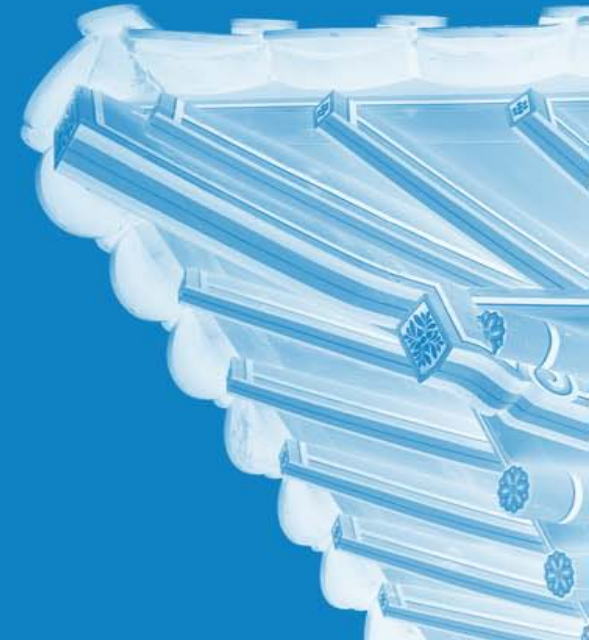


홈 헬스케어를 위한 휴대형 유방암 진단 시스템

- A Portable Breast Cancer Detection System
for Home Health Care



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Interdisciplinary Program - Bioengineering Major,
Graduate School, Seoul National University



**MEDICAL ELECTRONICS
LABORATORY**

<http://melab.snu.ac.kr>



MELAB

MEDICAL ELECTRONICS LABORATORY

* Contents

▪ Introduction

- Breast Cancer
- Challenges of Present Scanning Methods

▪ Materials and methods

- Hardware
- Experimental Procedure
- Sample Phantom Model Preparation

▪ Results and discussion

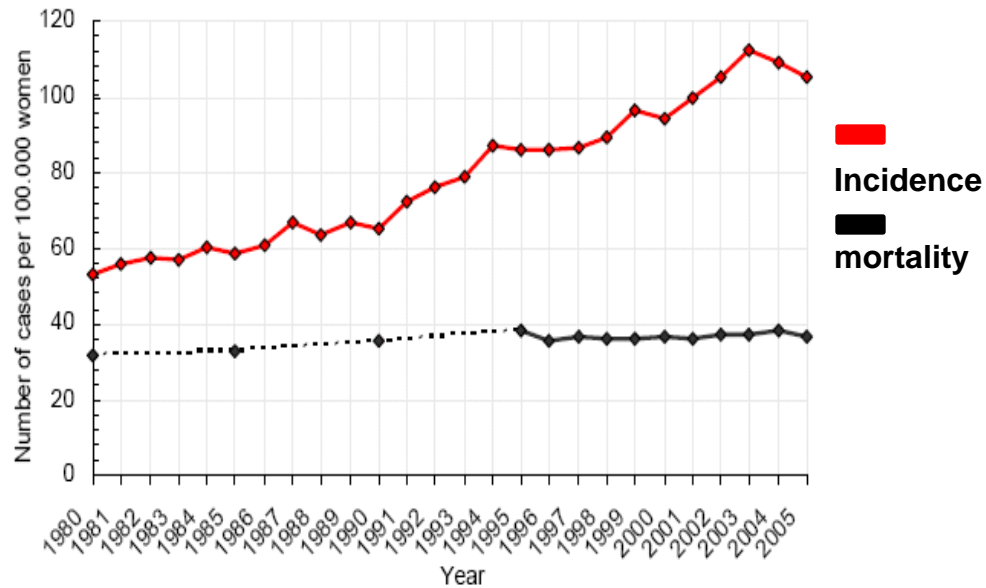
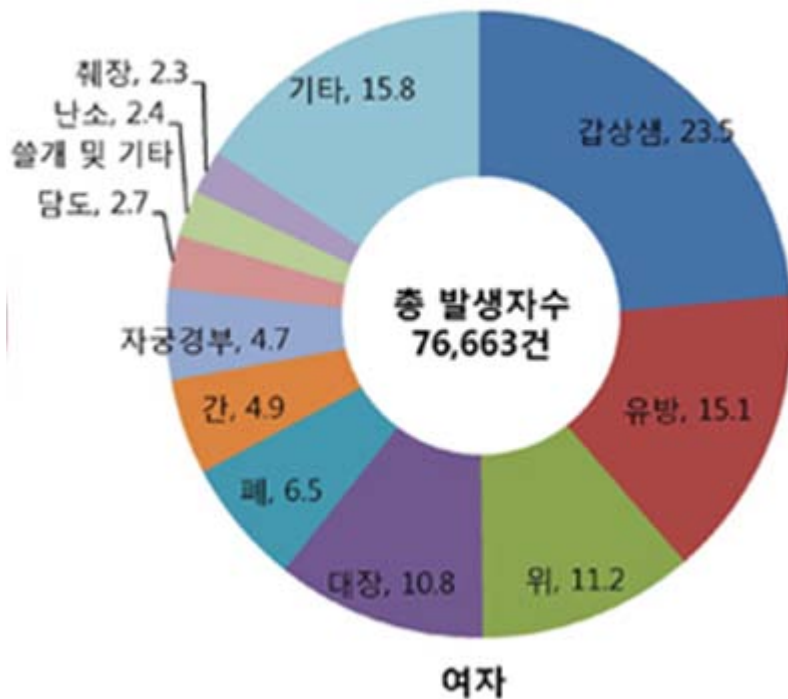
- Sensor Calibration
- Breast Cancer Dummy Scanning
- Phantom Model Scanning

