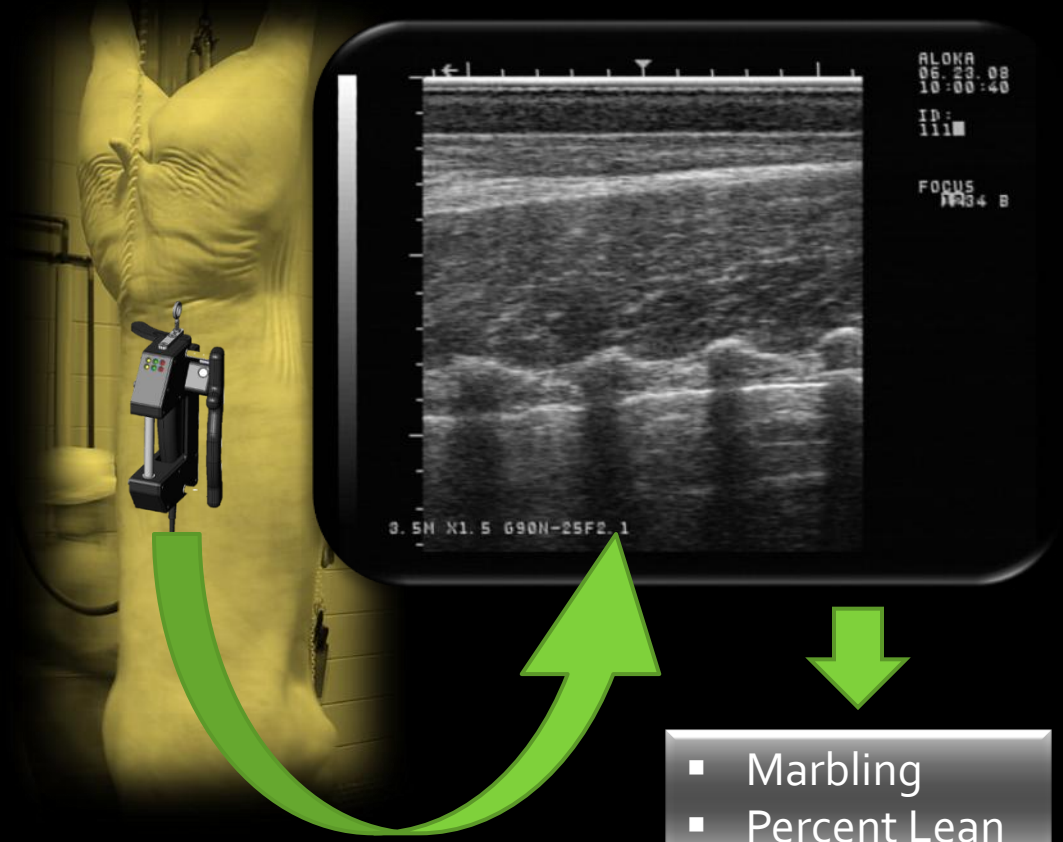


Doyle E. Wilson, PhD
President
Biotronics, Inc.
Ames, Iowa



- Marbling
- Percent Lean

BIOQSCAN® INSTRUMENT GRADING SYSTEM

Location

Aspen Business Park
1609 Golden Aspen Drive, Suite 105
Ames, IA 50010-8011 USA
(515) 233-4161
www.biotronics-inc.com



Biotronics, Inc.

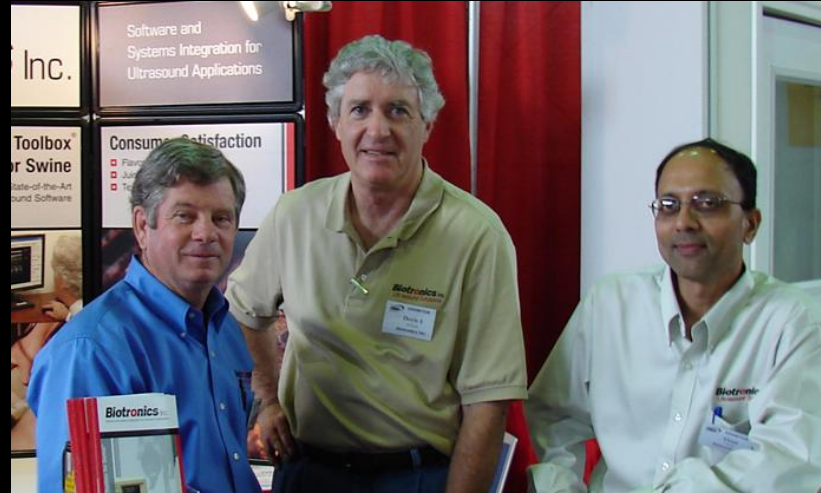
- Formed in 1998
 - For Profit Company
 - Incorporated in State of Iowa
- Develop software tools and systems for non-invasive measurement of body composition and quality traits in live food animals and carcasses
 - Manufacturing
 - Sales & Service
 - Training & Certification



Biotronics' Staff

Gene, Doyle & Viren

Renée



Kyle

Bill

Warren


Research & Development

- USDA/SBIR Competitive Grants
 - 2004 – 2009: \$440,000
- Objectives
 - Phase I: Accurate IMF models for live swine
 - Phase II: Included online carcass evaluation
- Prototype Development
 - Iowa Department of Economic Development
 - 2008-2009: \$150,000
- New USDA/SBIR Hybrid Project
 - 2011-2012: \$400,000





