

# Tech4Imaging Training

36-Channel Electrical Capacitance  
Volume Tomography Data Acquisition  
System and Image Reconstruction  
Software

# Tomography

Sectioning of a volume by means of a penetrating wave. Produces image of a cross-section in volume.

- **Radiology** – X-rays through volume (radiation concerns)
- **Computer-Assisted Tomography (CAT)** – Computer-processed x-rays (radiation, expensive)
- **Magnetic Resonance Imaging (MRI)** – Magnetically-disturbed atoms scanned (expensive, large)
- **Positron Emission Tomography (PET)** – Gamma ray detection for 3-D imaging (ionizing radiation)
- **Electrical Capacitance Tomography (ECT)** – Electric field disturbances analyzed for 2-D imaging
- **Electrical Capacitance Volume Tomography (ECVT)** – ECT with 3-D imaging capabilities

# Electrical Capacitance Volume Tomography (ECVT)

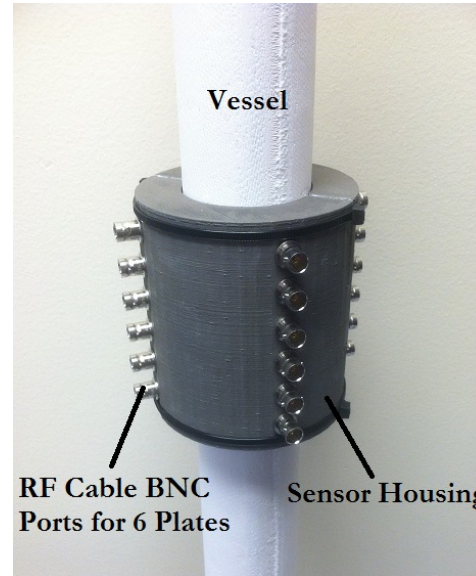
- Array of capacitor plates
- Real-time capacitance measurements reconstructed into image
- Multi-phase flow systems and volumes
- ECVT includes 3-dimensional image reconstruction

# Benefits of ECVT

- Non-invasive, non-interfering tomography
- Affordable
- Designable for varying systems and vessel sizes
- Quick image reconstruction
- Runs on standard host PC
- Provides 3-D image of volume
- High space and time resolutions (milliseconds between images)

# Tech4Imaging ECVT Data Acquisition System

- Unique capacitance sensor with up to 36 plates
- DAS-2 intermediary device between sensor and host PC
- USB connection to host PC
- All analysis and reconstruction occurs on PC



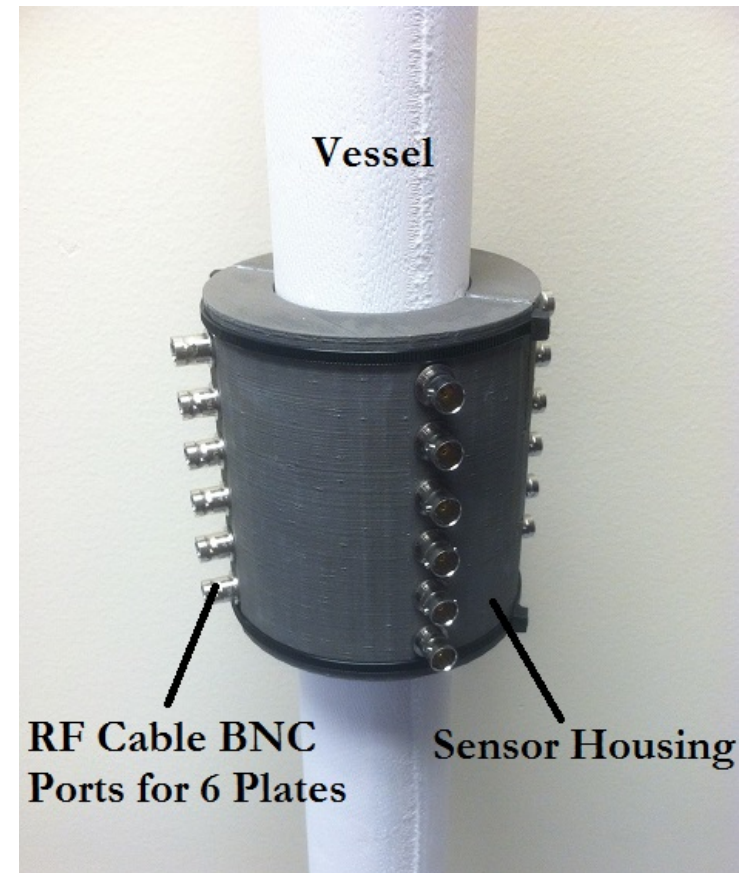
**ECVT Sensor**



**DAS-2 Device**

# ECVT Sensor

- Capacitance plates wrapped around vessel inside sensor housing
- Common sensors have 12, 24, or 36 plates
- Plates connect to DAS-2 with RF cables



# Data Acquisition System-2

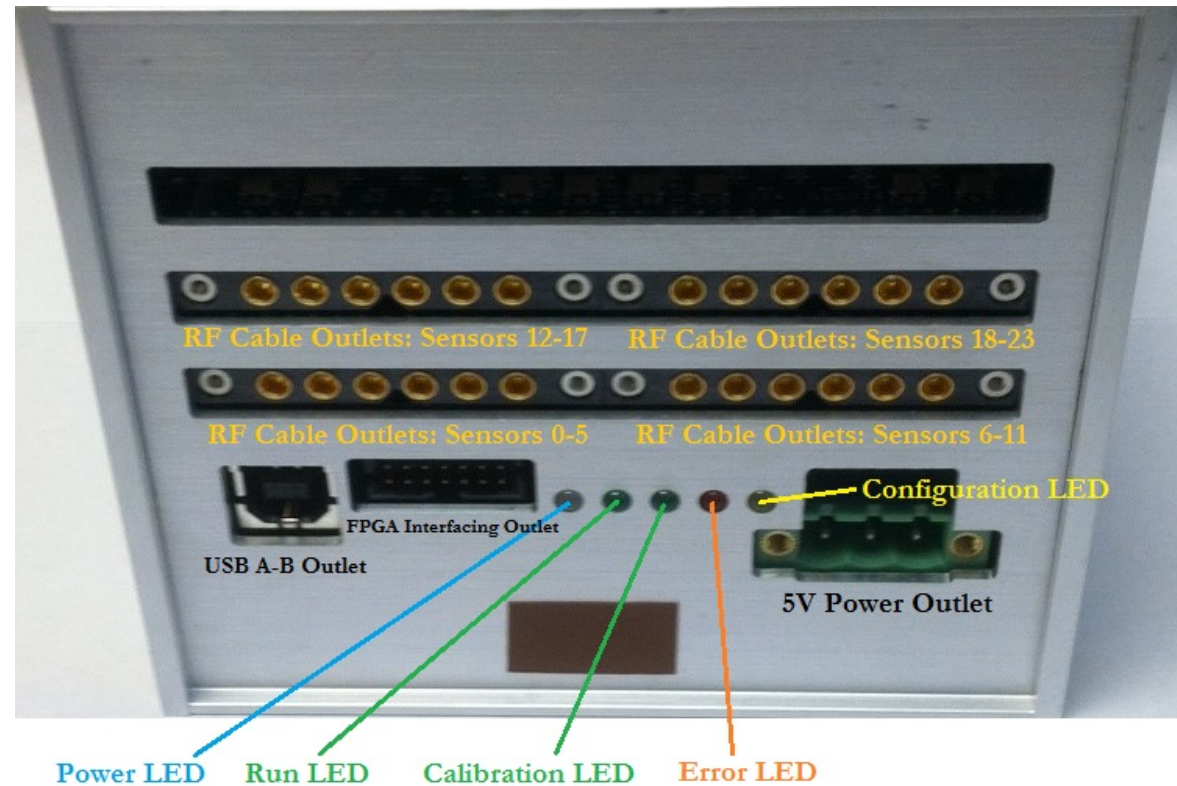
- Drives AC signals to and receives measurements from capacitor plates
- Uses USB to communicate with host computer
- Dynamic Link Library usage
- 5-Volt power source
- Download software on CD to host PC





# Data Acquisition System-2

- ECVT plate connections in groups of 6
- Three 12-plate receiver cards may be installed
- LEDs indicate power, run, and calibration status of DAS-2





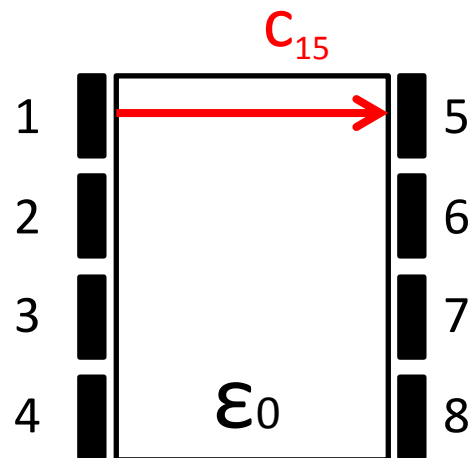
# Data Acquisition System-2

- Capacitance Reading Range: 1.1 fF ( $10^{-15}$  F) to 11 pF ( $10^{-12}$  F), 1 fF resolution
- Relative Permittivity Range: 0.01 to 100 (Dynamic ratio of 1 to 10,000)
- Typical Measurement Time: 18.1  $\mu$ s ( $10^{-6}$  s)
- For 24-plate setup, typical operating speed is 200 frames/second
- Receiver cards work in parallel to increase speed

# Capacitance Measurements

DAS-2 Measurement Process (for  $c_{15}$ ):

1. Send 2 MHz AC signal to driver plate (Plate 1)
2. Receive AC signal from excite plate (Plate 5)
3. Modulate and process excite plate signal to determine capacitance

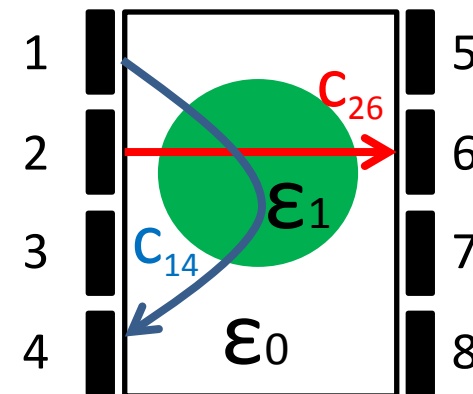
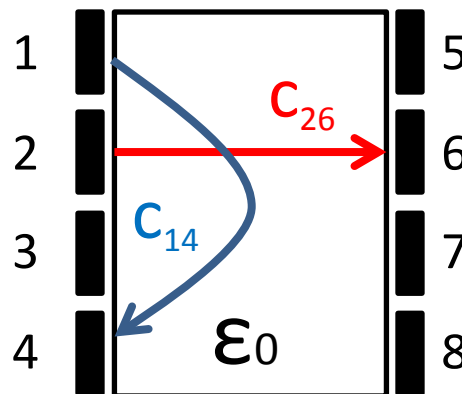


