

# DICOM US Image

Advanced Technology Consortium

for Clinical Trials Quality Assurance

John W. Matthews, D.Sc.

# US Image IOD Modules

IE	MODULE	Usage
Patient	Patient	M
	Clinical Trial Subject	U
Study	General Study	M
	Patient Study	U
Series	RT Series	M
Frame of Reference	Frame of Reference	M
	US Frame of Reference	C – Required if images are spatially related
Equipment	General Equipment	M
Image	General Image	M
	Image Pixel	M
	Contrast/bolus	C – Required if contrast media was used in image
	Palette Color Lookup Table	C – Required if Photometric Interp. is PALLETTE COLOR
	US Image	M
	Overlay Plane	U
	VOI LUT	U
	SOP Common	M

# US Frame of Reference Module

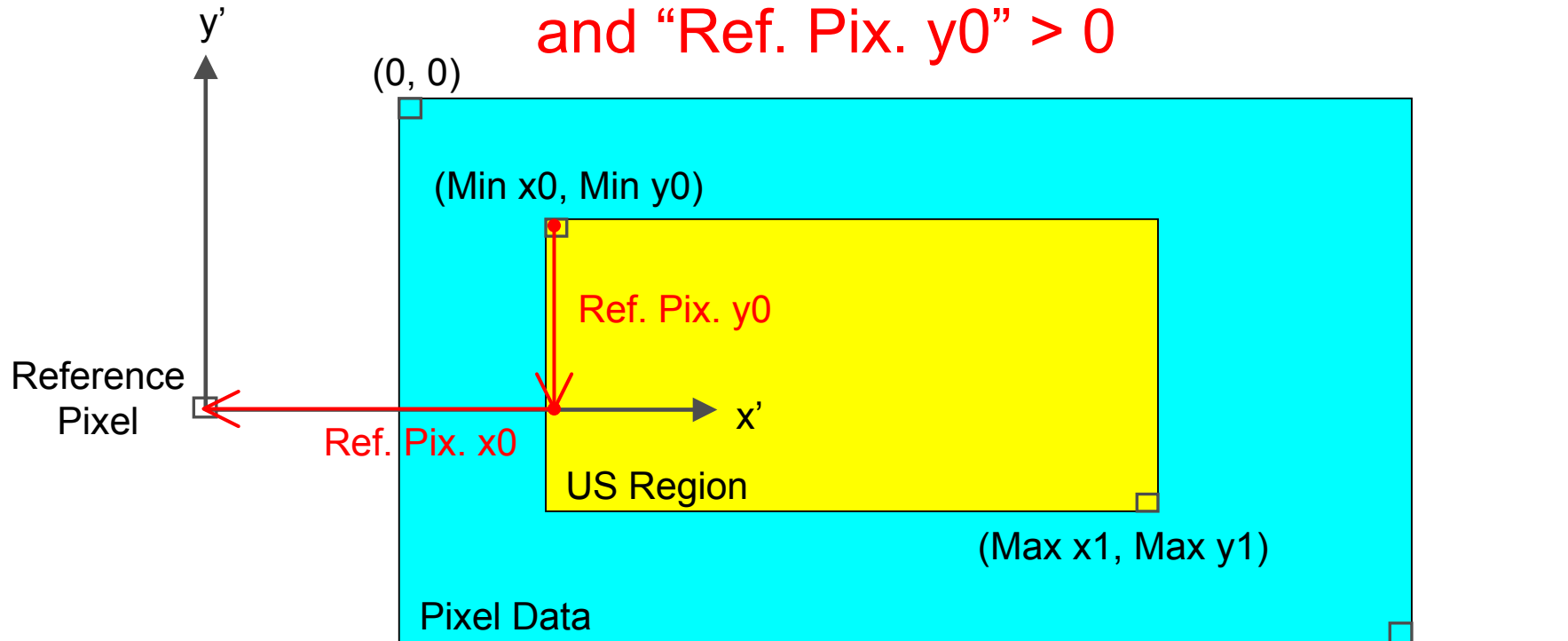
Field	Tag	Type	Comments
Region Location Min x0	(0018,6018)	1	Suggest 0
Region Location Min y0	(0018,601A)	1	Suggest 0
Region Location Max x1	(0018,601C)	1	Suggest "Columns" - 1
Region Location Max y1	(0018,601E)	1	Suggest "Rows" - 1
Physical Units X Direction	(0018,6024)	1	Must be "0003H" meaning cm
Physical Units Y Direction	(0018,6026)	1	Must be "0003H" meaning cm
Physical Delta X	(0018,602C)	1	X pixel size in cm
Physical Delta Y	(0018,602E)	1	Y pixel size in cm
Reference Pixel x0	(0018,6020)	3	Required; suggest 0; assumed to be 0, if not present  (Type should be 1C, see C.8.5.6.1.9)
Reference Pixel y0	(0018,6022)	3	Required; suggest 0; assumed to be 0, if not present  (Type should be 1C, see C.8.5.6.1.9)

# US Image Module

Field	Tag	Type	Comments
Samples per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Bits Allocated	(0028,0100)	1	8
Bits Stored	(0028,0101)	1	8
High Bit	(0028,0102)	1	7
Pixel Representation	(0028,0103)	1	Unsigned Integer
Image Type	(0008,0008)	2	
Image Transformation Matrix	(0018,5210)	3	Required by ITC [1, 0, 0] [0, -1, 0] for supine viewed from foot
Image Translation Vector	(0018,5212)	3	Required by ITC [Xt,Yt,Zt] (in mm) coordinates of the "Reference Pixel" in patient space

# US Region Location

As drawn "Ref. Pix. x0" < 0  
and "Ref. Pix. y0" > 0



$$0 \leq \text{Min } x0 < \text{Max } x1 \leq \text{Columns}-1$$

(Columns-1, Rows-1)