Presentation Overview

- BioQscan[®] System Layout
 - Operation
 - Capture & Analysis
 - Accuracy
 - Benefits & Challenges
- 

System Layout

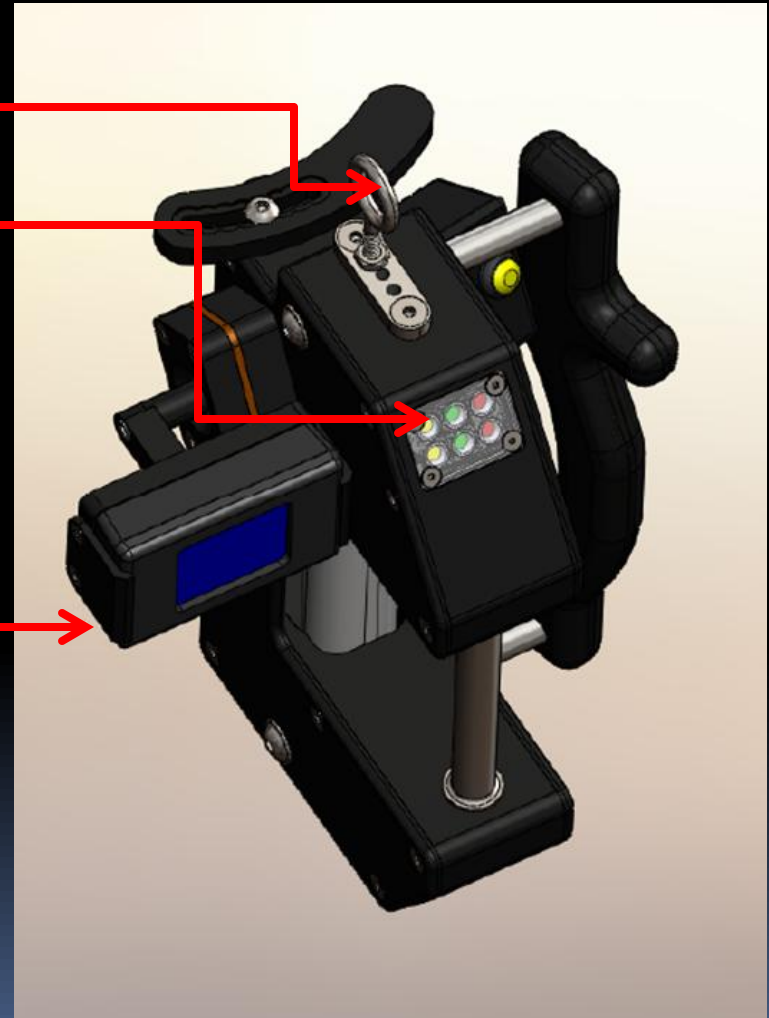
- Modularized Design
 - Client can supply the cabinet
- Prototype Cabinet
 - **Power:** 110 v, 5 amp
 - **Compressed Air:** 85 psi
 - **Weight:** 275 lbs
 - **Footprint:** 25"x29"x55"
 - **Portable:** casters
 - **Interfaces:** Serial, VGA, USB, Ethernet, Video



Prototype BioQscan®

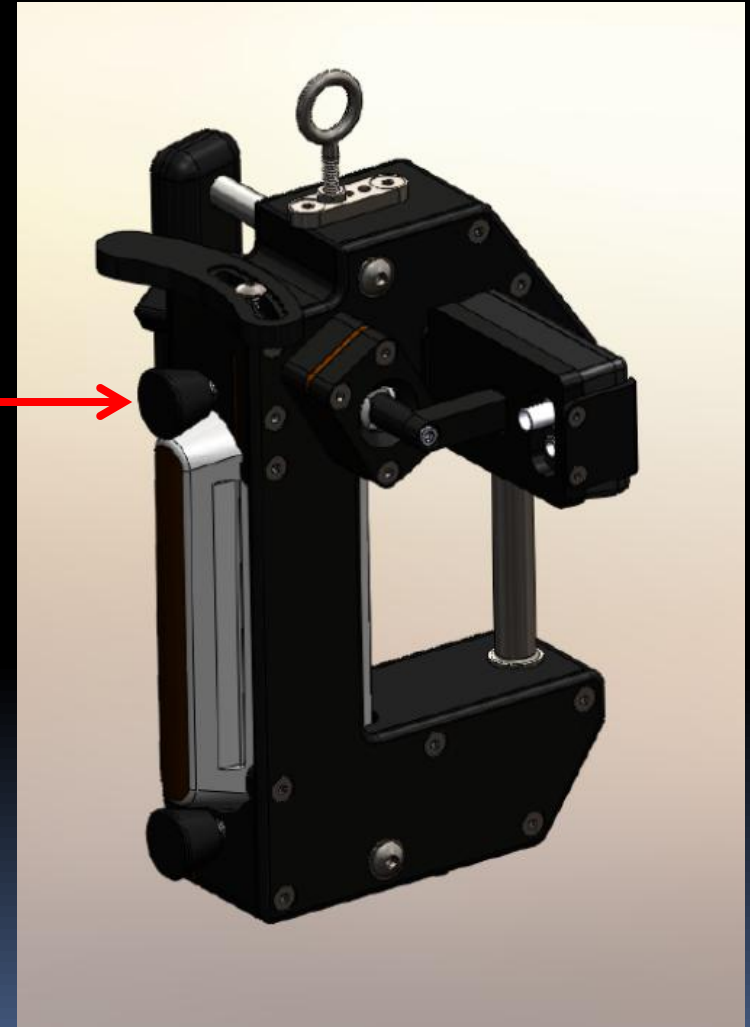
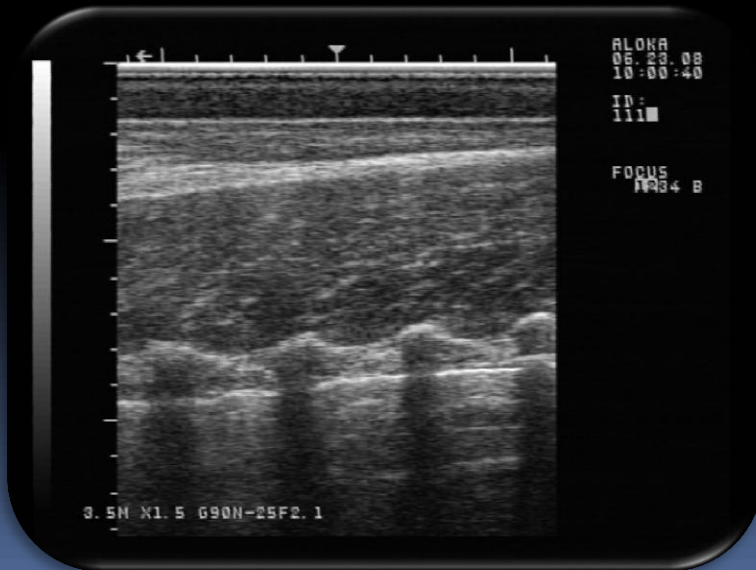
Probe Holder

