (0028,0122) and Float Pixel Padding Range Limit (0028,0124) will contain the same value. 2. The general considerations described in Section C.7.5.1.1.2 may be helpful in understanding the corresponding floating point attributes, but are not normative. |

XX.6.1.3.2.3 Parametric Map Image

| Attribute Name | Tag | Type | Attribute Description |
|---|-------------|------|---|
| Image Type | (0008,0008) | 4 | <p>Image identification characteristics.</p> <p>Enumerated Values for Value 1: DERIVED —</p> <p>Enumerated Values for Value 2: PRIMARY —</p> <p>Value 3 shall be Image Flavor, Defined Terms for which are specified in Section C.8.16.1.3.</p> <p>Value 4 shall be Derived Pixel Contrast, common Defined Terms for which are specified in Section C.8.16.1.4 and MR-specific Defined Terms for which are specified in Section C.8.13.1.1.1.4.</p> |
| <i>Include Table 10-12 "Content Identification Macro"</i> | | | |
| ... | | | |
| Bits Allocated | (0028,0100) | 4 | <p>Number of bits allocated for each pixel sample.</p> <p>Enumerated Values if Pixel Data (7FE0,0010) or Pixel Data Provider URL (0028,7FE0) is present: 16 —</p> <p>Enumerated Values if Float Pixel Data (7FE0,0008) is present: 32 —</p> <p>Enumerated Values if Double Float Pixel Data (7FE0,0000) is present: 64 —</p> |
| Bits Stored | (0028,0101) | 4C | <p>Number of bits stored for each pixel sample.</p> <p>Enumerated Values: 16 —</p> <p>Required if Pixel Data (7FE0,0010) or Pixel Data Provider URL (0028,7FE0) is present.</p> |
| High Bit | (0028,0102) | 4C | Most significant bit for pixel sample data. |

Commented [CvWW75]: Shall be FMRI

Commented [CvWW75]: Shall be FMRI

Commented [CvWW76]: Any special value that we need to define here?

Commented [CvWW76]: Any special value that we need to define here?

| Attribute-Name | Tag | Type | Attribute-Description |
|--|------------------------|--------------|---|
| | | | Enumerated Values: 15 Required if Pixel Data (7FE0,0010) or Pixel Data Provider URL (0028,7FE0) is present. |
| Lossy Image Compression | (0028,2410) | 4 | Specifies whether an image has undergone lossy compression (at a point in its lifetime), or is derived from lossy compressed images. Enumerated Values: 00—Image has NOT been subjected to lossy compression. 01—Image has been subjected to lossy compression. Once this value has been set to 01 it shall not be reset. See Section C.8.32.2.1 and Section C.7.6.1.1.5. |
| | | | |
| Parametric Map Threshold Sequence | | | |

Commented [CvWW77]: Value shall be 00

Commented [CvWW77]: Value shall be 00

Commented [CvWW78]: TODO: add this sequence through CP or this supp

Commented [CvWW78]: TODO: add this sequence through CP or this supp

490 **XX.6.1.3.2.3 Multi-frame Functional Groups**

| Attribute-Name | Tag | Type | Attribute-Description |
|--|------------------------|--------------|--|
| Shared Functional Groups Sequence | (5200,9229) | 1 | Sequence that contains the Functional Group Macros that are shared for all frames in this SOP Instance and Concatenation. Note The contents of this sequence are the same in all SOP Instances that comprise a Concatenation. Only a single Item shall be included in this sequence. See Section C.7.6.16.1.1 for further explanation. |
| >Include one or more Functional Group Macros that are shared by all frames. The selected Functional Group Macros shall not be present in the Per-frame Functional Groups Sequence (5200,9230). | | | For each IOD that includes this module, a table is defined in which the permitted Functional Group Macros and their usage is specified. |

Commented [CvWW79]: Not sure yet if we will have a specific preference for groups in the sequence.