# Capacitance Measurements

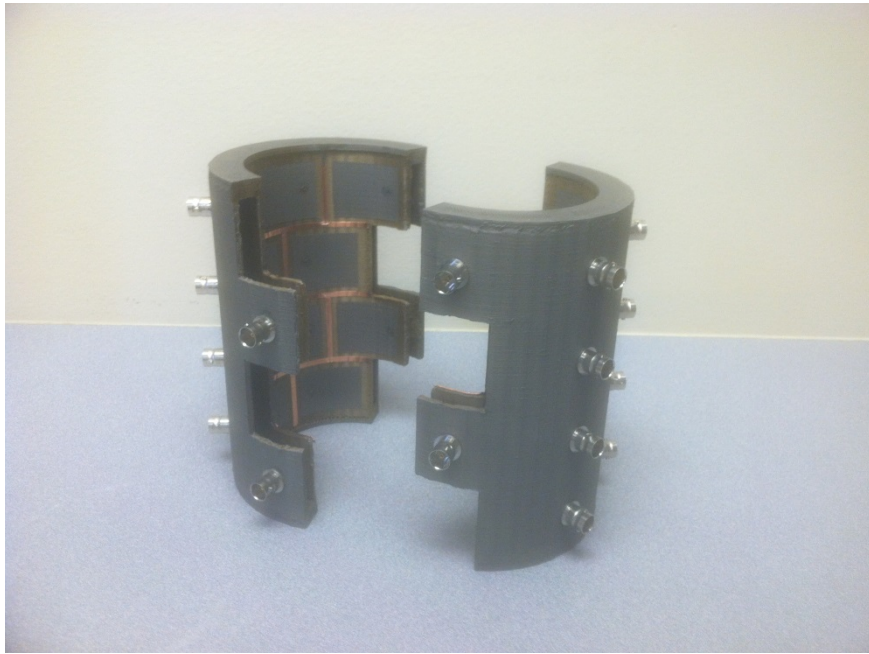
- For an n-plate sensor, the number of unique plate pairs (channels) M is given by:

$$M = \frac{n \times (n - 1)}{2}$$

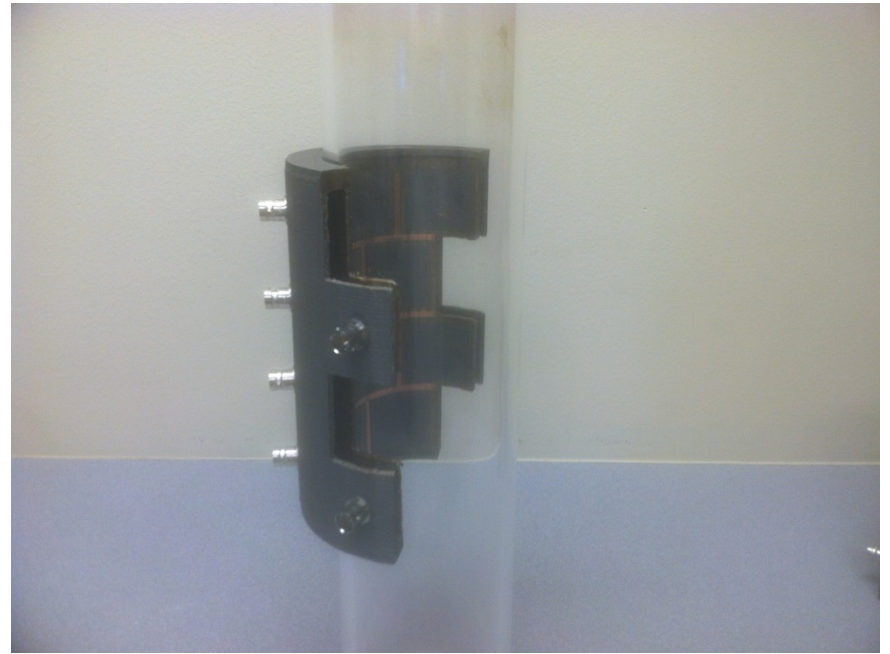
- Vertically-distant plates (farther than 5 cm) have low signal-to-noise ratios
- $c_{14}$  will not differentiate the presence of new objects inside sensor volume
- Such channels are not used in image reconstruction (channel vector rejects these plate pairs)



# Equipment Connections

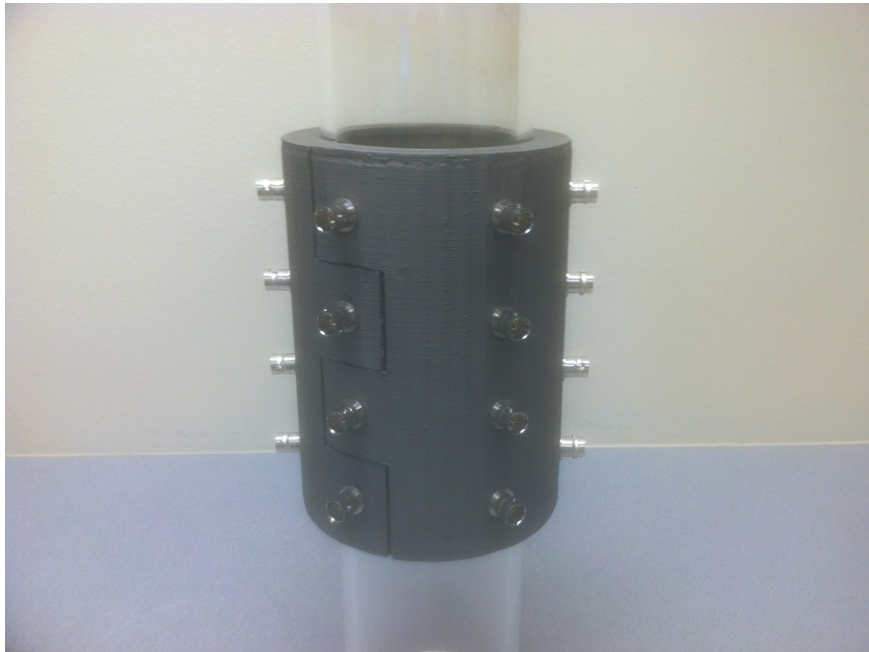


**24-Plate ECVT Sensor Halves**

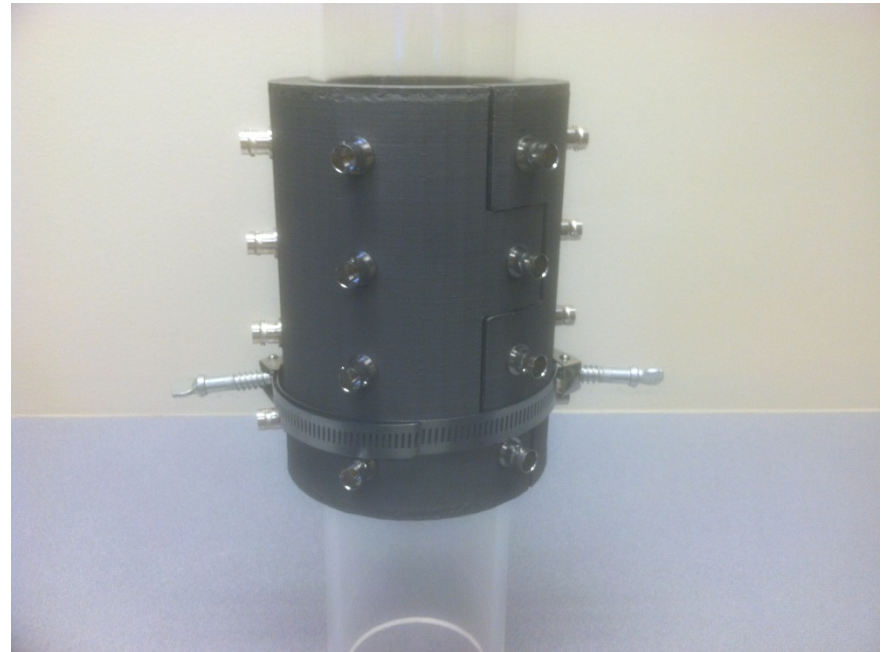


**Sensor Half around Vessel**

# Equipment Connections



**Full Sensor around Vessel**



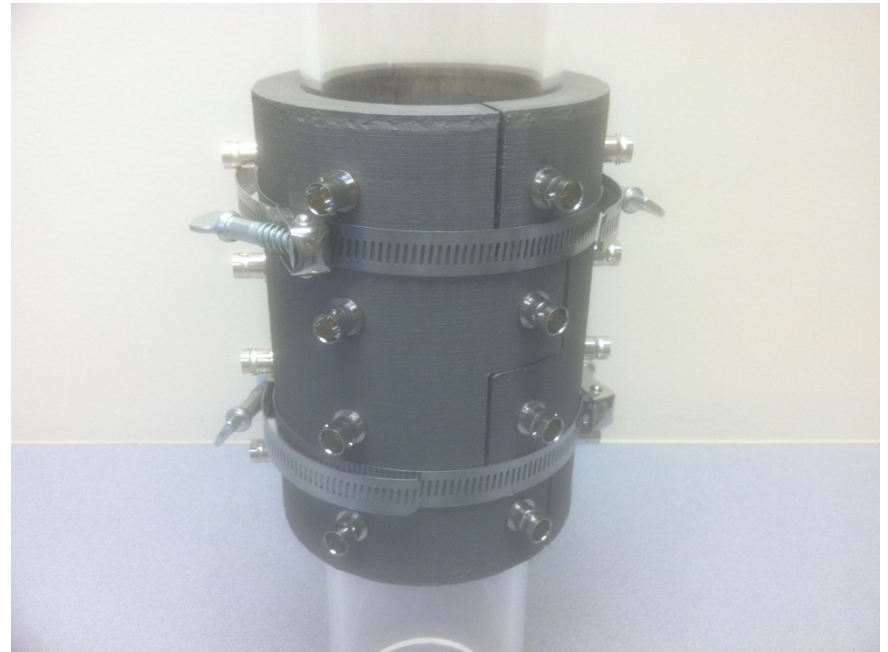
**Metal Cable Tie around Sensor**



# Equipment Connections



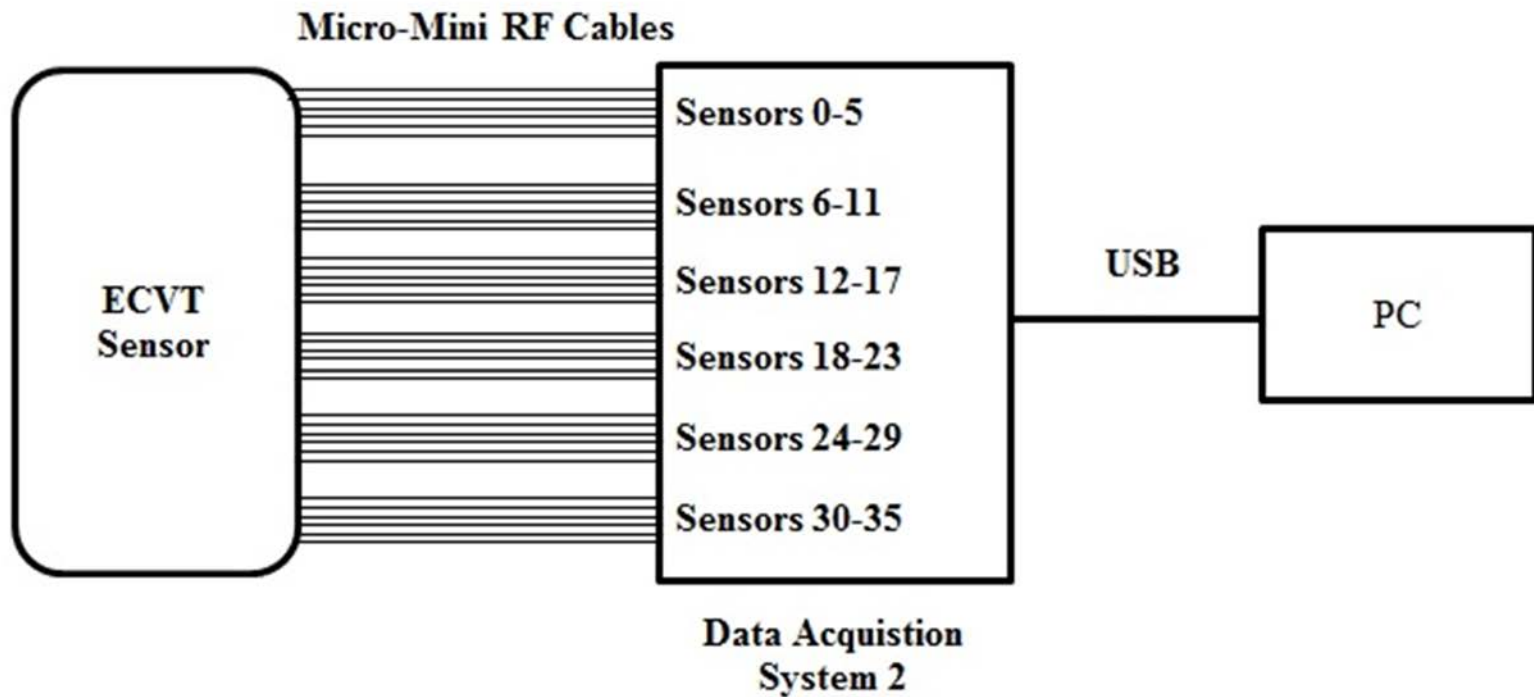
**Fastened Cable Tie**



**Fully-Attached Sensor**



# Equipment Connections



# Data Acquisition Software

The screenshot displays the Data Acquisition Software interface, organized into several functional panels:

- Initialization Panel:** Contains buttons for 'INIT', 'New Calibration', 'Save Calibration File', 'Reload Calibration', 'New Normalization', 'Reload Normalization', 'EEPROM->LUTS', and 'LUTS->EEPROM'.
- Status Panel:** Displays system information: 'Number of plates is set to: 6', 'FPGA Version: 6', and 'SW Version: 2.8'.
- Image Reconstruction Panel:** Features a radio button for 'Plot Image Reconstruction' and a red 'EXIT' button.
- Capacitance Data Panel:** A graph with 'Cap Reading' on the y-axis (ranging from -0.2 to 1.8) and 'Bin Number' on the x-axis (ranging from 1 to 15). The plot shows a flat line at zero across all bins.
- Controls Panel:** Includes a 'Test Duration' section with radio buttons for 'Count' and 'Time' (selected), and a 'Capture Time' input set to 1000. It also has 'Cap. Cycles' (6), 'Driver Amplitude' (100), and 'Analog Wait Time' (20.00) inputs. The 'Excite Attenuation' section has radio buttons for 1.0 (selected), 0.1, and 0.01. Other options include 'Disable Real-Time Plots', 'Log to file', and 'Normalize'. A 'Start' button is green and a 'Stop' button is red. The 'Cap. Measure Time' is 'Static Text'. Performance metrics show 'Frame Count' (798), 'Time Elapsed' (2.7 sec), and 'Frame Rate' (294.5). A 'Logging Data Normalized' checkbox is checked. Action buttons include 'Plot Log File' and 'Save to .mat File'. An 'FPGA Reset' radio button is also present.

# Calibration

- System must be calibrated for the types of materials to be seen in a measurement
- Three options for calibration:
  1. Perform new calibration
  2. Reload a saved calibration
  3. Load calibration values from device EEPROM

# Calibration

### Initialization

INIT

1 New Calibration Save Calibration File

2 Reload Calibration

New Normalization Reload Normalization

3 EEPROM->LUTS LUTS->EEPROM

### Status

Number of plates is set to: 6


FPGA Version: 6

SW Version: 2.8

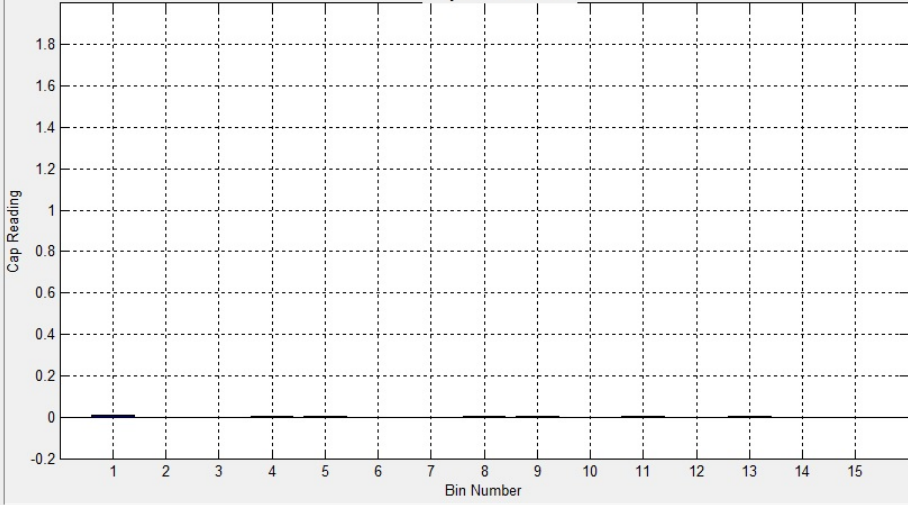
### Image Reconstruction

Plot Image Reconstruction

EXIT



### Capacitance Data



Bin Number	Cap Reading
1	0.02
2	0.01
3	0.01
4	0.01
5	0.01
6	0.01
7	0.01
8	0.01
9	0.01
10	0.01
11	0.01
12	0.01
13	0.01
14	0.01
15	0.01

### Controls

Test Duration:  Count  Time (1000)

Cap. Cycles: 6 Driver Amplitude: 100

Analog Wait Time: 20.00

Excite Attenuation:  1.0  0.1  0.01

Disable Real-Time Plots  Log to file  Normalize

Cap. Measure Time: Static Text  FPGA Reset

Start

Stop

Frame Count: 798 Time Elapsed: 2.7 sec Frame Rate: 294.5

Logging Data Normalized

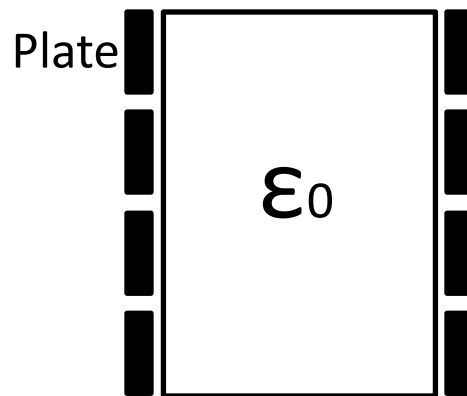
Plot Log File Save to .mat File

# New Calibration

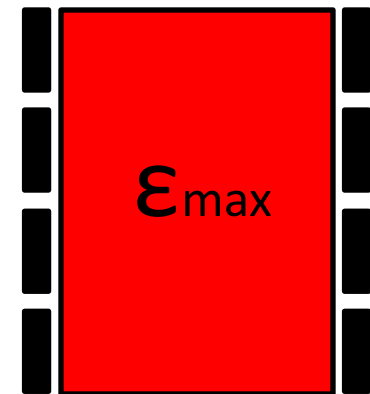
1. Select “New Calibration”
2. Input number of capacitor plates
3. Fill vessel with air or vacuum to calibrate minimum capacitance
4. Fill vessel with highest-dielectric material to calibrate maximum capacitance
5. Save calibration file if desired

\*May take up to 30 minutes

\*\*The orange “Error” LED on the DAS-2 front panel will be lit if calibration cannot be performed. Usually this is can be corrected by setting the Driver Amplitude to a lower value.



Step 3



Step 4

# Normalization

- Host computer must be normalized to the range of expected capacitance readings
- Three options for normalization:
  1. Perform new normalization
  2. Reload a saved normalization
  3. Load normalization values from device EEPROM



# Normalization

**Initialization**

INIT

New Calibration Save Calibration File

Reload Calibration

1 New Normalization 2 Reload Normalization

3 EEPROM->LUTS LUTS->EEPROM

**Status**

Number of plates is set to: 6

FPGA Version: 6

SW Version: 2.8

**Image Reconstruction**

Plot Image Reconstruction

EXIT

**TECH 4IMAGING**

**Capacitance Data**

Cap Reading

Bin Number

**Controls**

Test Duration

Count Capture Time

Time 1000

Cap. Cycles: 6 Driver Amplitude: 100

Analog Wait Time: 20.00

Excite Attenuation

1.0

0.1

0.01

Disable Real-Time Plots

Log to file

Normalize

Start

Stop

Cap. Measure Time: Static Text

FPGA Reset

Frame Count: 798

Time Elapsed: 2.7 sec

Frame Rate: 294.5

Plot Log File

Save to .mat File

Logging Data Normalized

# Normalization

- Calibration determines minimum and maximum capacitances for each plate pair
- Normalization converts each plate pair reading to a percentage of its range:

$$C_{pair} = \frac{\text{measured value} - \text{empty value}_{pair}}{\text{full value}_{pair} - \text{empty value}_{pair}}$$

- Allows comparison of different plate pair readings

# Data Acquisition

Set test parameters for data acquisition:

- **Test Duration** (Num. of Frames or Time in Secs.)
- **Capacitance Measurement Duration** (Num. of Cycles)
- **Driver Signal Amplitude (%)**
- **Wait Period between Measurements** ( $\mu$ secs.)
- **Excite Signal Attenuation**

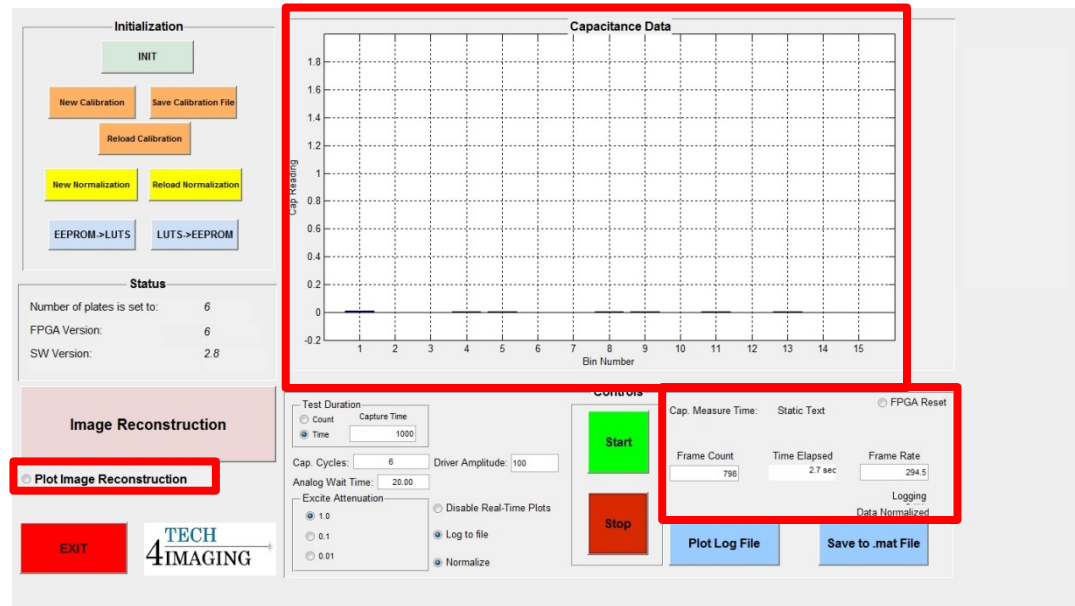
The screenshot displays the software interface for data acquisition, divided into several functional panels:

- Initialization:** Contains buttons for 'INIT', 'New Calibration', 'Save Calibration File', 'Reload Calibration', 'New Normalization', 'Reload Normalization', 'EEPROM->LUTS', and 'LUTS->EEPROM'.
- Status:** Displays system information: 'Number of plates is set to: 6', 'FPGA Version: 6', and 'SW Version: 2.8'.
- Image Reconstruction:** Includes a 'Plot Image Reconstruction' checkbox and a red 'EXIT' button.
- Capacitance Data:** A graph titled 'Capacitance Data' with 'Cap. Reading' on the y-axis (ranging from -0.2 to 1.8) and 'Bin Number' on the x-axis (ranging from 1 to 15). The plot area is currently empty.
- Controls:** A central panel with a red border containing:
  - Test Duration:** Radio buttons for 'Count' and 'Time' (selected), with a 'Capture Time' input field set to 1000.
  - Cap. Cycles:** Input field set to 6.
  - Driver Amplitude:** Input field set to 100.
  - Analog Wait Time:** Input field set to 20.00.
  - Excite Attenuation:** Radio buttons for 1.0 (selected), 0.1, and 0.01.
  - Disable Real-Time Plots:** A checkbox.
  - Log to file:** A checked radio button.
  - Normalize:** A checked radio button.
- Start/Stop:** A green 'Start' button and a red 'Stop' button.
- Monitoring:** 'Cap. Measure Time' (Static Text), 'FPGA Reset' checkbox, 'Frame Count' (798), 'Time Elapsed' (2.7 sec), and 'Frame Rate' (294.5).
- Export:** 'Plot Log File' and 'Save to .mat File' buttons.
- Logging:** 'Logging Data Normalized' checkbox.