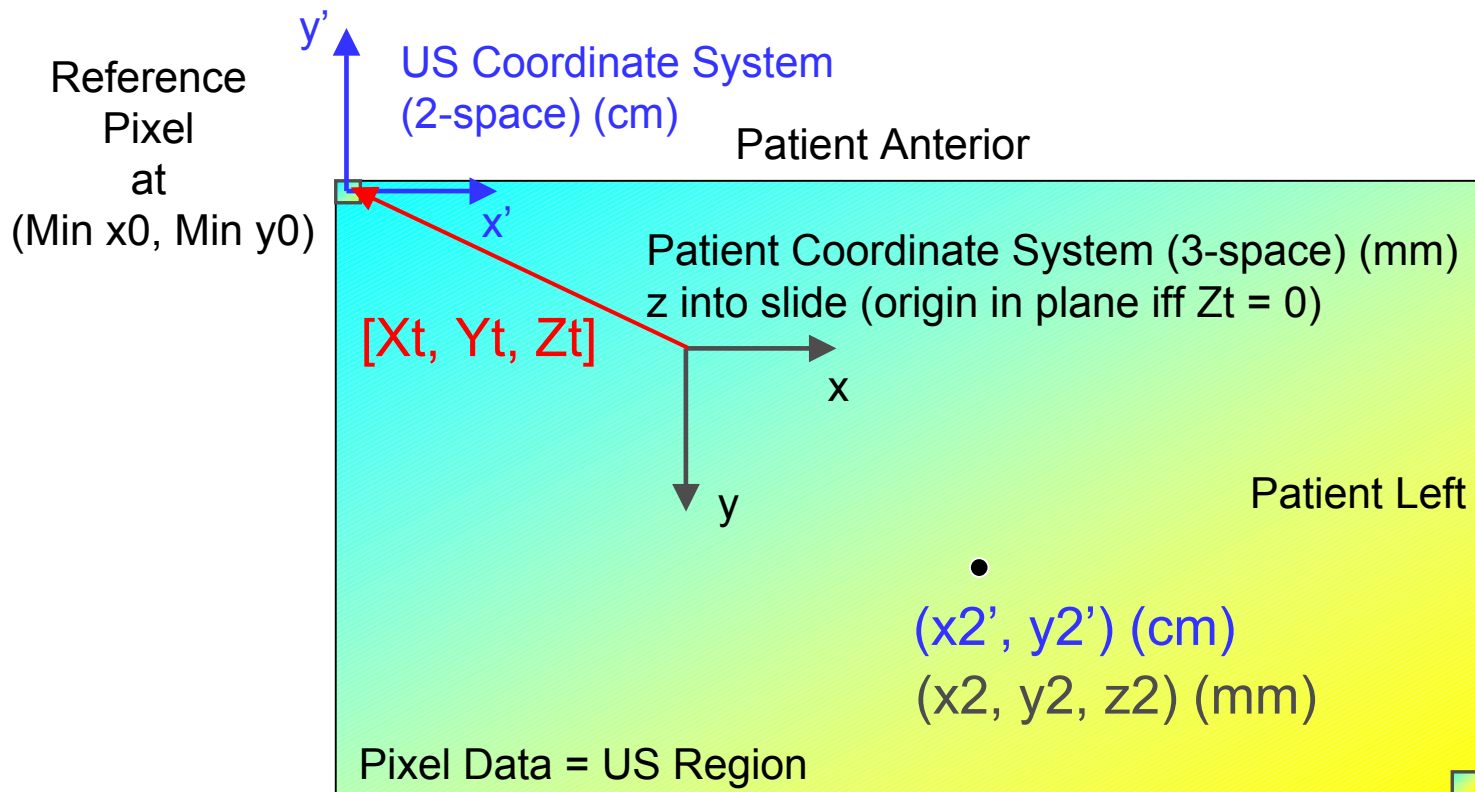
$$0 \leq \text{Min } y0 < \text{Max } y1 \leq \text{Rows}-1$$

N.B., all but  $x', y'$  are integer pixel counts

# Suggested US coordinate system

- Use (the center of) upper left pixel as the origin of the  $x', y'$  US Image coordinate system
  - Min  $x_0 = \text{Min } y_0 = 0$
  - Reference Pixel  $x_0 = \text{Reference Pixel } y_0 = 0$
- Translation Vector specifies the patient-space coordinates of (the center of) the Reference Pixel
- Transformation Matrix Rotates Pixel plane to patient coordinate system
  - Use  $[1, 0, 0] [0, -1, 0]$  for supine viewed from foot

# Diagram of Suggested US system



$$\begin{aligned}
 x_2 &= 10 (x_2') + X_t && (\text{Max } x_1, \text{Max } y_1) \\
 y_2 &= 10 (-y_2') + Y_t \\
 z_2 &= Z_t
 \end{aligned}$$

# Specialization of Image Pixel Attributes in Modules

Attribute	CT Image	MR Image	US Image	RT Dose	RT Image
Samples per Pixel	1	1	1 or 3	1	1
Photometric Interpretation	MONOCROME2, MONOCHROME1	MONOCROME2, MONOCHROME1	MONOCROME2, RGB ...	MONOCROME2	MONOCROME2
Bits Allocated	16	16	8 or 16	16 or 32	8 or 16
Bits Stored	12 to 16	not specialized	8 or 16	16 or 32	8 or 16
High Bit	Bits Stored - 1	not specialized	Bits Stored - 1	Bits Stored - 1	Bits Stored - 1
Pixel Representation	not specialized	not specialized	Unsigned Integer	Unsigned Integer	Unsigned Integer

Red indicates ITC requirements