▪ Conclusion



* Introduction – Breast Cancer Statistics

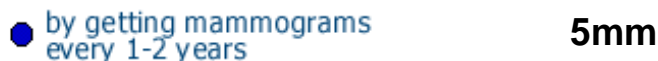
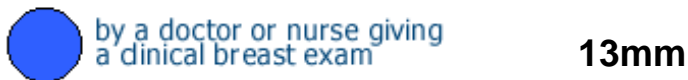
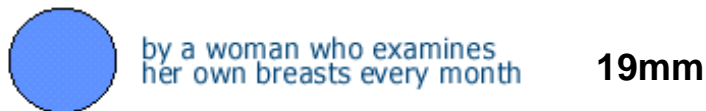
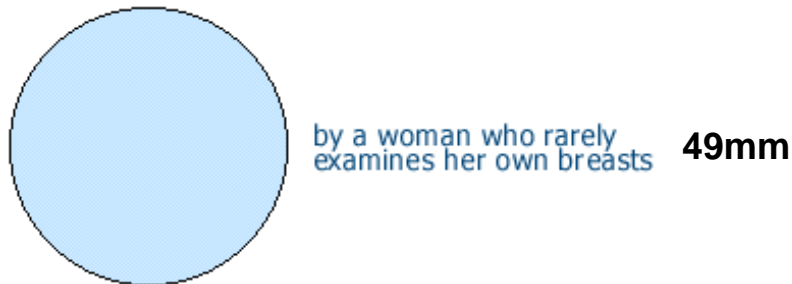
(단위: %)



Source: National Cancer Registry,
Institute of Health Information and Statistics of the Czech Republic

* Introduction – Breast Cancer Detection

▪ Tumor Size Detection



<http://www.publichealthgrandrounds.unc.edu/brcancer/necklace.htm>

▪ Tumor Shape

- Irregular shape

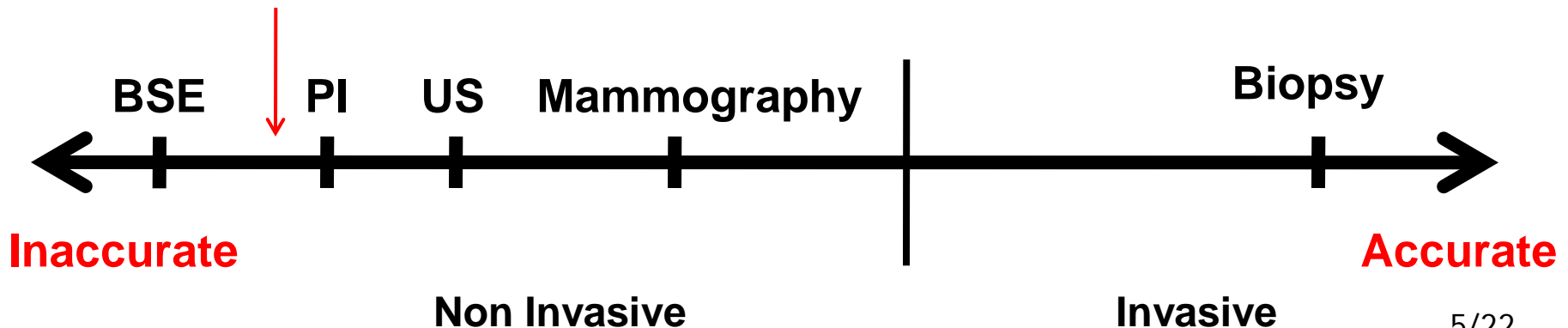
- feel bumpy

- ***very hard***
like a bit of raw carrot

* Introduction

▪ Breast Cancer Diagnosis Modalities

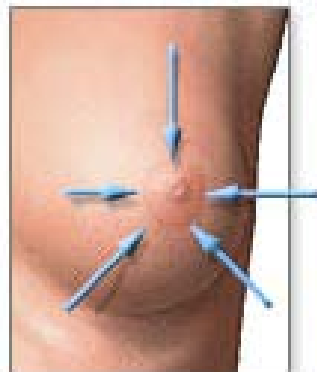
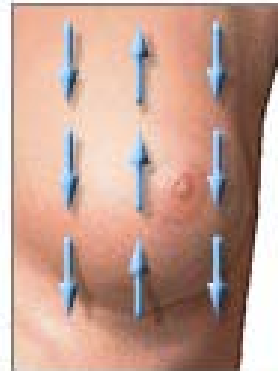
- Breast Self Exam (BSE)
- Ultrasound (US)
- Mammography
- Pressure Imaging (PI)