Commented [CvWW79]: Not sure yet if we will have a specific preference for groups in the sequence.

| Attribute Name | Tag | Type | Attribute Description |
|---|-------------|------|--|
| | | | The Item may be empty if the requirements for inclusion of the Functional Groups are not satisfied. |
| Per-frame-Functional-Groups-Sequence | {5200,9230} | 4 | Sequence that contains the Functional Group Sequence Attributes corresponding to each frame of the Multi-frame Image. The first Item corresponds with the first frame, and so on. One or more Items shall be included in this sequence. The number of Items shall be the same as the number of frames in the Multi-frame image. See Section C.7.6.16.1.2 for further explanation. |
| >Include one or more Functional Group Macros. | | | For each IOD that includes this module, a table is defined in which the permitted Functional Group Macros and their usage is specified. An Item may be empty if the requirements for inclusion of the Functional Groups for the corresponding frame are not satisfied. |
| --- | | | |
| Representative-Frame-Number | {0028,6010} | 3 | The frame number selected for use pictorial representation (e.g., icon) of multi-frame Image. |
| --- | | | |

Commented [CvWW80]: Do we want to recommend something here?

Commented [CvWW80]: Do we want to recommend something here?

XX.6.1.3.2.3 Multi-frame Dimension

Commented [CvWW81]: Question: assume this is a single volume, give typical example of the needed dimensions.

| Attribute Name | Tag | Type | Attribute Description |
|---------------------------------|-------------|------|---|
| Dimension-Organization-Sequence | {0020,9221} | 1 | Sequence that lists the Dimension Organization UIDs referenced by the containing SOP Instance. See Section C.7.6.17.2 for further explanation. One or more Items shall be included in this Sequence. |
| >Dimension-Organization-UID | {0020,9164} | 4 | Uniquely identifies a set of dimensions referenced within the containing SOP Instance. See Section C.7.6.17.2 for further explanation. |
| Dimension-Organization-Type | {0020,9311} | 3 | Dimension organization of the instance. Defined Terms: 3D — Spatial Multi-frame image of equally spaced parallel planes (3D volume set) |

| Attribute Name | Tag | Type | Attribute Description |
|-----------------------------------|-------------|------|--|
| | | | 3D_TEMPORAL Temporal loop of equally spaced parallel-plane 3D-volume sets. |
| Dimension-Index-Sequence | (0020,9222) | 4 | Identifies the sequence containing the indices used to specify the dimension of the multi-frame object. One or more Items shall be included in this sequence. |
| >Dimension-Index-Pointer | (0020,9165) | 4 | Contains the Data-Element-Tag that is used to identify the Attribute-connected with the index. See Section C.7.6.17.1 for further explanation. |
| >Dimension-Index-Private-Creator | (0020,9213) | 4C | Identification of the creator of a group of private data elements. Required if the Dimension-Index-Pointer (0020,9165) value is the Data-Element-Tag of a Private-Attribute. |
| >Functional-Group-Pointer | (0020,9167) | 4C | Contains the Data-Element-Tag of the Functional-Group-Sequence that contains the Attribute that is referenced by the Dimension-Index-Pointer (0020,9165). See Section C.7.6.17.1 for further explanation. Required if the value of Dimension-Index-Pointer (0020,9165) is the Data-Element-Tag of an Attribute that is contained within a Functional-Group-Sequence. |
| >Functional-Group-Private-Creator | (0020,9238) | 4C | Identification of the creator of a group of private data elements. Required if the Functional-Group-Pointer (0020,9167) value is the Data-Element-Tag of a Private-Attribute. |
| >Dimension-Organization-UID | (0020,9164) | 4C | Uniquely identifies a set of dimensions referenced within the containing SOP Instance. In particular the dimension described by this sequence item is associated with this Dimension-Organization-UID. See Section C.7.6.17.2 for further explanation. Required if the value of Dimension-Organization-Sequence (0020,9221) contains Items |
| >Dimension-Description-Label | (0020,9421) | 3 | Free-text description that explains the meaning of the dimension. |

XX.6.1.3.2.3 SOP Common

| Attribute Name | Tag | Type | Attribute Description |
|------------------|-------------|------|---|
| SOP-Class-UID | (0008,0016) | 4 | Uniquely identifies the SOP-Class. See Section C.12.1.1.1 for further explanation. See also PS3.4. |
| SOP-Instance-UID | (0008,0018) | 4 | Uniquely identifies the SOP Instance. See Section C.12.1.1.1 for further explanation. See also PS3.4. |
| ... | | | |