# Data Acquisition

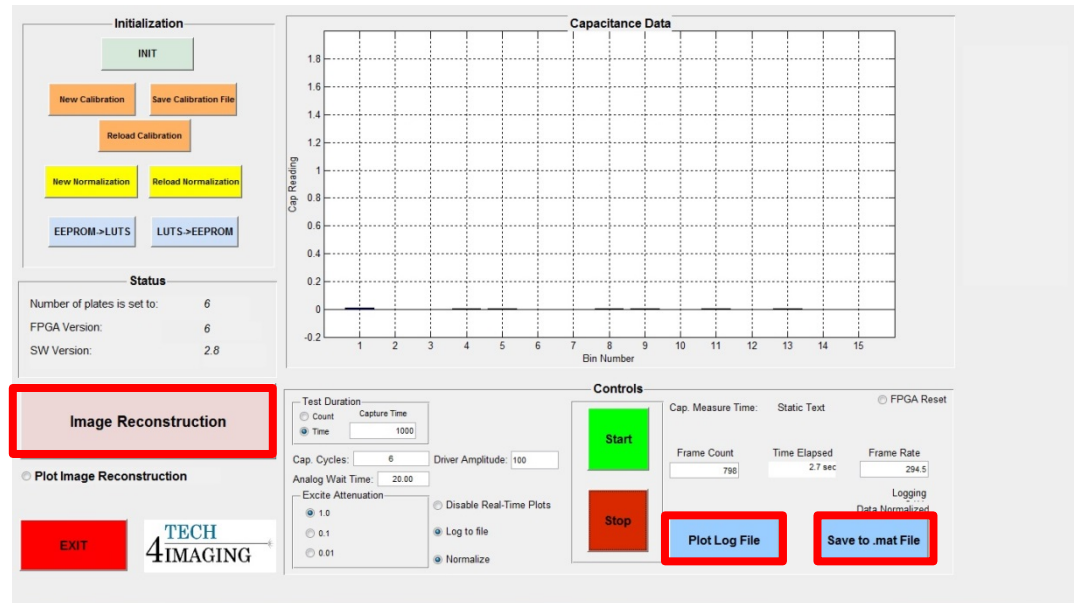
Begin test and observe collected data:

- Display capacitance readings for each plate in real time
- Can also display rough reconstructed images in real time (slows down acquisition)
- Displays frames captured, run time, frame rate
- Shows logging status and location



# Data Acquisition

- **Plot Log File**- shows evolution of capacitances over test
- **Save to .mat File**- saves all data frames for later reconstruction
- **Image Reconstruction**- opens new interface



# Image Reconstruction Software

**4 TECH IMAGING**

Load Data

Sensitivity Matrix:   Reconstruction Mode:

Data Vectors:

Reconstruction Method:  Alpha:  Iterations:

Color Bar Min:  Color Bar Max:  Isosurface Value:

Sensitivity Matrix: Total Channels:  Pixels/Channels:

Capacitance Matrix: Frames:  Capacitance Sensor:

Plotting Parameters: Frame Range (min):  Frame Range (max):  Reconstruction Step:  Go to Frame #:

Current Frame:

The software interface displays four views of a reconstructed capacitor: X-Z plane, Y-Z plane, X-Y planes, and an Isometric View. Each view shows a color-coded intensity map. The X-Z and Y-Z planes are 2D cross-sections, while the X-Y planes and Isometric View are 3D representations. A color bar below each view indicates intensity from 0.4 (blue) to 1.0 (red). The Isometric View shows the capacitor's top and bottom plates and the dielectric between them.



# Sensitivity Matrix

- Determines relationship between sensor plates and changes in capacitance
- Studied volume divided into many small volumes (voxels)
- Matrix shows each plate pair response to capacitance change in each voxel
- Used in reconstruction algorithms to relate data to image

# Loading Data

1. Select “Plot Data” as current mode
2. Select sensitivity matrix
3. Select previously-saved capacitance data vector
4. Select channel vector

The screenshot displays the 'Load Data' section of the TECH 4 IMAGING software. The interface includes a logo at the top center. Below the logo, there are several input fields and buttons for loading data. A red box highlights the 'Sensitivity Matrix' field, which contains the path 'C:\Users\Rami.tech4imaging\Desktop\Chris\_Z\Task2\Task2\FB\_24plates\_4P\_NoEdge\_20\_Full.nsm.mat' and a 'Browse' button. To the right of this field is a 'Reconstruction Mode' dropdown menu set to 'Plot Data'. Below this, another red box highlights the 'Data Vectors' field, which contains the path 'C:\Users\Rami.tech4imaging\Desktop\Chris\_Z\Task2\Task2\WC\_ba' and a 'Browse' button. To the right of this field is another 'Data Vectors' field containing the path 'C:\Users\Rami.tech4imaging\Desktop\Chris\_Z\Task2\Task2\chx\FB4' and a 'Browse' button. Below these fields, there are several other controls: 'Reconstruction Method' set to 'LBP', 'Alpha' set to 0.50, 'Iterations' set to 50, 'Color Bar Min' set to 0.34, 'Color Bar Max' set to 1, and 'Isosurface Value' set to 0.2933. At the bottom, there are two sections: 'Sensitivity Matrix' with 'Total Channels' set to 276 and 'Pixels/Channels' set to 8000, and 'Capacitance Matrix' with 'Frames' set to 101 and 'Capacitance Sensor' set to 276. Red numbers 1, 2, 3, and 4 are overlaid on the interface to indicate the steps described in the list above.

TECH  
4 IMAGING

Load Data

Sensitivity Matrix: C:\Users\Rami.tech4imaging\Desktop\Chris\_Z\Task2\Task2\FB\_24plates\_4P\_NoEdge\_20\_Full.nsm.mat Browse Reconstruction Mode: Plot Data

Data Vectors: C:\Users\Rami.tech4imaging\Desktop\Chris\_Z\Task2\Task2\WC\_ba Browse C:\Users\Rami.tech4imaging\Desktop\Chris\_Z\Task2\Task2\chx\FB4 Browse

Reconstruction Method: LBP Alpha: 0.50 Iterations: 50

Color Bar Min: 0.34 Color Bar Max: 1 Isosurface Value: 0.2933

Sensitivity Matrix: Total Channels: 276 Pixels/Channels: 8000

Capacitance Matrix: Frames: 101 Capacitance Sensor: 276

# Reconstruction Methods

Three methods are available for image reconstruction:

1. **Linear Back Projection (LBP)** – Fastest, least accurate
2. **Landweber Iteration** – Slower, more accurate
3. **3-D Neural Network Multicriterion Optimization Image Reconstruction Technique (NNMOIRT)** – Slowest, most accurate

Method Parameters:

- **Alpha**
  - Landweber Method
  - Sets step size
  - Between 0 and 1
- **Iterations**
  - Landweber and NNMOIRT Methods
  - Determines iteration count for algorithm
  - Positive integer

The screenshot displays the TECH 4IMAGING software interface. At the top, the logo 'TECH 4IMAGING' is visible. Below it, the 'Load Data' section includes fields for 'Sensitivity Matrix' and 'Data Vectors', both with 'Browse' buttons. The 'Reconstruction Method' is set to 'LBP', with 'Alpha' at 0.50 and 'Iterations' at 50. Other parameters include 'Color Bar Min' (0.34), 'Color Bar Max' (1), and 'Isosurface Value' (0.2933). The 'Sensitivity Matrix' section shows 'Total Channels' as 276 and 'Pixels/Channels' as 8000. The 'Capacitance Matrix' section shows 'Frames' as 101 and 'Capacitance Sensor' as 276. On the right, 'Plotting Parameters' are set to 'Frame Range (min)' 40, 'Frame Range (max)' 50, and 'Reconstruction Step' 1. The 'Go to Frame #' is set to 40. A green 'Process' button is prominent, along with navigation buttons '<<' and '>>'. The 'Current Frame' is 45, and there are 'Generate Video', 'Reset', and 'Exit' buttons at the bottom. The main display area shows four 3D visualizations: 'X-Z plane', 'Y-Z plane', 'X-Y planes', and 'Isometric View', each with a corresponding color bar ranging from 0.4 to 1.0.

# Linear Back Projection (LBP)

- Fastest, least accurate method
- One-equation solution:

$$\hat{\mathbf{g}} = \mathbf{S}^T \boldsymbol{\lambda}$$

$\hat{\mathbf{g}}$  = image vector [N terms for N voxels in image]

$\boldsymbol{\lambda}$  = normalized capacitance vector [M terms for M plate pairs]

$\mathbf{S}$  = sensitivity matrix [M x N]

# Landweber Iteration

- Slower but more accurate method
- Image vector equation solved a set number of times:

$$\hat{\mathbf{g}}_{k+1} = \hat{\mathbf{g}}_k - \alpha \mathbf{S}^T (\mathbf{S} \hat{\mathbf{g}}_k - \boldsymbol{\lambda})$$

$k$  = iteration number

$\hat{\mathbf{g}}_k$  =  $k^{\text{th}}$  image vector

$\hat{\mathbf{g}}_0$  = initial condition zero vector = [0,0,0, ... ,0]

$\alpha$  = relaxation factor (Between 0 and 1)

$\boldsymbol{\lambda}$  = normalized capacitance vector [M terms for M plate pairs]

$\mathbf{S}$  = sensitivity matrix [M x N]

- More iterations = longer solving time and more accurate image
- Alpha determines step size between iterations

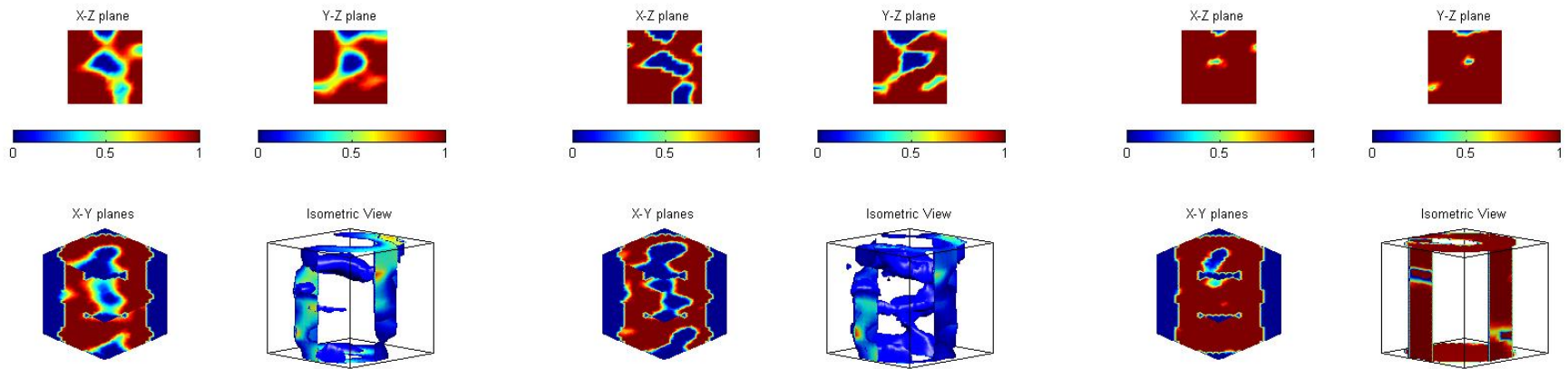
# 3-D Neural Network Multicriterion Optimization Image Reconstruction Technique (NNMOIRT)

- Slowest, most accurate method
- Finds image vector  $\hat{g}$  that simultaneously minimizes four objective functions:
  1. Negative Entropy
  2. Least Square Error
  3. Smoothness and Small-Peakedness
  4. 3D-to-2D Matching
- Enhances quality of 3-D image reconstruction
- Best noise filtering