* Introduction – Breast Self Exam



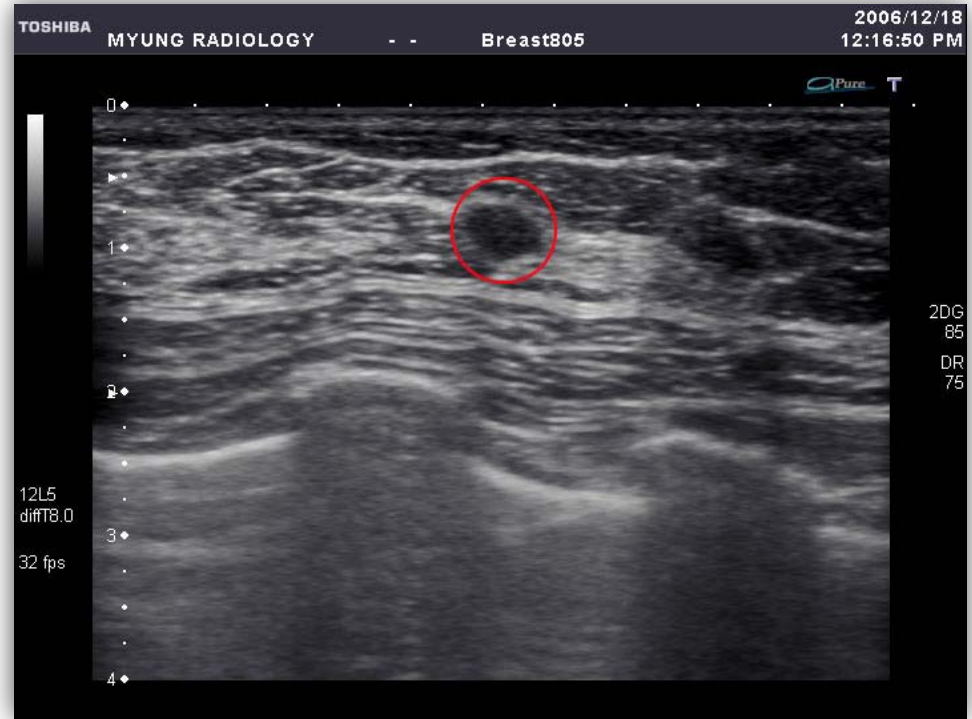
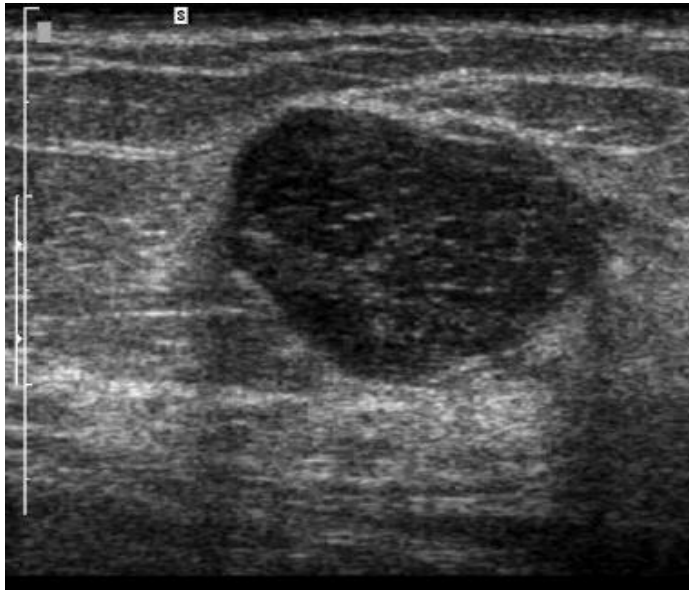
With fingertips close together, gently probe each breast in one of these three patterns



- | | |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pros. | Possible regular check up
Comfortable |
| Cons. | Lack of confidence <ul style="list-style-type: none">• Don't know what to feel for Limited tactile sensitivity <ul style="list-style-type: none">• With a bare hand |

Breast self-exam:
Manual examination
(standing)

* Introduction – Ultrasound



Pros.

- Sensitive
- Harmless

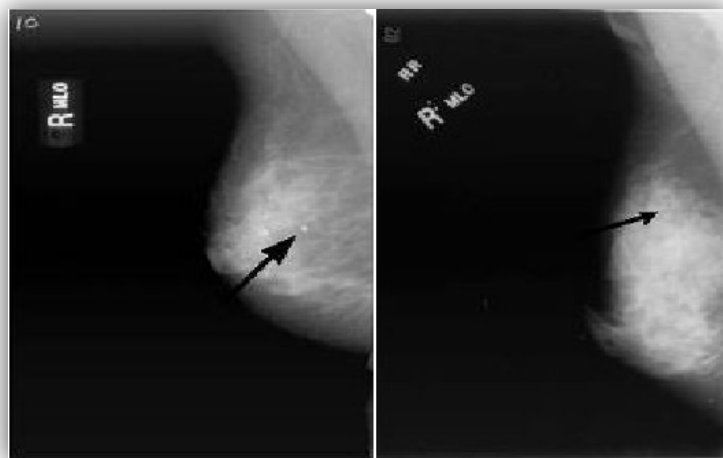
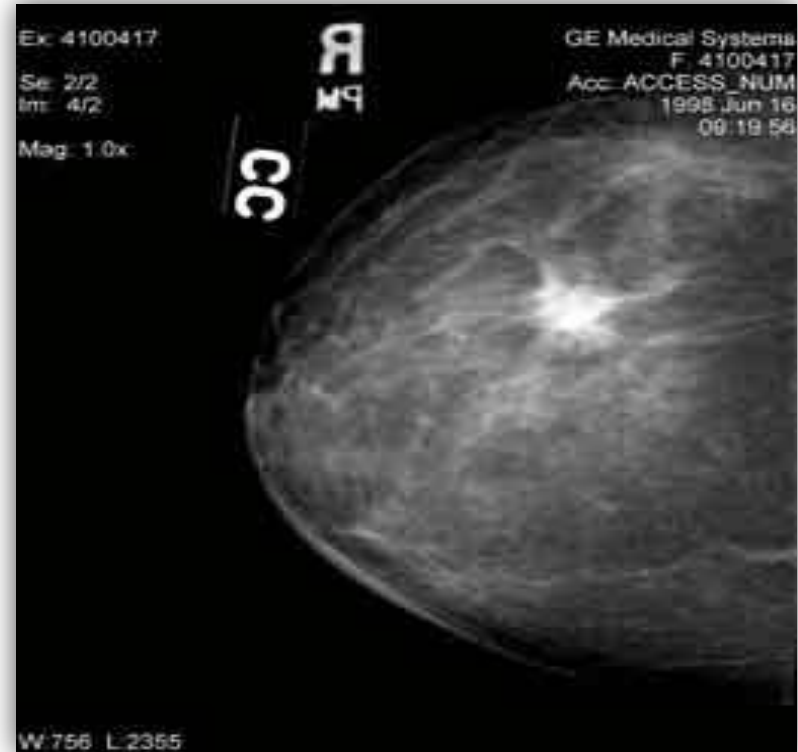
Cons.

- Not for routine examination
- Uncomfortable
- Bulky

(a) woorimtech.com
(b),(c) mdrc.co.kr

7/22

* Introduction – Mammography



Pros.