| Attribute Name | Tag | Type | Attribute Description |
|-------------------------------------|-------------|------|---|
| Timezone Offset From UTC | {0008,0201} | 3 | <p>Contains the offset from UTC to the timezone for all DA and TM Attributes present in this SOP Instance, and for all DT Attributes present in this SOP Instance that do not contain an explicitly encoded timezone offset.</p> <p>Encoded as an ASCII string in the format "&ZZXX". The components of this string, from left to right, are & "+" or "-", and ZZ = Hours and XX = Minutes of offset. Leading space characters shall not be present.</p> <p>The offset for UTC shall be +0000; -0000 shall not be used.</p> <p>Note</p> <ol style="list-style-type: none"> 1.—This encoding is the same as described in PS3.5 for the offset component of the DT Value Representation. 2.—This Attribute does not apply to values with a DT Value Representation, that contains an explicitly encoded timezone offset. 3.—The corrected time may cross a 24 hour boundary. For example, if Local Time = 1.00 a.m. and Offset = +0200, then UTC = 11.00 p.m. (23.00) the day before. 4.—The "+" sign may not be omitted. <p>Time earlier than UTC is expressed as a negative offset.</p> <p>Note</p> <p>For example:</p> <p>UTC = 5.00 a.m.</p> <p>Local Time = 3.00 a.m.</p> <p>Offset = -0200</p> <p>The local timezone offset is undefined if this Attribute is absent.</p> |
| Contributing Equipment Sequence | {0018,A001} | 3 | <p>Sequence of Items containing descriptive attributes of related equipment that has contributed to the acquisition, creation or modification of the composite instance.</p> <p>One or more Items are permitted in this Sequence.</p> <p>See Section C.12.1.1.5 for further explanation.</p> |
| >Purpose of Reference Code Sequence | {0040,A170} | 1 | <p>Describes the purpose for which the related equipment is being referenced.</p> <p>Only a single Item shall be included in this sequence.</p> <p>See Section C.12.1.1.5 for further explanation.</p> |

| Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|---|
| >>Include Table 8.8-1 "Code Sequence Macro Attributes" | | | Defined CID-7005 "Contributing Equipment Purposes of Reference". |
| ... | | | |
| >Contribution-DateTime | (0018,A002) | 3 | The Date & Time when the equipment contributed to the composite instance. |
| >Contribution-Description | (0018,A003) | 3 | Description of the contribution the equipment made to the composite instance. |
| ... | | | |

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XX.6.1.3.2.3 Common Instance Reference

| Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|--|
| Referenced Series Sequence | (0008,1115) | 1C | Sequence of Items each of which includes the Attribute of one Series. One or more Items shall be included in this sequence. Required if this Instance references Instances in this Study. |
| >Series Instance UID | (0020,000E) | 4 | Unique identifier of the Series containing the referenced Instances. |
| >Referenced Instance Sequence | (0008,114A) | 1 | Sequence of Items each providing a reference to an Instance that is part of the Series defined by Series Instance UID (0020,000E) in the enclosing Item. One or more Items shall be included in this sequence. |
| >>Include Table 10-11 "SOP Instance Reference Macro Attributes" | | | |
| Studies Containing Other Referenced Instances Sequence | (0008,1200) | 1C | Sequence of items each identifying a Study other than the Study of which this Instance is a part, which Studies contain Instances that are referenced elsewhere in this Instance. One or more Items shall be included in this sequence. Required if this Instance references Instances in other Studies. |
| >Study Instance UID | (0020,000D) | 4 | Unique identifier of the Study containing the referenced Instances. |
| >Include Table 10-4 "Series and Instance Reference Macro Attributes" | | | |

Commented [CvWW82]: References the Image series the object is related to.

PUT in the functional-groups for the parametric map.

Copy for second parametric map.

500

~~Blending object needs to be defined and also have the example here.~~

Commented [CvWW83]: New object.

~~Table C.11.14-1. Presentation State Blending Module Attributes~~

| Attribute Name | Tag | Type | Attribute Description |
|---|-------------|------|---|
| Blending-Sequence | (0070,0402) | 4 | <p>A Sequence of Items, one identifying and describing transformations upon a set of underlying grayscale images, and the other identifying and describing transformations upon a set of superimposed grayscale images.</p> <p>Two Items shall be included in this sequence.</p> <p>See Section C.11.14.1.1.</p> |
| >Blending-Position | (0070,0405) | 4 | <p>Whether or not the contents of the represent the superimposed or underlying image set.</p> <p>Enumerated Values: SUPERIMPOSED — UNDERLYING</p> |
| >Study Instance-UID | (0020,000D) | 4 | <p>Unique identifier for the Study that contains the images, which may differ from the Study in which the presentation state is contained.</p> |
| >Include Table C.11.11-1b "Presentation State Relationship Macro Attributes" | | | |
| >Include Table C.11-1b "Modality LUT Macro Attributes" if a Modality LUT is to be applied to referenced image(s). | | | |
| >Softcopy-VOILUT-Sequence | (0028,3110) | 4C | <p>Defines a sequence of VOILUTs or Window Centers and Widths and to which images and frames they apply.</p> <p>No more than one VOILUT Sequence containing a single item or one pair of Window Center/Width values shall be specified for each image or frame.</p> <p>One or more Items shall be included in this sequence.</p> |