- Counter Balance: ≈ 5 lbs
- LED Pressure Sensor Lights
- Two toggle switches
 - Software defined
- Carcasses moving from right to left
 - Reverse handle for left to right
- LCD Video Monitor



Probe Holder

- Probe: 12cm linear array
- Pressure Sensor Pads
- Housing: Food grade ABS plastic



Aloka SSD 500V Version



System Operation

Operational Schematic (Looking Down)

10 Feet of Rub Rails

3 Feet



BioQscan®
Cabinet

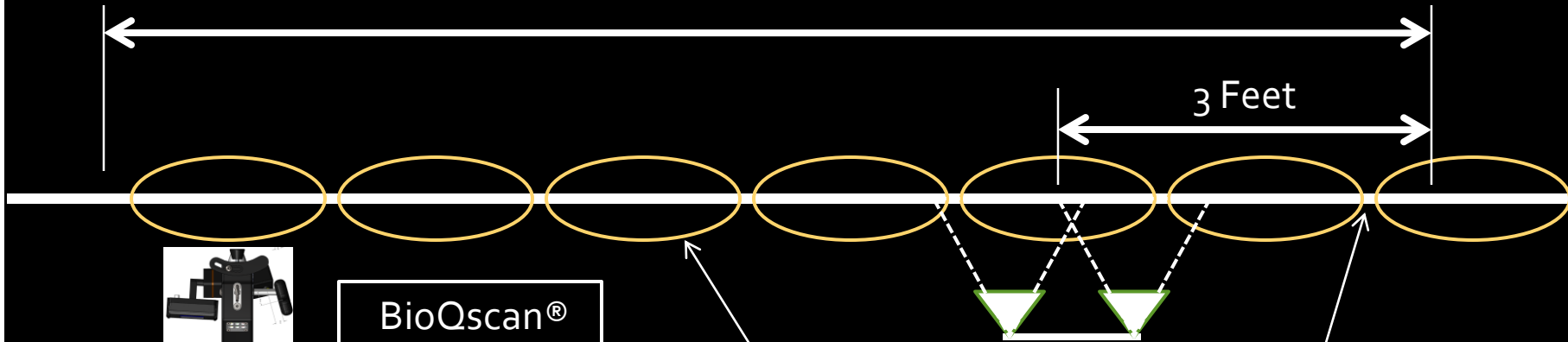
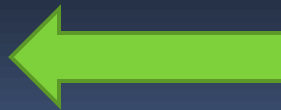
Stable
Carcass

Water
Spray

Rail

Operator

Chain Travel Direction



Carcass Alignment

- Rail space needed for a carcass to stabilize
 - 600/hr: 6 ft
 - 1,400/hr: 10 ft
- Rub bars are required
 - Directly below the gambrel
 - Behind the scanning location (???)
 - Cannot further distort loin presentation
 - Cannot introduce more instability
 - Cannot butterfly (open) the carcasses up more (split carcasses)



Carcass Presentation

- Must be stable
 - Not swinging or rotating
- Must be wet
 - Re-wet if station not located within 8 ft of a wash
- Intact carcasses work **"best"**
 - No trim issues
 - Rib to Lumbar vertebra location easy to find
 - Skin surface is smooth