- Sensitive

Cons.

- May cause defects(X-Ray)
- Longer examination time
- Bulky

(a) genglob.com

(b) <http://blog.daum.net/e-vven/17202447>

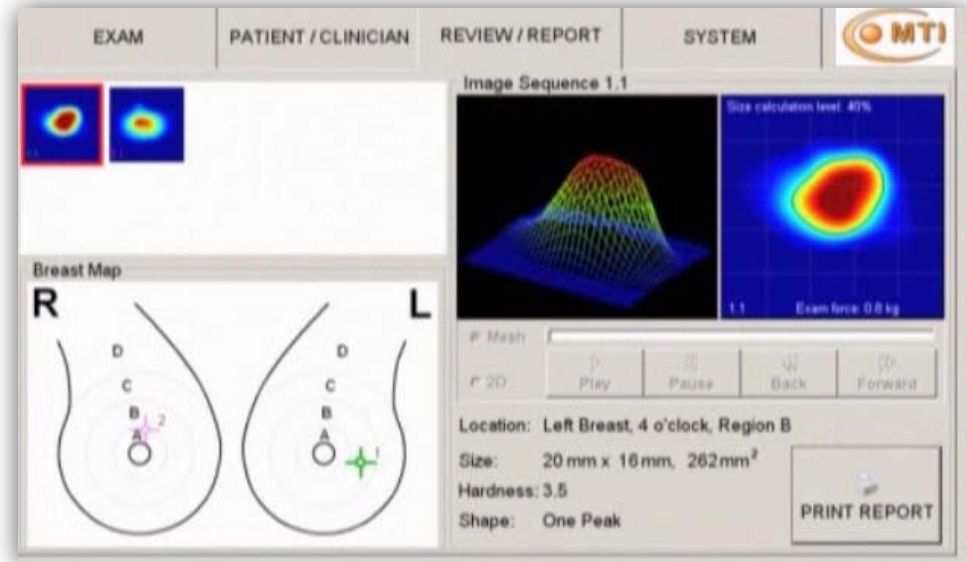
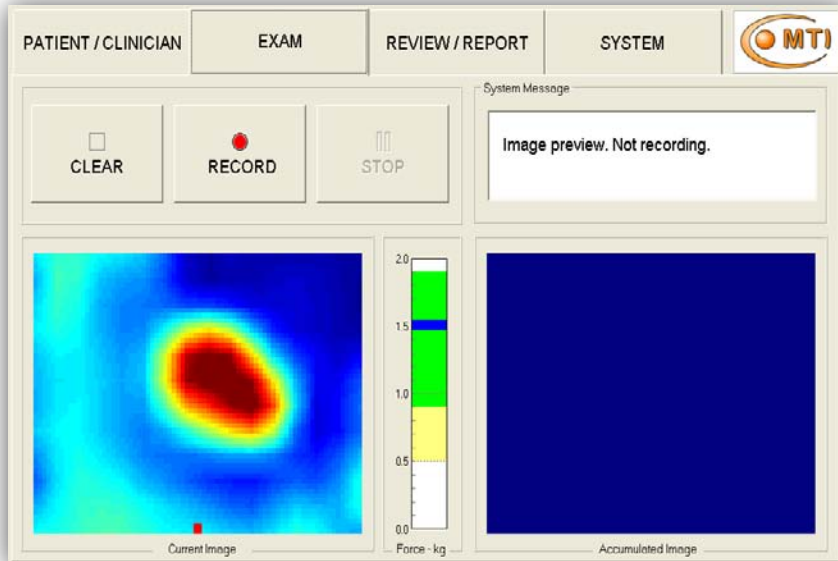
(c) www.christchurchradiology.co.nz/...ography/



* Introduction – Pressure Imaging



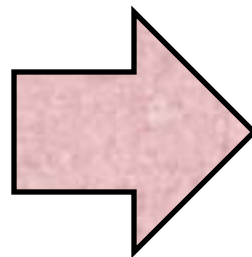
- | | |
|--------------|---------------------|
| Pros. | • Harmless |
| Cons. | • Clinical use only |
| | • Expensive |



(a) www.healthmanagementmedia.co.za/
(b) (c) <http://www.pressureprofile.com/case-study-mti.php/>

Common Screening Methods

- Bulky & Heavy
- Clinical use only
- Expensive
- Uncomfortable
- Inconvenient



Proposed System

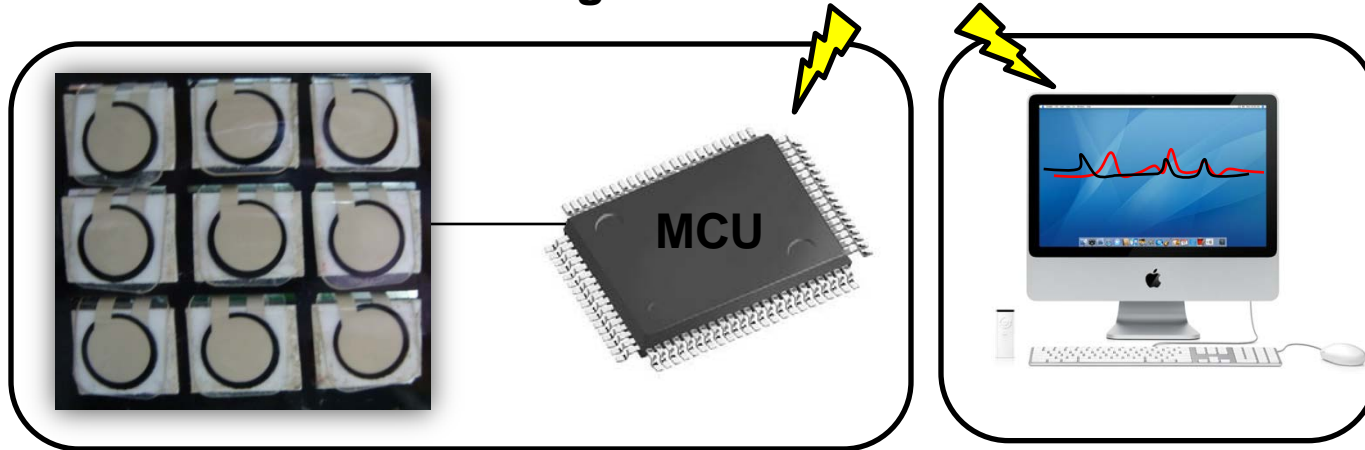
- Home health care use
- Cheap
- Comfortable
- Definite decision
- Magnified tactile
- Real Time