# Reconstruction Method

## Signal-to-Noise Ratio Effects

### 0 dB SNR



Linear Back Projection  
MSE = 0.4729

Landweber\*<sup>†</sup>  
MSE = 1.1794

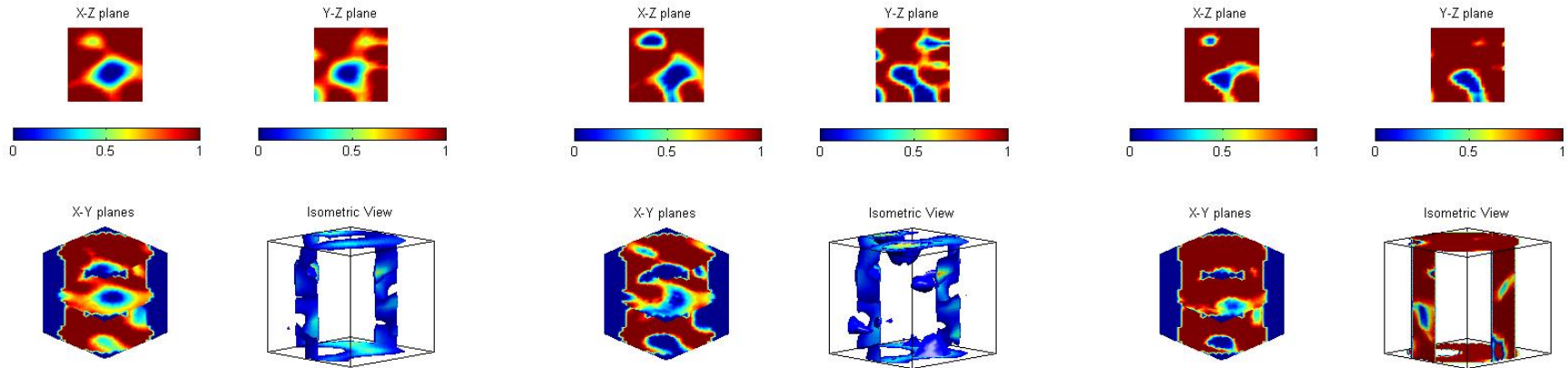
3-D NNMOIRT\*<sup>†</sup>  
MSE = 0.2485



# Reconstruction Method

## Signal-to-Noise Ratio Effects

### 5 dB SNR



Linear Back Projection  
MSE = 0.3175

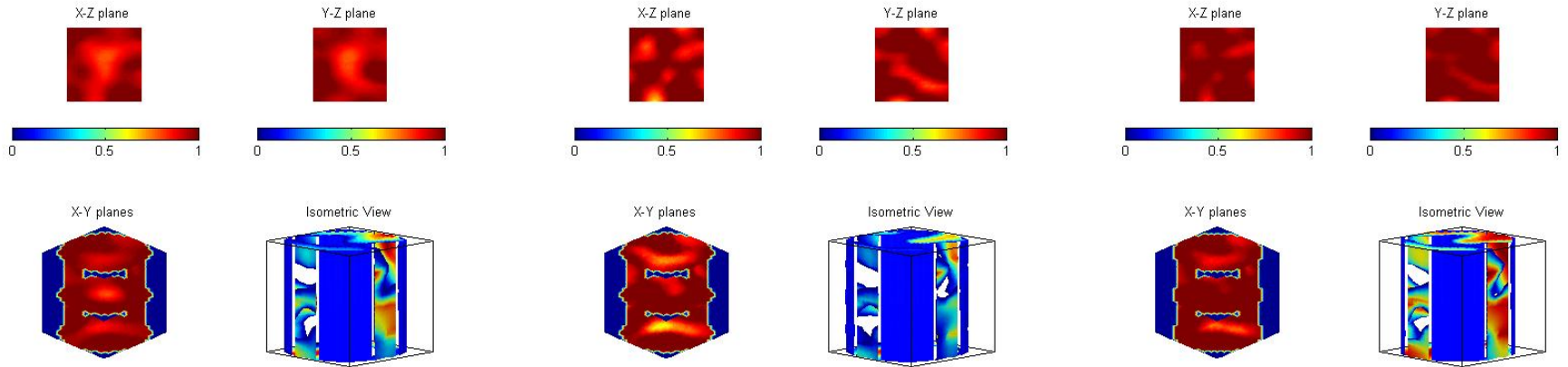
Landweber\*†  
MSE = 0.5656

3-D NNMOIRT†  
MSE = 0.2644

# Reconstruction Method

## Signal-to-Noise Ratio Effects

### 20 dB SNR



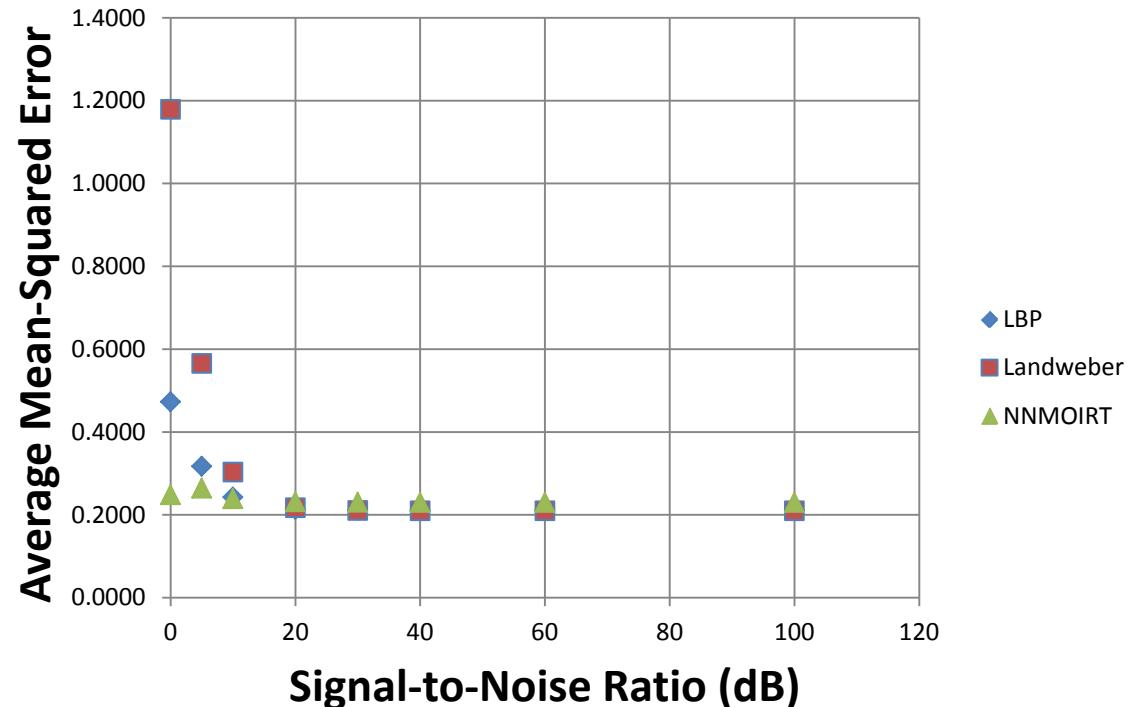
Linear Back Projection  
MSE = 0.2134

Landweber\*<sup>†</sup>  
MSE = 0.2172

3-D NNMOIRT\*<sup>†</sup>  
MSE = 0.2317

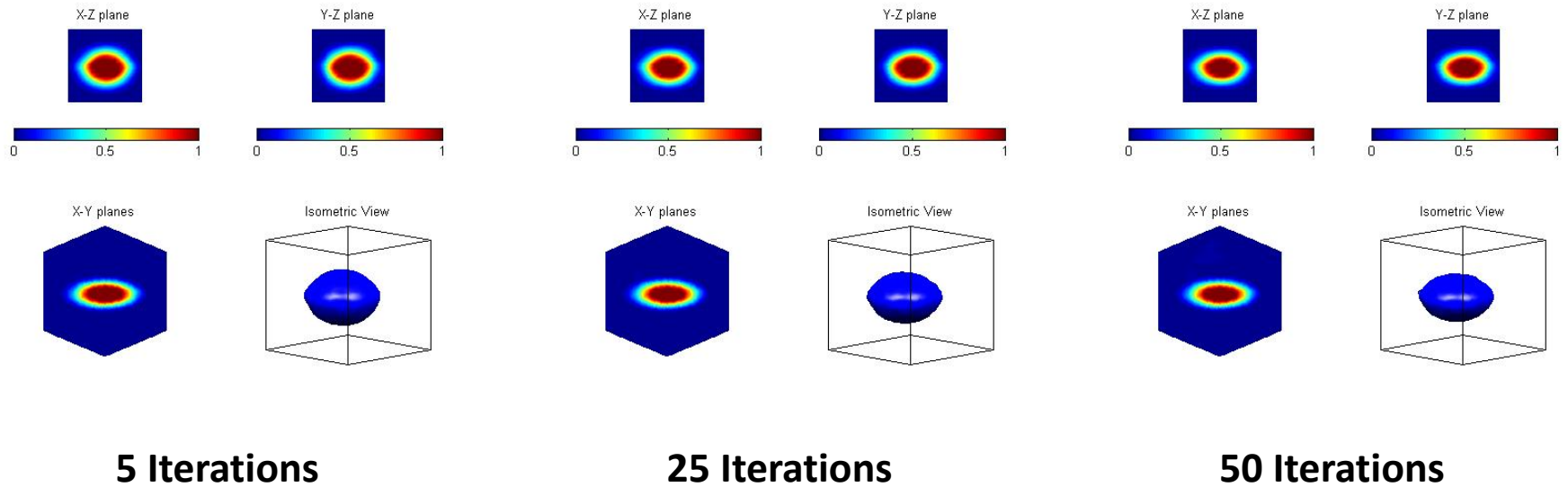
# Reconstruction Method Signal-to-Noise Ratio Effects

- 3-D NNMOIRT method least affected by low SNRs
- Three methods reach maximum performance at 20 dB
- Standard DAS-2 signal-to-noise ratio is 60 dB