Carcass Presentation



Best



Fair



Bad

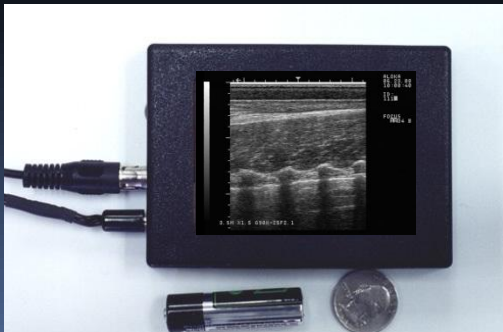
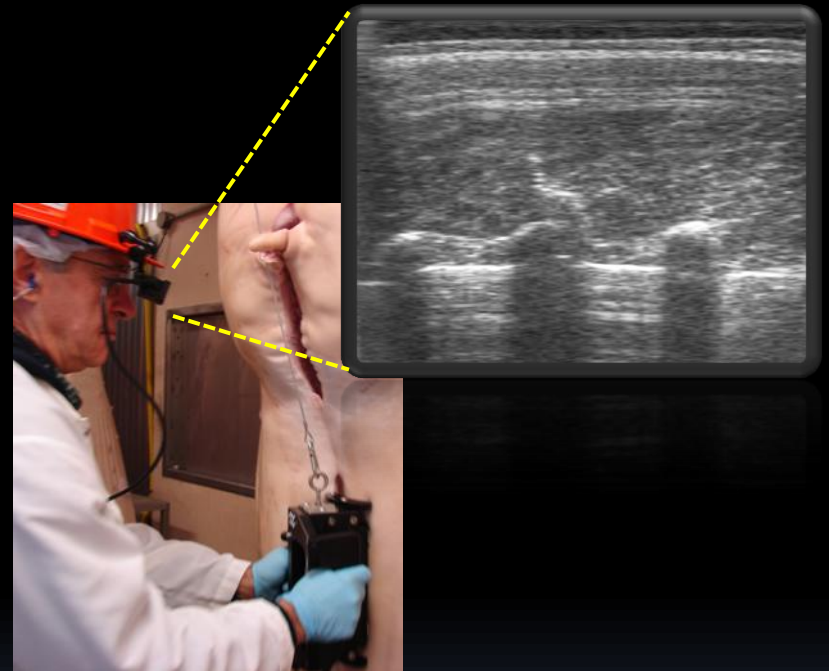
Touch Screen



LOGIN	BIOQSCAN® SYSTEMS OPERATION												
<p>LINE</p>	<ul style="list-style-type: none"><input type="radio"/> SCANNER/VIDEO<input type="radio"/> TRANSDUCER FIXTURE<input type="radio"/> TEMPERATURE<input type="radio"/> PLANT INTERFACE												
<p>PLANT MGT</p>	<p>Are the top LEDs cycling yellow, green, and red?</p> <p>YES</p> <p>NO</p>												
<p>SERVICE</p>	<p><input type="text"/></p> <p>ENTER</p> <p>SHUTDOWN COMPUTER</p>												
<p>BIOTRONICS</p> <table border="1"><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>4</td><td>5</td><td>6</td></tr><tr><td>7</td><td>8</td><td>9</td></tr><tr><td>0</td><td></td><td></td></tr></table>	1	2	3	4	5	6	7	8	9	0			
1	2	3											
4	5	6											
7	8	9											
0													

Operator Display Options

- Head Mounted Video Display
 - Signal comes directly from scanner
- Miniature LCD Monitor located on the probe holder

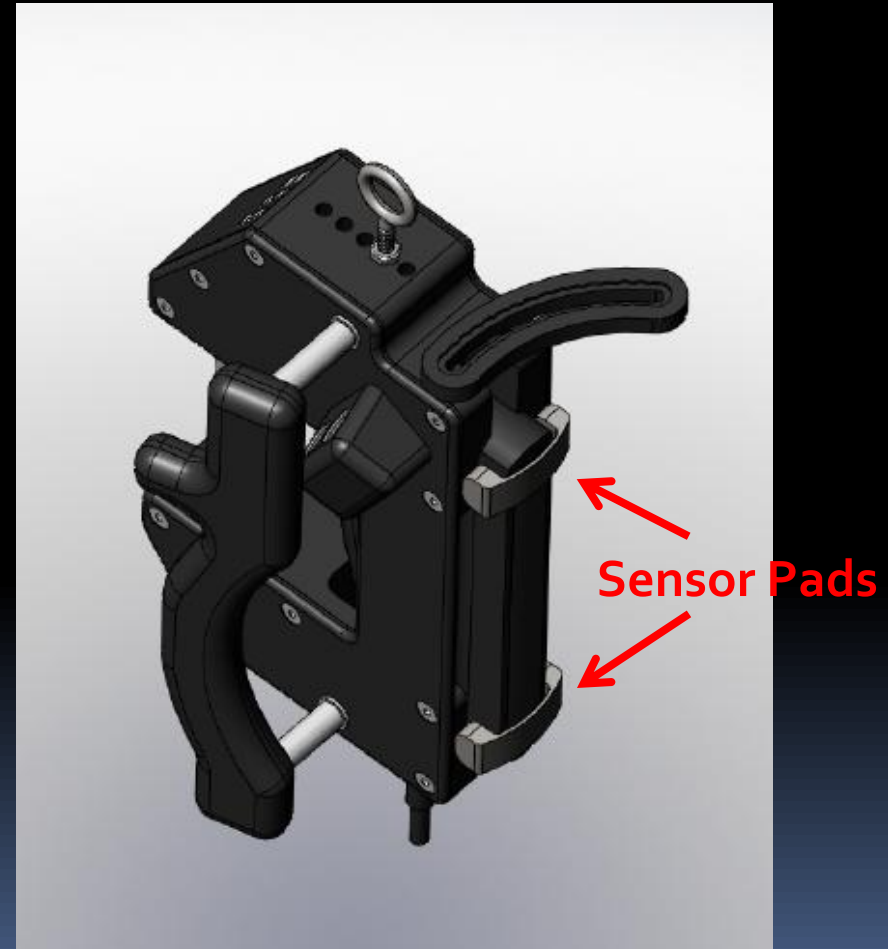




Capture & Analysis

Image Capture & Processing

- Four pending patents
- “Acceptable” images gated by pressure sensors
 - Min & max thresholds
 - Pressure rate of change
- Capture @ 15 frames/sec
- Each carcass will typically have 3 to 10 frames processed