Breast Self Examination

- Indefinite decision
- Limited tactile sensitivity

* Material and Methods – Hardware

▪ Hardware Block Diagram



▪ Hardware Specification

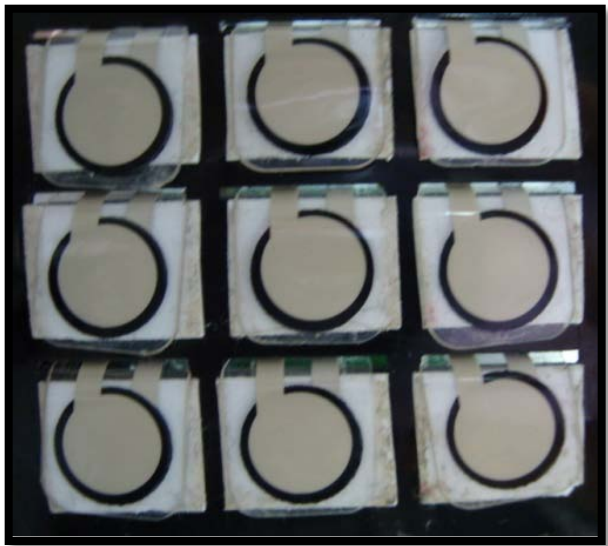
- Flexiforce Force Sensing Resistor (FSR) 1 lb (450g) Multi-Array
- Micro-controller
- 6Hz Low pass filter
- 12 Bit ADC
- 50 Hz Data Sampling
- Wireless (Bluetooth)

* Material and Methods – Experimental Procedure

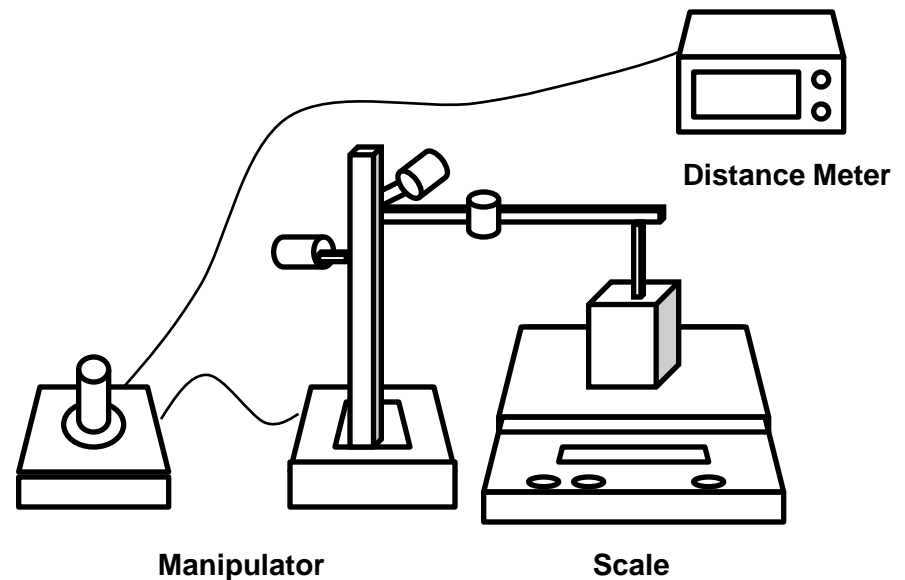
- **Breast Scanning to detect Pressure Change vs. Time**
- **Fact**
Breast : $<100\text{kPa}$
Tumor : $>100\text{kPa}$
- **Device Pressure**
20g = user maximum force with the device
(Pressure value from the device < 100)