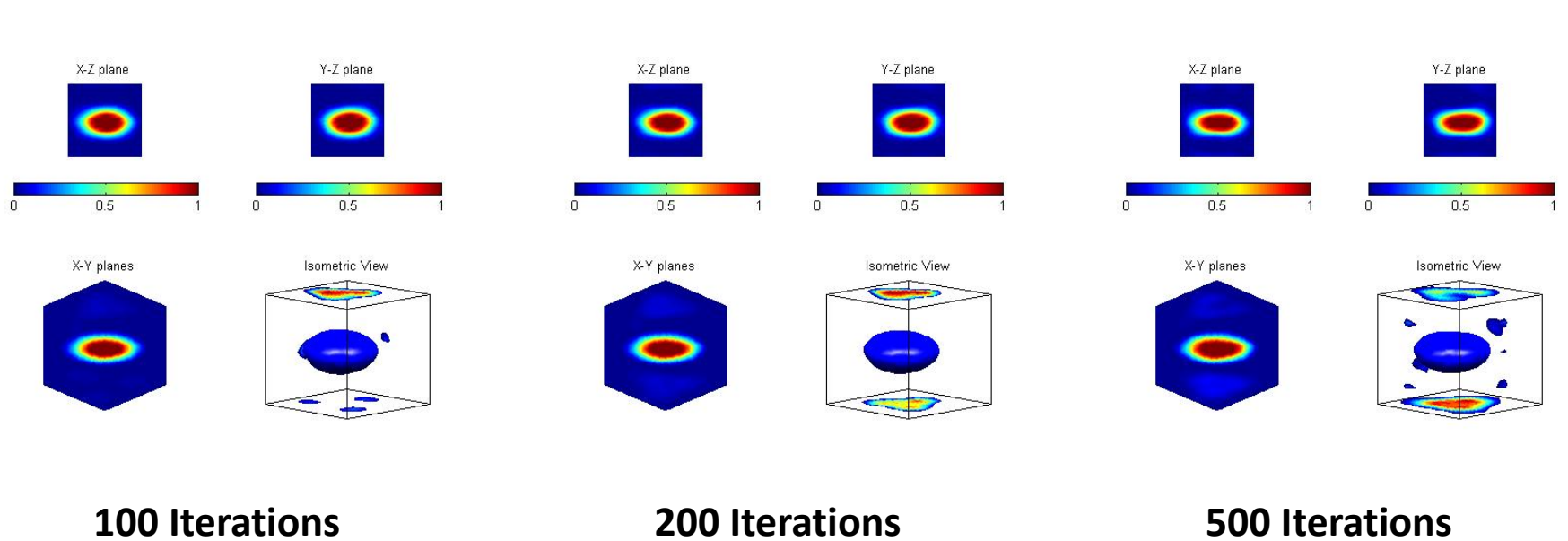
# Reconstruction Method

## Landweber Iteration Effects



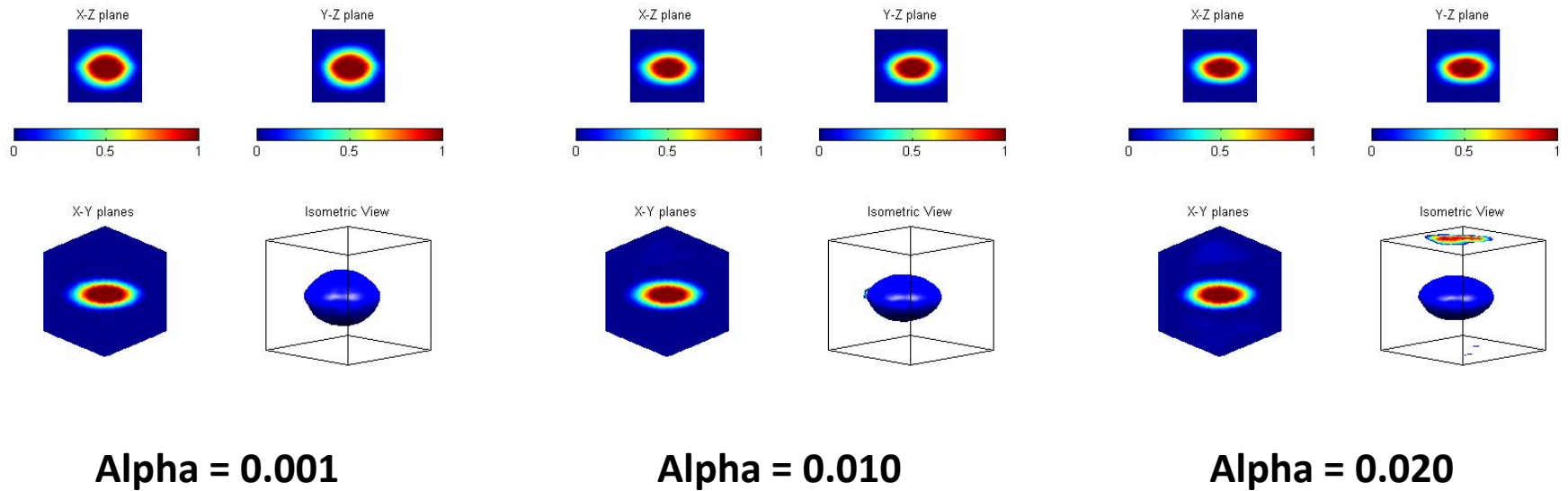
# Reconstruction Method

## Landweber Iteration Effects



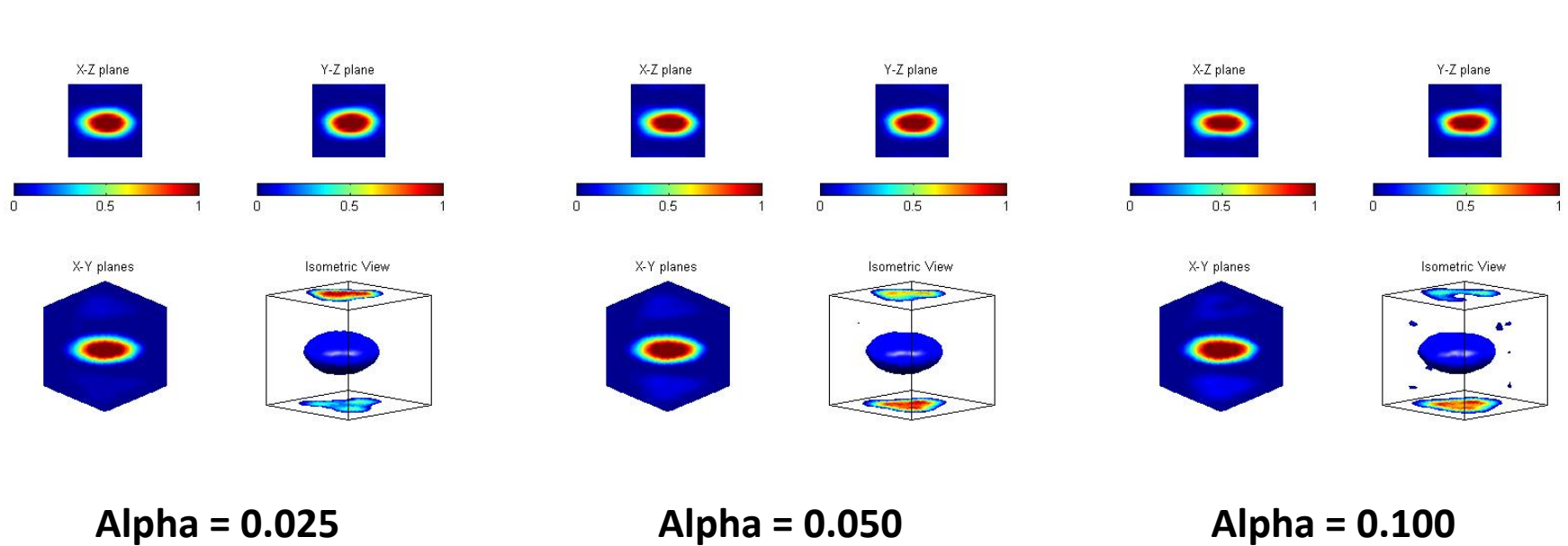
# Reconstruction Method

## Landweber Alpha Effects



# Reconstruction Method

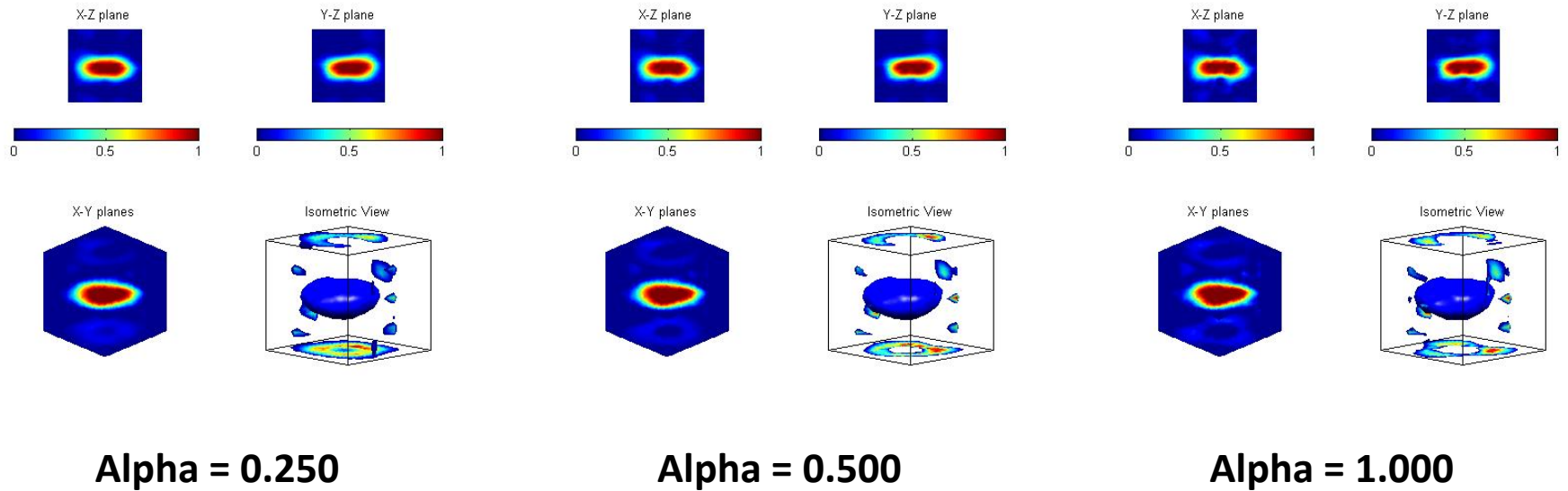
## Landweber Alpha Effects





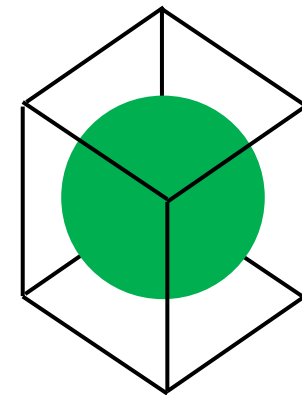
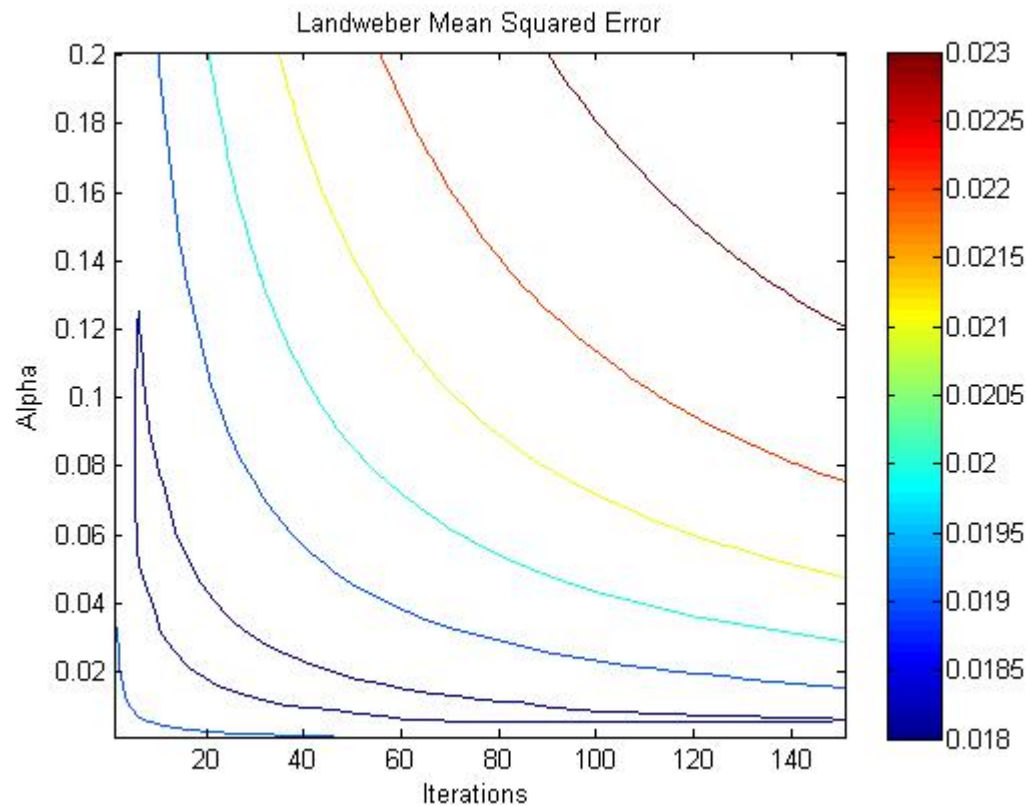
# Reconstruction Method