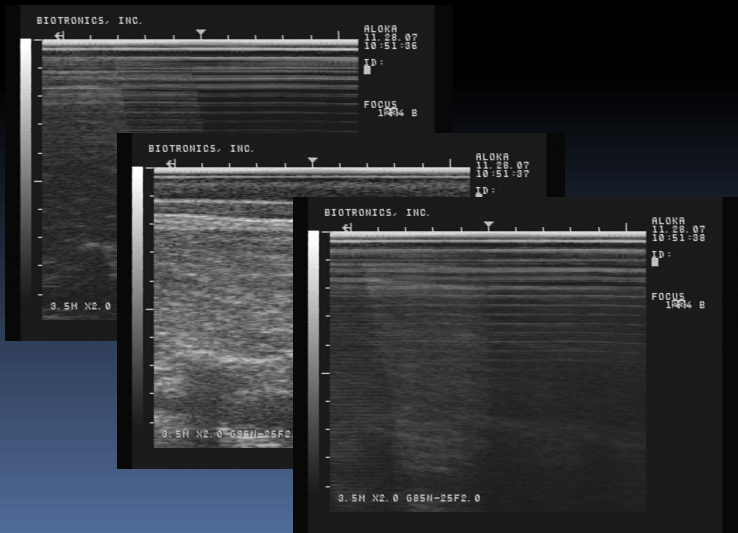
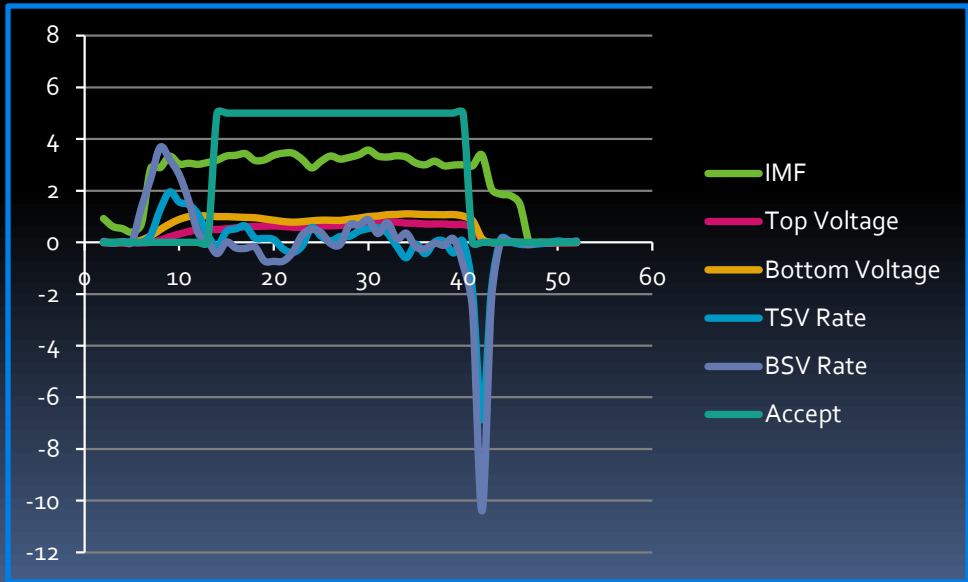
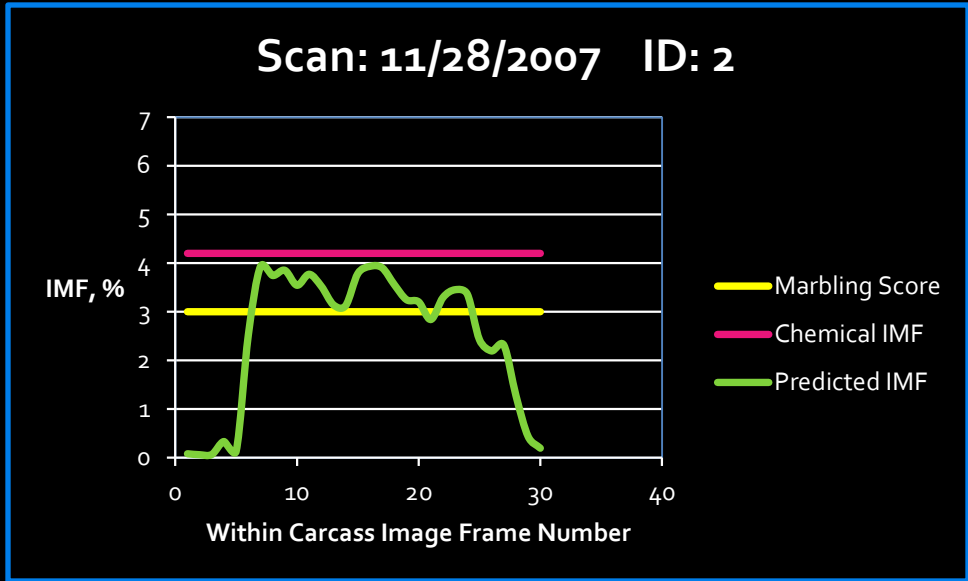