* Material and Methods – Sensor Calibration

▪ Multi-Sensor Array

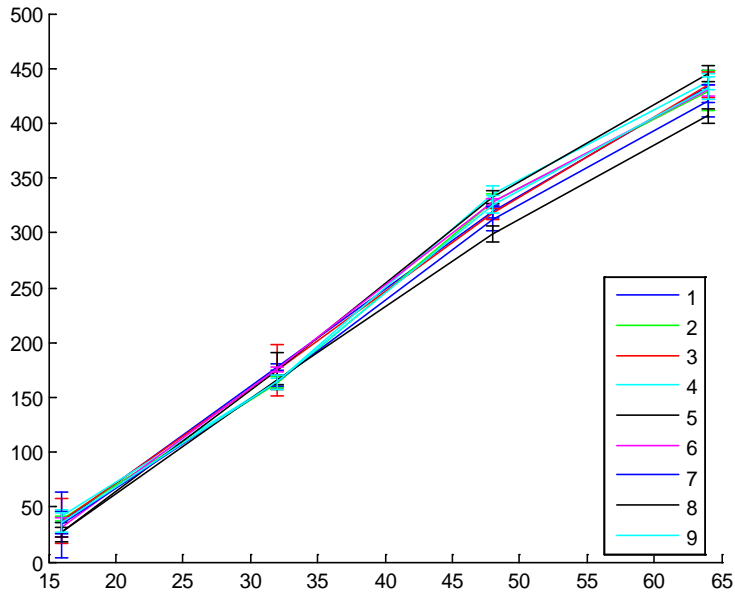


▪ Calibration Experimental Set-up

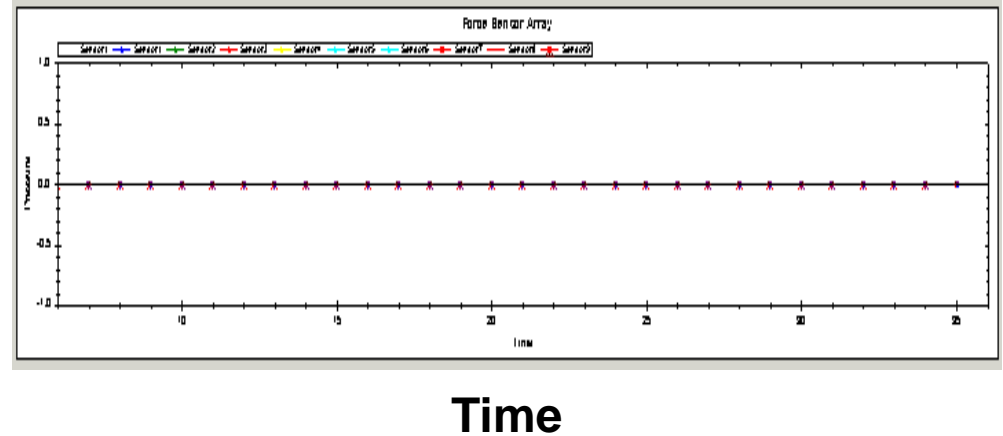


* Results and Discussion – Sensor Calibration

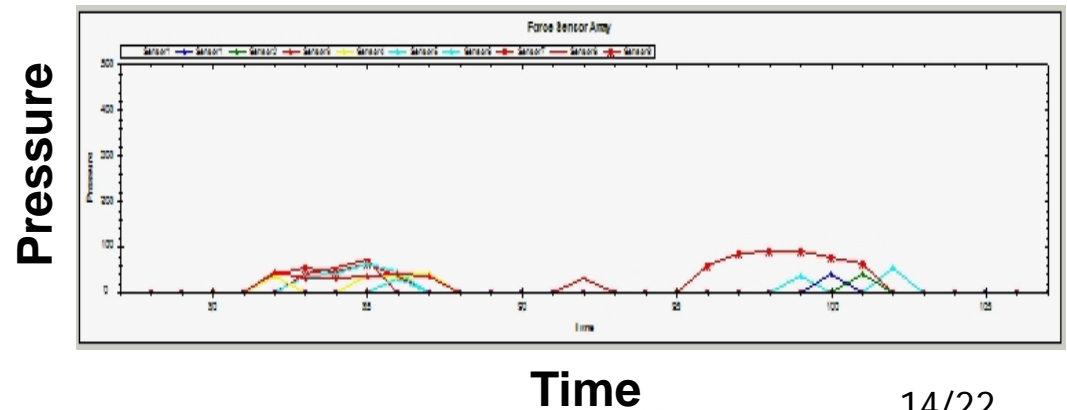
■ Calibration



■ Resting Position



■ Breast (without Tumor)



* Material and Methods – Phantom Model

Dummy



Size

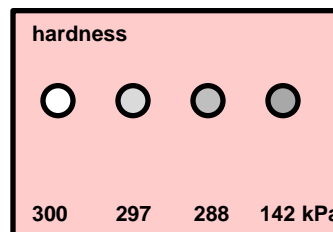
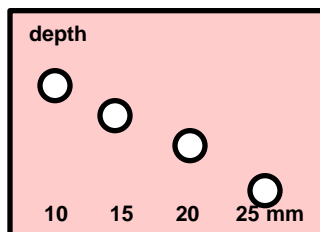
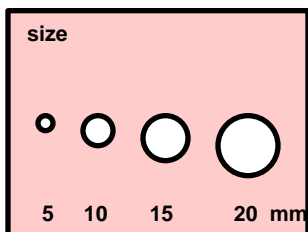
Depth

hardness



↕ 60mm

TOP



▪ Tumor

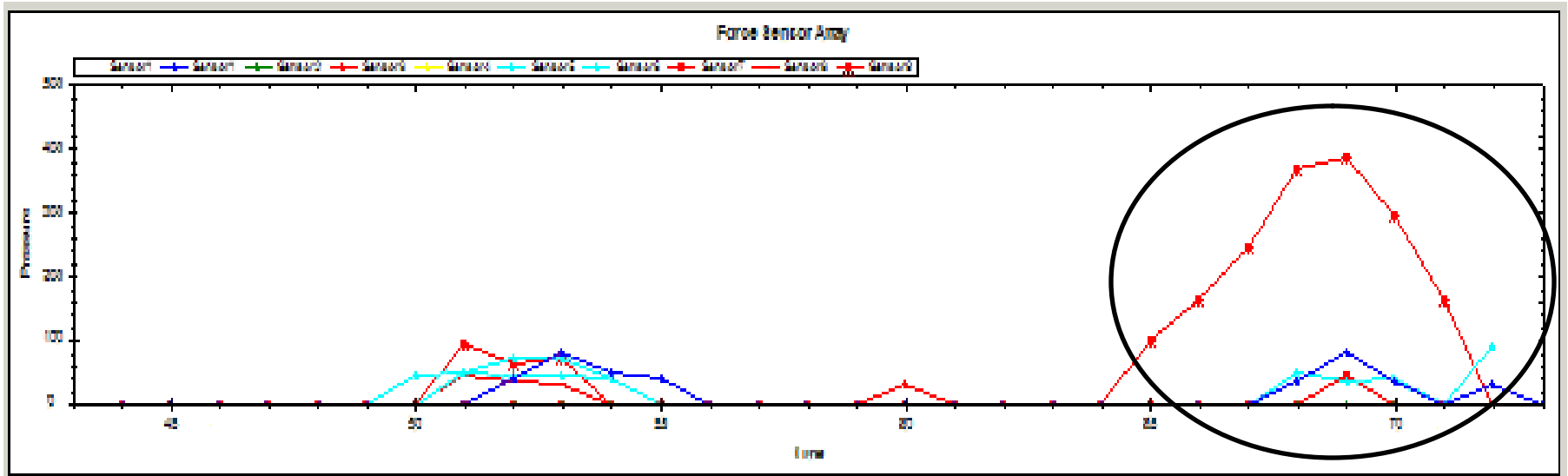
Phantom Number	Size (mm)	Depth (mm)	Hardness (silicone: curing reagent)	Young's Modulus (kPa)
1	5	10	1:1	300
2	10	10	1:1	300
3	15	10	1:1	300
4	20	10	1:1	300
5	17	5	1:1	300
6	17	10	1:1	300
7	17	15	1:1	300
8	17	20	1:1	300
9	17	10	1:1	300
10	17	10	1:5	297
11	17	10	1:10	288
12	17	10	1:15	142