Commented [CvWW84]: Can we extend the number of overlays, or should that be a sequence of blending objects. Order of overlays is significant. WG06. Threshold per parametric map is needed as these can have different types and values

Commented [CvWW84]: Can we extend the number of overlays, or should that be a sequence of blending objects. Order of overlays is significant. WG06. Threshold per parametric map is needed as these can have different types and values

| Attribute Name | Tag | Type | Attribute Description |
|--|-------------|------|---|
| | | | Required if a VOI LUT is to be applied to referenced image(s). |
| >>Referenced Image Sequence | (0008,1140) | 4C | Sequence of Items identifying images that are defined in the enclosing Item of Blending Sequence (0070,0402), to which this VOI LUT or Window Center and Width applies. One or more Items shall be included in this sequence. Required if the VOI LUT transformation in this Item does not apply to all the images and frames in the enclosing Item of Blending Sequence (0070,0402). |
| >>>Include Table 10-3 "Image SOP Instance Reference Macro Attributes" | | | |
| >>Include Table C.11-2b "VOI LUT Macro Attributes" | | | |
| Relative Opacity | (0070,0403) | 4 | A value from 0.0 to 1.0 indicating the relative opacity of the pixels of the superimposed image, where 1.0 means that pixels of the superimposed image completely replace the pixels of the underlying image, and 0.0 means that the pixels of the underlying image completely replace the pixels of the superimposed image. See PS3.4 for a detailed description of the blending operation. |
| Referenced Spatial Registration Sequence | (0070,0404) | 3 | A reference to Spatial Registration Instances that may be used to register the underlying and superimposed images. One or more Items are permitted in sequence. Note A Spatial Registration Instance may identify registration between frames of reference, or between explicitly identified images. In the latter case, the list of images referenced by the Presentation State, not the list of images referenced by the Spatial Registration Instance, are to be blended. |
| >>>Include Table C.17-3 "Hierarchical SOP Instance Reference Macro Attributes" | | | |

Commented [CvWW85]: on map level
Commented [CvWW85]: on map level

Commented [CvWW86]: How flexible do we want to be here, restrict to MR or e.g. in other modalities. Registration is used and should be possible.
Commented [CvWW86]: How flexible do we want to be here, restrict to MR or e.g. in other modalities. Registration is used and should be possible.

505 ~~Graphic overlay IS NEEDED BUT NOT required~~

~~How to standardize the Color scale information. This would be needed on Parametric map level, how this is displayed is up to the display system but is will be recommended to be able to switch between the different scales.~~

~~Spatial transformation is not needed.~~

510 ~~Graphic group not sure.~~

~~Color information needs to be a sequence as Parametric MAP has no color information for the float objects.~~

~~ICC profile also not needed~~

~~Displayed area will be present, typically it will be the complete image.~~

515 ~~Might look at MultiPlanar PS.~~

~~XX.6.2 Case #2: Description of use case~~

~~As example for the objects created and there specific content we use the use case of a patient up for surgery and for this it is needed to identify the motor strip.~~

~~Procedure order delivers the plan for the Acquisition where a paradigm is created which will be acquired with only 5 volumes. The acquired data will be stored in two Enhanced MR objects, and a Parametric Map with a single threshold range.~~

~~Showing the main content of the Enhanced objects related to the fMRI acquisition, which are the important parameters.~~

~~XX.6.2.1 User scenario~~

525 **~~XX.6.2.2 Encoding outline~~**

~~XX.6.2.3 Encoding details~~

~~XX.6.2.3.1 Enhanced MR Image IOD~~

~~XX.6.2.3.2 Parametric Map IOD~~

530

Commented [CvWW87]: Is two use cases enough or are there more variations that we need to show. Do we have more (than 2) variations in the Parametric Map that we need to show?

Commented [CvWW88]: Describe use case