Aquila Vet Probe Holder



Filters

Pressure sensors & image quality



Processed Image

09/06/08
16:50:55
L 3.5 MHz

dnf F R→
26 Fps

Memory: 1

Standard

TG : 255
NG : 81
FB : 1



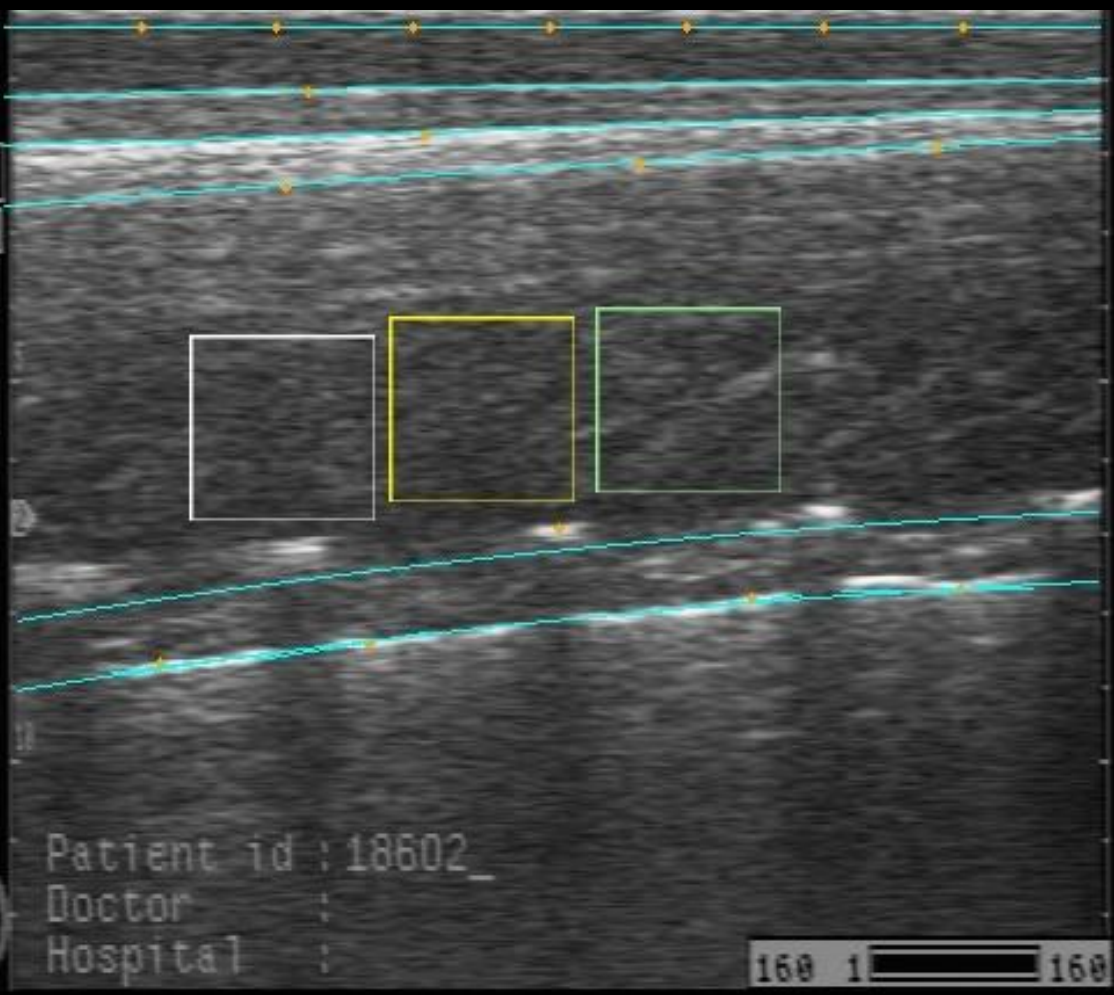
Patient id : 18602_
Doctor :
Hospital :

160 1 160

Backfat Layers

Loin Muscle & Marbling ROIs

Intercostales Muscles



Processing

- Algorithm places region of interests (ROI) above rib tops
 - Regression equation using texture parameters to predict IMF level
- Backfat depth & loin depth
 - Can be determined & averaged at multiple positions
 - Example: 4 measurements across 3-4 ribs
- Post-filter statistical analysis
- Results within milliseconds of scanning