▪Breast : Silicon Rubber, 31 kPa

* Results and Discussion – Breast Cancer Dummy



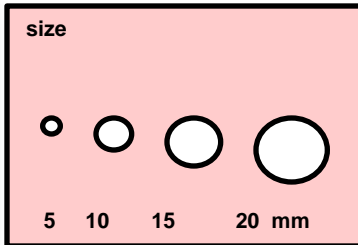
- **Dummy Specification**
Tumor Size: 20mm
Location: 2mm down
- **Result**
Detected pressure > 200



* Results and Discussion -Size



5mm 10mm 15mm 20mm



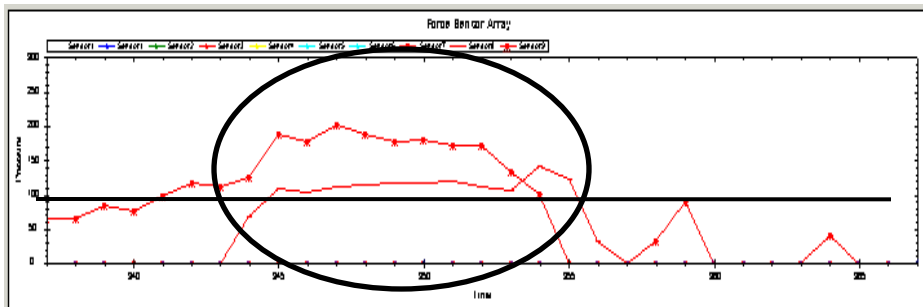
Phantom Model Specification

- Tumor Size : a) 5 mm
- b) 10 mm
- c) 15 mm
- d) 20 mm

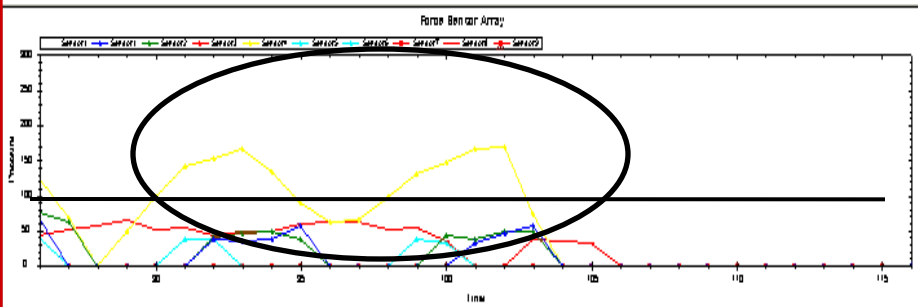
Depth: 10mm down

Hardness: 300kPa

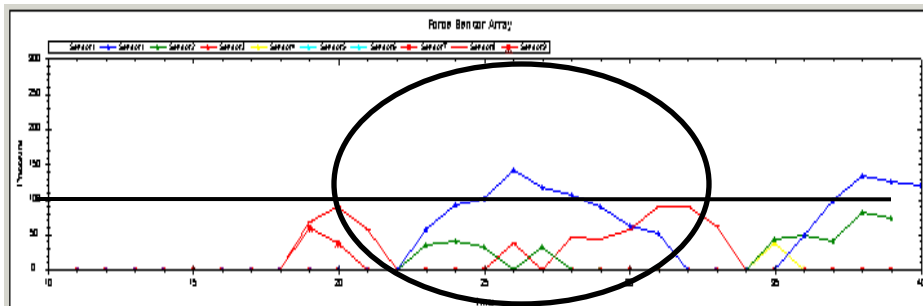
(a) 5mm



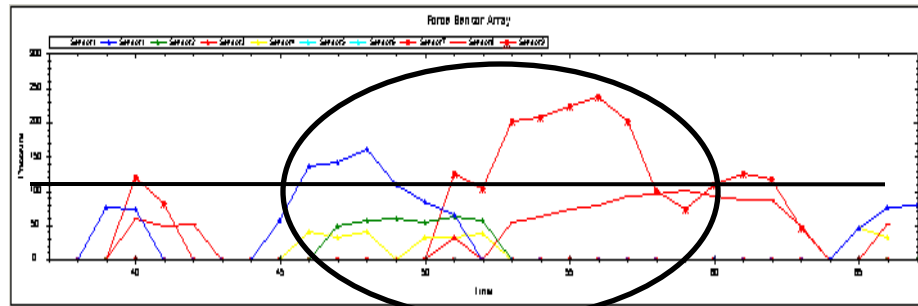
(c) 15mm



(b) 10mm