## Landweber Alpha Effects



# Reconstruction Method

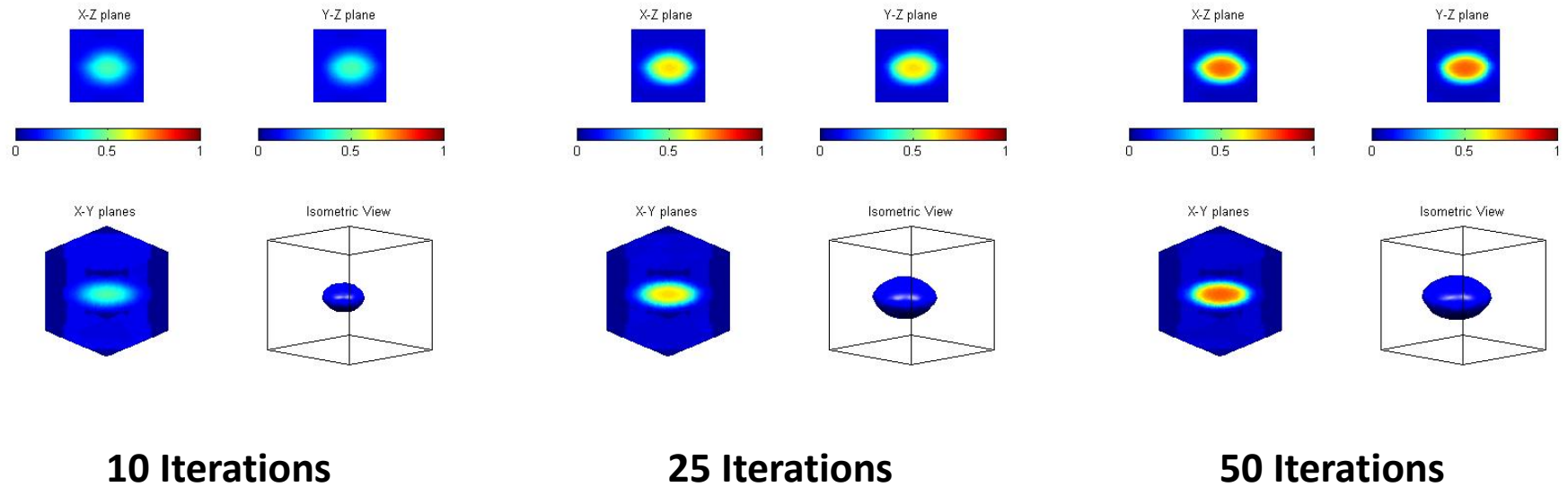
## Landweber Parameter Effects



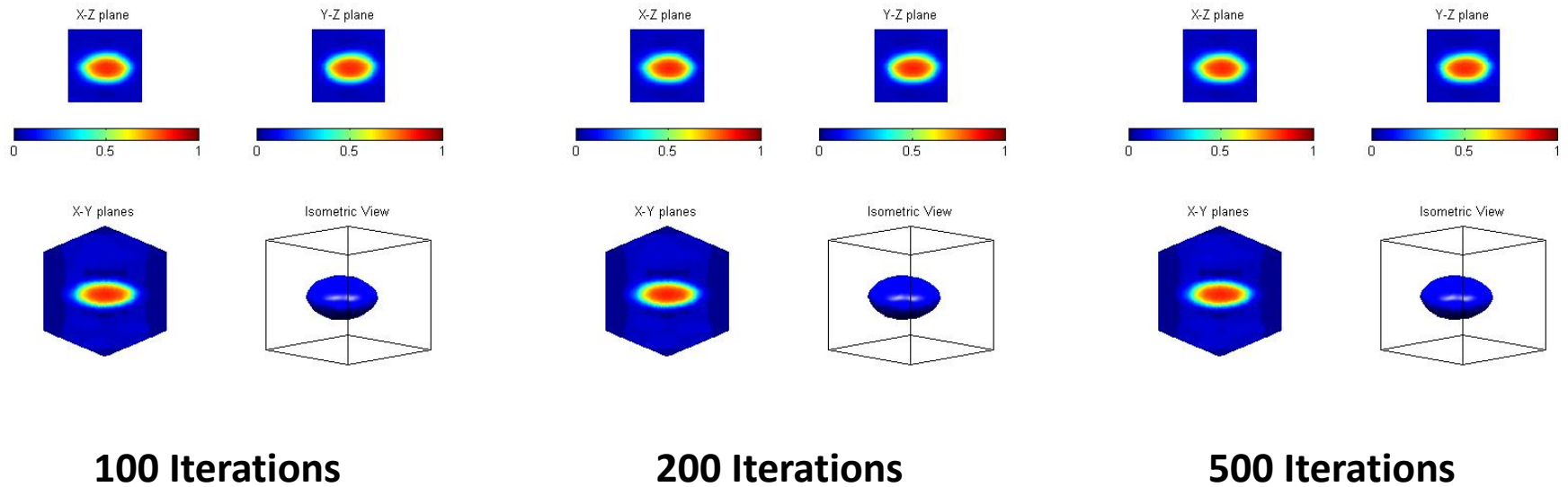
**True Image:**  
Centered Ball

Alpha and iteration count effects on algorithm mean-squared error from ideal image

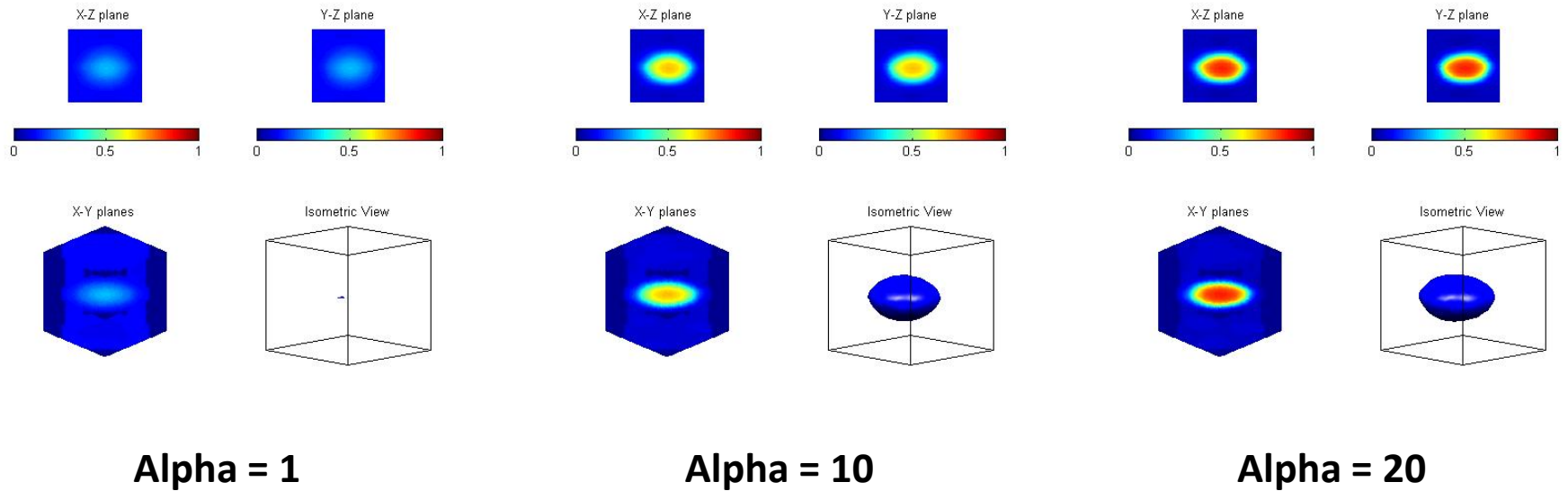
# Reconstruction Method 3-D NNMOIRT Iteration Effects



# Reconstruction Method 3-D NNMOIRT Iteration Effects

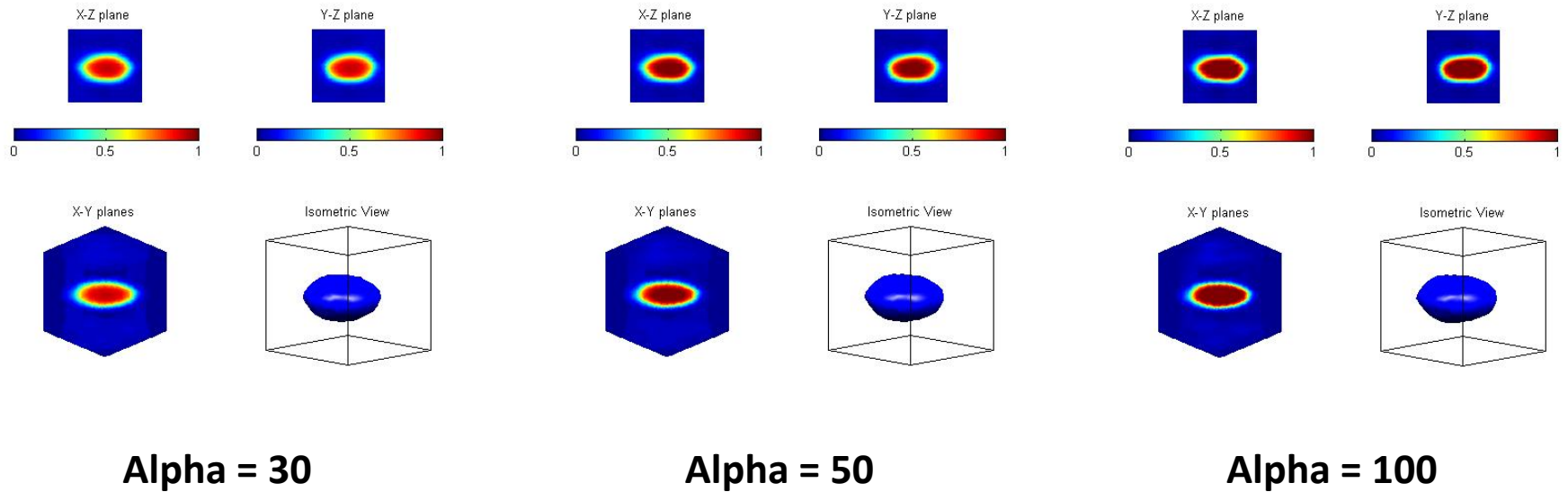


# Reconstruction Method 3-D NNMOIRT Alpha\* Effects



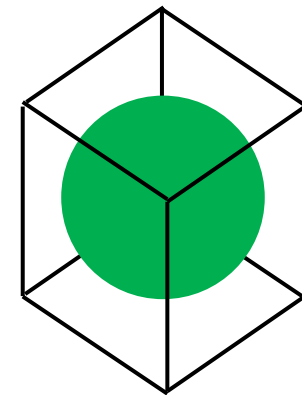
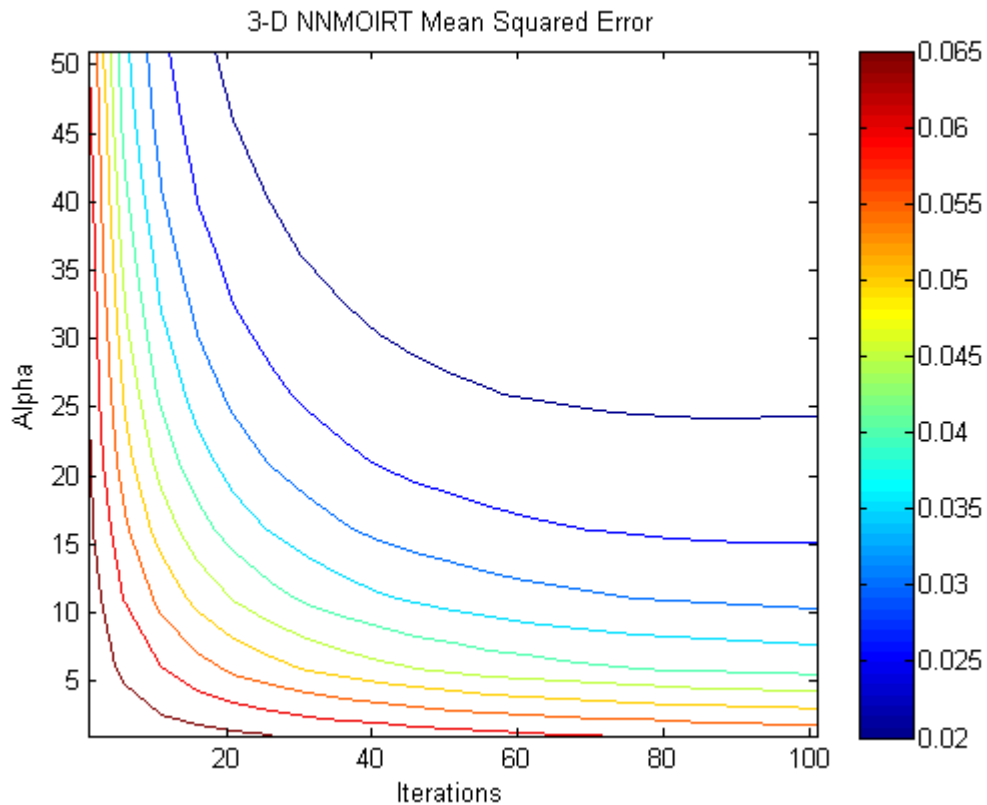
\*The 3-D NNMOIRT Alpha parameter is another variable used during image reconstruction that is normally held at 20; it is not usually a controllable variable