OPERATOR

ID **1**
 START **10:49**
 PROCESSED **104**

**ADVANCED
 SETTINGS**

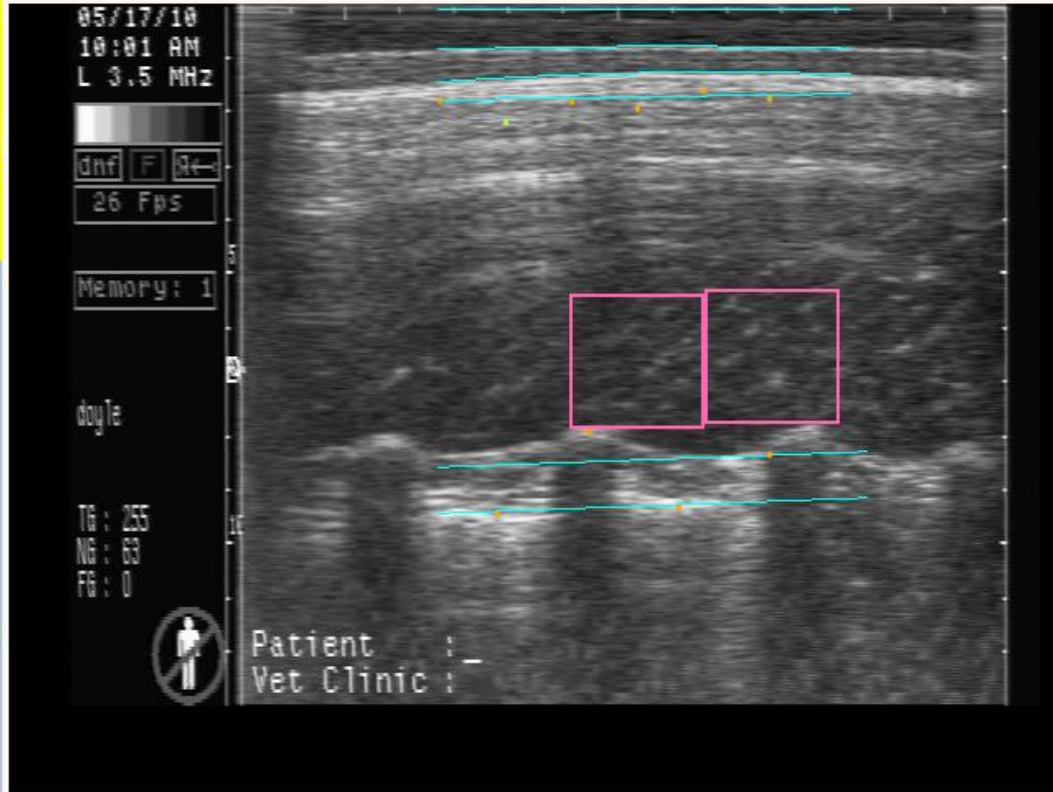
LOGOUT

Reference Image

Previous Carcasses

Shift Stats

Sort Stats



Sort	Count
1 <= 1.5	12
2 <= 2.5	35
3 <= 3.5	33
4 <= 4.5	13
5 <= 5.5	7
6 <= 6.5	2
7 > 6.5	2
IMF AVG	2.8

RESET

SYSTEM

- SCANNER/VIDEO
- TRANSDUCER FIXTURE
- TEMPERATURE
- PLANT INTERFACE

#: 1303 ID: - - - - -

IMF (%)	SORT	FAT (mm)	LOIN (mm)	LEAN (%)
2.7	3	16	67	57
6/6		6/6	6/6	


BioQscan

CGS 1000

10:55:38 AM



Processed Data

- Linked to trolley ID
 - Stored in BioQscan® database
 - Sent to plant database
 - Ethernet
 - Serial
- 



Accuracy

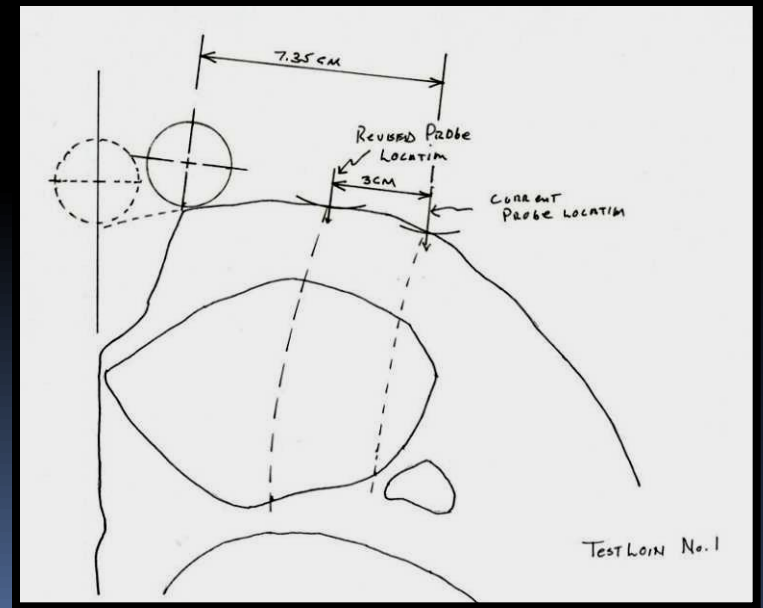
Backfat/Loin Depth Accuracy

- 941 carcass ; 11 scanning sessions
- A test of being able to identify the correct boundaries
 - Manual image measurement is the reference

Trait	R ²	r	Root Mean Square Error, ±mm
Auto Backfat depth, mm	.89	.94	1.61
Auto Loin depth, mm	.65	.81	3.71

Backfat/Loin Depth Carcass Validation

- Twenty (20) Carcass Loin Samples
 - Repeat scanned: polisher & grading stations
 - Fat-O-Meater probed
 - Loins taken to ISU Meat Laboratory for dissection and measurements.



Backfat Results

Definitions:

Acetate: Biotronics' ruler measure on acetate tracing from actual loin cross-section

Ultrasound: Automatic backfat depth algorithm/ultrasound images

Plant Measure: Ruler measure on actual loin cross-section

FOM: Fat-O-Meat'er plant reading

Regression	R ²	Root Mean Square Error (±), mm
Acetate on Ultrasound (Polisher Station)	.93	1.55
Acetate on Ultrasound (Grading Station)	.94	1.37
Plant Measure on FOM	.92	1.60

Loin Depth Results

Definitions:

Acetate: Biotronics' ruler measure on acetate tracing from actual cross-section

Ultrasound: Automatic loin depth algorithm/ultrasound images

Plant Measure: Plant ruler measure on actual loin cross-section

FOM: Fat-O-Meat'er plant reading

Regression	R ²	Root Mean Square Error (±), mm
Acetate on Ultrasound (Grading Station)	.48	6.58
Plant Measure on Ultrasound (Polisher)	.48	6.39
Plant Measure on Ultrasound (Grading)	.70	4.89
Plant Measure on FOM	.41	6.80

Marbling (IMF) Determination

- Statistical Process
- Texture Analysis

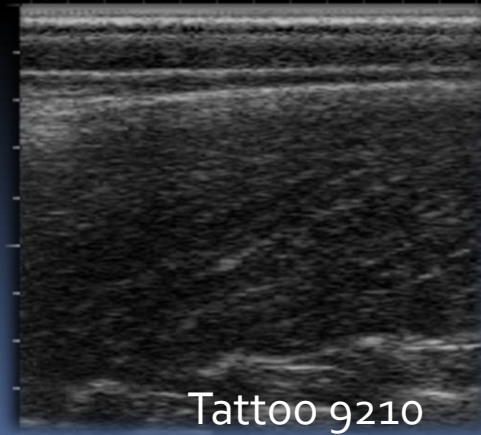
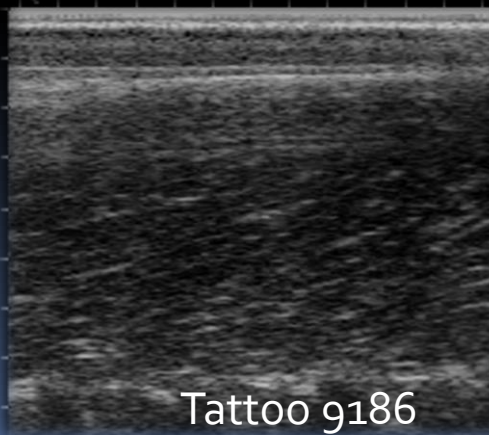
IMF=1.4%



IMF=3.2%



IMF=12.6%



Marbling Prediction Models

- Regressing Chemical IMF on:
 - BioQscan® Prediction
 - Visual Marbling Score

Model	R ² (r)	RMSE (±%)
Aloka SSD 500V		
BioQscan® (639 carcasses)	.47 (.69)	.70
Marbling Score (639)	.41 (.64)	.74
Aquila Vet		
BioQscan® (80)	.36 (.60)	.62
Marbling Score (80)	.40 (.63)	.60


BioQscan[®] -- Adding Value

“Sorting Loins”

- Packing Plant sets sort criteria
 - Multiple levels possible
 - Example: Identify loins with > 3.0 % IMF
- Standard Error of Prediction
 - IMF Prediction is a statistical process
 - Carcass presentation
 - Operator skill
 - BioQscan[®] texture and prediction analysis
 - Plant tests to determine “best” IMF sort spec



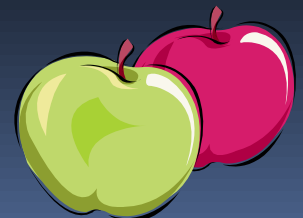
Operational Experience

- Testing began in December 2009
 - Prototype has been tested in three different plants
 - $\approx 20,000$ carcasses processed
- 

Benefits

- BioQscan® is the **only** grading technology that is applied “equally**” on the live animal and the carcass
 - Carcass data: marbling, backfat depth and loin depth have direct counterparts in live scanning and genetic improvement programs
 - Breeding companies and producers can directly respond to hog procurement incentives for composition and marbling

****BioSoft Toolbox® II for Live Swine = BioQscan®**

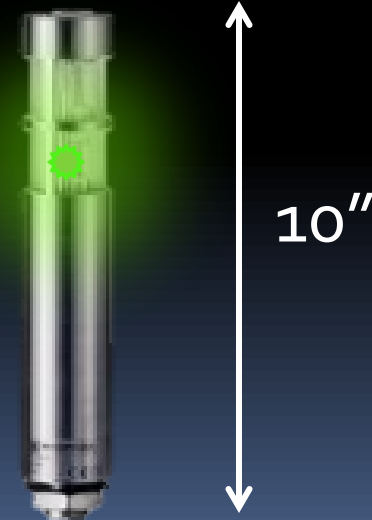


Benefits

- Instrument graded loins, not subjectively scored
- Non-invasive
- Determines both % Lean & Marbling
- Minor Plant Modifications
 - Rub bars for a stable carcass
- Easily integrated with trolley ID tracking systems

Implementation

- Technology will require tech support
 - Custom integration
 - Service contract
- Operators must be trained
- Scanning data must be 'linked' to a carcass
 - Trolley ID,
 - Or carcass "identifier"



Flashing Light Pole



BioQscan® Summary

- Non-invasive instrument grading of marbling in intact loins and for carcass percent lean
 - Operational at speeds of 1,400 carcasses/hr
 - Analytical customization
 - At least as accurate as visual scoring for marbling
 - Competitive with Fat-O-Meat'er accuracies
- 