# Reconstruction Method 3-D NNMOIRT Alpha Effects



# Reconstruction Method

## NNMOIRT Parameter Effects



**True Image:**  
Centered Ball

Alpha and iteration count effects on algorithm mean-squared error from ideal image



# Image Reconstruction

Set plotting parameters:

- **Color Bar Min:** Normalized capacitance value that will appear dark blue
- **Color Bar Max:** Normalized capacitance value that will appear bright red
- **Isosurface Value:** 3-D isometric view scaling
- All values are between 0 and 1

Set plot range:

- **Frame Min**
- **Frame Max**
- **Reconstruction Step:** Number of frames to increment between images

The screenshot displays the TECH 4IMAGING software interface. The top section contains a 'Load Data' area with fields for 'Sensitivity Matrix' and 'Data Vectors', each with a 'Browse' button. Below this, the 'Reconstruction Method' is set to 'LBP', 'Alpha' is 0.50, and 'Iterations' is 50. A red box highlights the 'Color Bar Min' (0.34), 'Color Bar Max' (1), and 'Isosurface Value' (0.2933) fields. The 'Sensitivity Matrix' section shows 'Total Channels' as 276 and 'Pixels/Channels' as 8000. The 'Capacitance Matrix' section shows 'Frames' as 101 and 'Capacitance Sensor' as 276. The main display area shows four 3D reconstructions: 'X-Z plane', 'Y-Z plane', 'X-Y planes', and 'Isometric View'. A color bar at the bottom of each view ranges from 0.4 (dark blue) to 1 (dark red). On the right side, a 'Plotting Parameters' panel is highlighted with a red box, showing 'Frame Range (min)' as 40, 'Frame Range (max)' as 50, and 'Reconstruction Step' as 1. Below this panel, there are controls for 'Go to Frame #' (set to 40), a 'Process' button, navigation arrows, 'Current Frame' (set to 45), 'Generate Video', 'Reset', and 'Exit' buttons.

# Image Reconstruction

Four views of 3-D volume presented

- XZ Plane
- YZ Plane
- Multiple XY-Plane Slices
- 3-D Isosurface View

Move through images

- Jump to specific frame
- Move forwards/backwards through frame range
- Only frames in defined range can be viewed

Generate Video opens new interface

The screenshot displays the TECH 4IMAGING software interface. At the top, the logo 'TECH 4IMAGING' is visible. Below it, the 'Load Data' section includes fields for 'Sensitivity Matrix' and 'Data Vectors', each with a 'Browse' button. The 'Reconstruction Method' is set to 'LBP', with 'Alpha' at 0.50 and 'Iterations' at 50. 'Color Bar Min' is 0.34 and 'Color Bar Max' is 1. The 'Sensitivity Matrix' section shows 'Total Channels' as 276 and 'Pixels/Channels' as 8000. The 'Capacitance Matrix' section shows 'Frames' as 101 and 'Capacitance Sensor' as 276. The 'Plotting Parameters' section includes 'Frame Range (min)' at 40, 'Frame Range (max)' at 50, and 'Reconstruction Step' at 1. The 'Go to Frame #' field is set to 40. A 'Process' button is highlighted in green. Below it are navigation buttons '<<' and '>>'. The 'Current Frame' is 45. A 'Generate Video' button is highlighted in light blue. At the bottom, there are 'Reset' and 'Exit' buttons. The main visualization area shows four views: 'X-Z plane', 'Y-Z plane', 'X-Y planes', and 'Isometric View'. Each view has a color bar ranging from 0.4 to 1.0. The 'X-Z plane' and 'Y-Z plane' views show 2D cross-sections of a circular object. The 'X-Y planes' view shows a 3D perspective of the object. The 'Isometric View' shows a 3D perspective of the object with a blue isosurface.

# Video Generation Software

**TECH 4IMAGING**

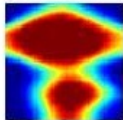
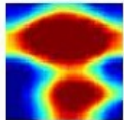
Video Parameters


Browse Directory  **Browse** Data File

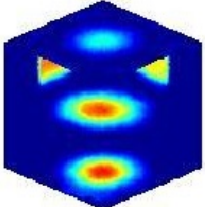
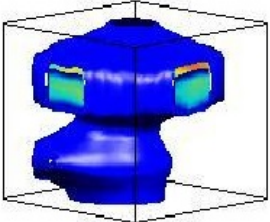
Video File Name  Format  Video Frame Rate  Recon. Step

Reconstruction  Iterations  Alpha  Isoval

ColorBar Min   ColorBar Max

X-Z plane   
Y-Z plane 



X-Y planes   
Isometric View 

Export Video Data

Total Frames

Frame Range (min)

Frame Range (max)

**Generate Video**

Export Image Data

Frame Range (min)

Frame Range (max)

Enter Frame #

**Save Image**

**Play**

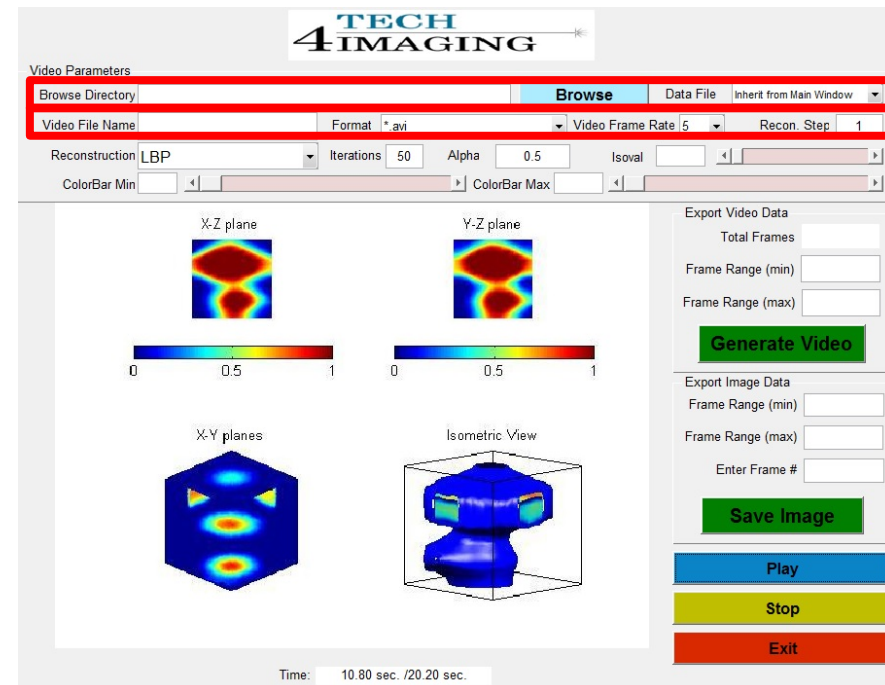
**Stop**

**Exit**

Time:

# Video Generation

1. Load data to use - .mat file containing previously-reconstructed images
2. Name video file
3. Select video type - .avi, .flv, .mp4, or .mpeg
4. Choose frame rate - 5 to 50 frames per second
5. Set reconstruction step - number of frames to increment between images



# Video Generation

## 6. Set plotting parameters

- Color Bar Min
- Color Bar Max
- Isosurface Value

TECH 4IMAGING

Video Parameters

Browse Directory  **Browse** Data File

Video File Name  Format \*.avi Video Frame Rate 5 Recon. Step 1

Reconstruction LBP Iterations 50 Alpha 0.5 Isoval

ColorBar Min  ColorBar Max

X-Z plane Y-Z plane

X-Y planes Isometric View

Export Video Data

Total Frames

Frame Range (min)

Frame Range (max)

**Generate Video**

Export Image Data

Frame Range (min)

Frame Range (max)

Enter Frame #

**Save Image**

**Play**

**Stop**

**Exit**

Time: 10.80 sec. /20.20 sec.

# Video Generation

## Generate Video

- Set range of frames to include
- All frames included if range not specified
- Press **“Generate Video”**

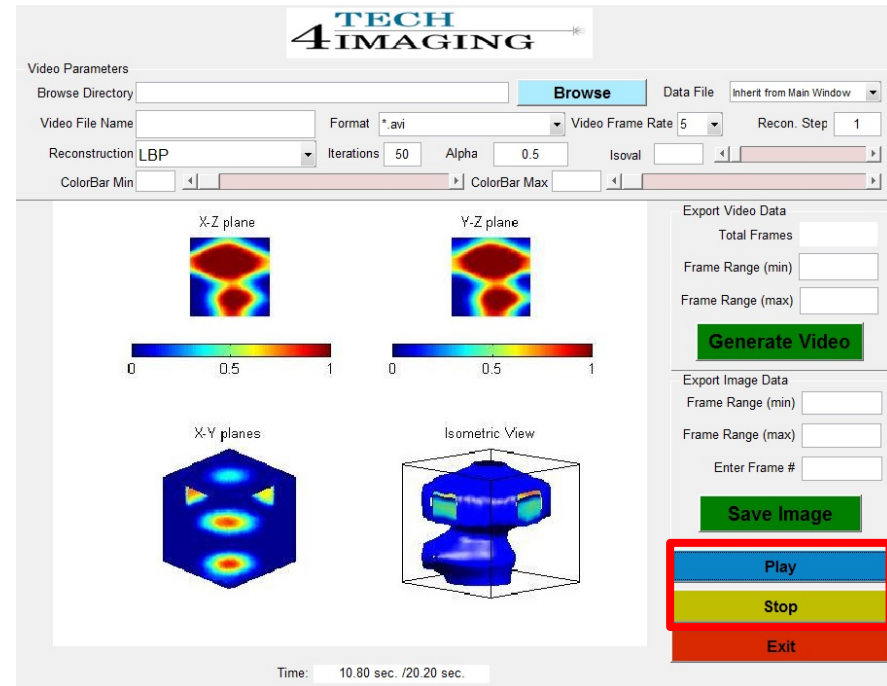
## Generate Images

- Set range of frames to generate  
or
- Enter specific frame number
- Press **“Save Image”**

The screenshot displays the TECH 4IMAGING software interface. At the top, the logo "TECH 4IMAGING" is visible. Below it, the "Video Parameters" section includes fields for "Browse Directory", "Video File Name", "Format" (set to \*.avi), "Video Frame Rate" (set to 5), "Recon. Step" (set to 1), "Reconstruction" (set to LBP), "Iterations" (set to 50), "Alpha" (set to 0.5), and "Isoval". There are also "ColorBar Min" and "ColorBar Max" fields. The main display area shows four views: "X-Z plane", "Y-Z plane", "X-Y planes", and "Isometric View", each with a corresponding color scale from 0 to 1. On the right side, there are two sections: "Export Video Data" and "Export Image Data", both containing "Frame Range (min)", "Frame Range (max)", and "Enter Frame #" fields. Below these are buttons for "Generate Video", "Save Image", "Play", "Stop", and "Exit". A red box highlights the "Export Video Data" and "Export Image Data" sections. At the bottom, a status bar shows "Time: 10.80 sec. /20.20 sec."

# Viewing Videos

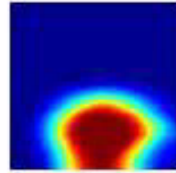
1. Press yellow button (will display “Browse”)
2. Select video
3. Press blue button (will display “Play”)
4. Play video
  - Blue button now displays “Pause”
  - Yellow button now displays “Stop”
5. Stop current video to select another



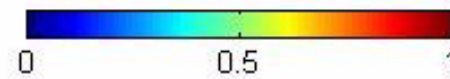
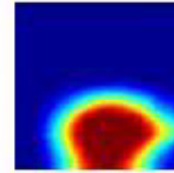


# ECVT Video

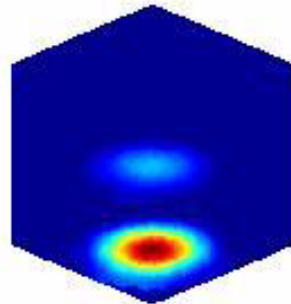
X-Z plane



Y-Z plane



X-Y planes



Isometric View