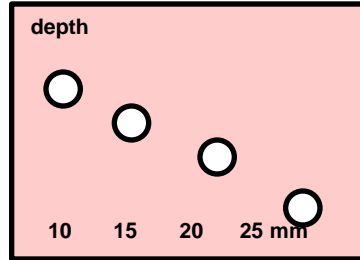
(d) 20mm



* Results and Discussion -Depth



10mm 15mm 20mm 25mm



Phantom Model Specification

Tumor Depth: a) 10 mm

b) 15 mm

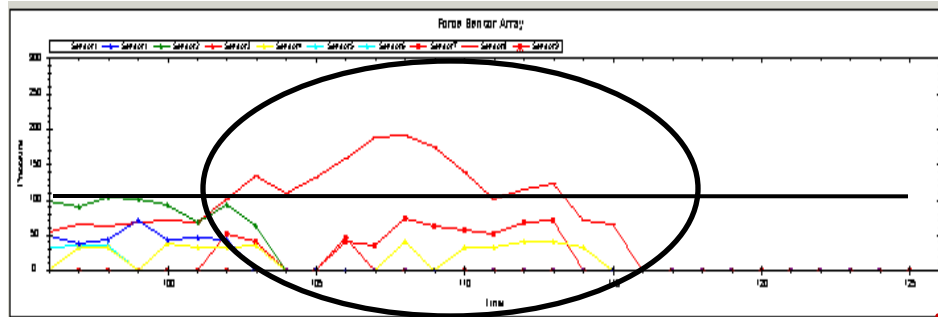
c) 20 mm

d) 25 mm

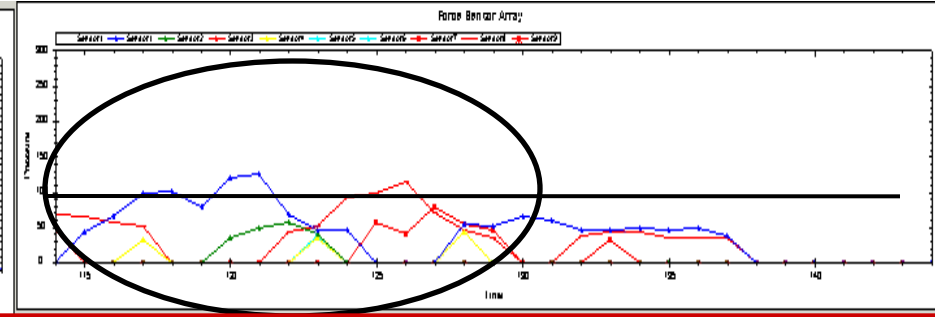
Size: 15mm

Hardness: 300kPa

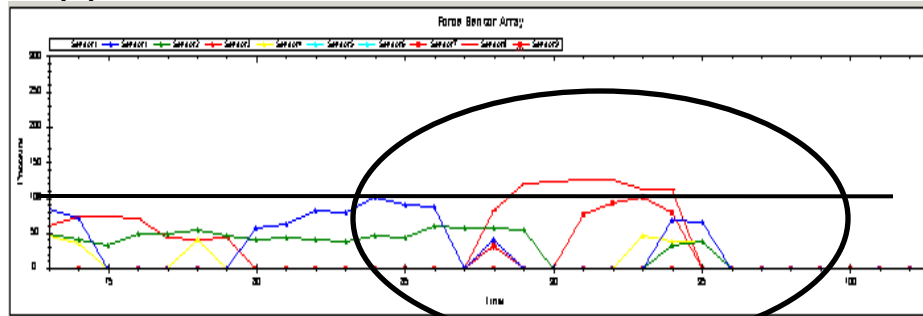
(a) 10mm



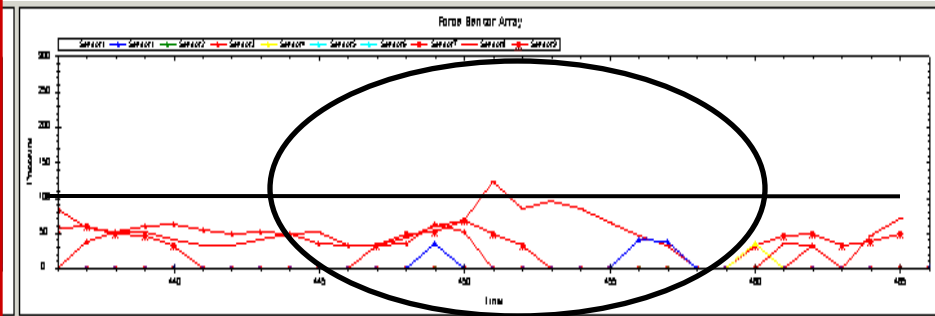
(c) 20mm



(b) 15mm



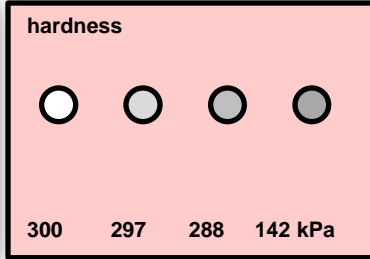
(d) 25mm



* Results and Discussion – Hardness



300kPa 297kPa 288kPa 142kPa

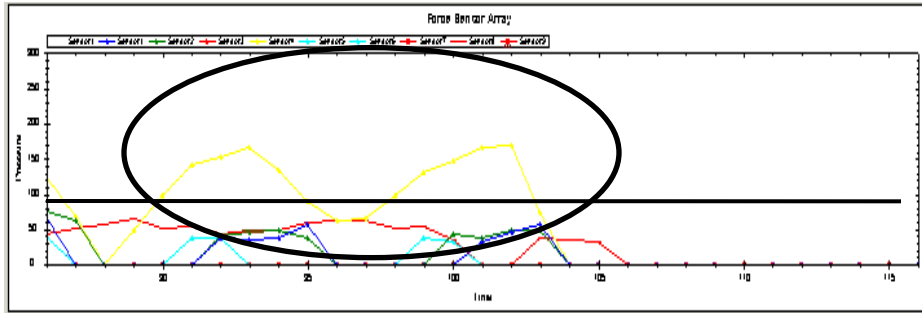


Phantom Model Specification

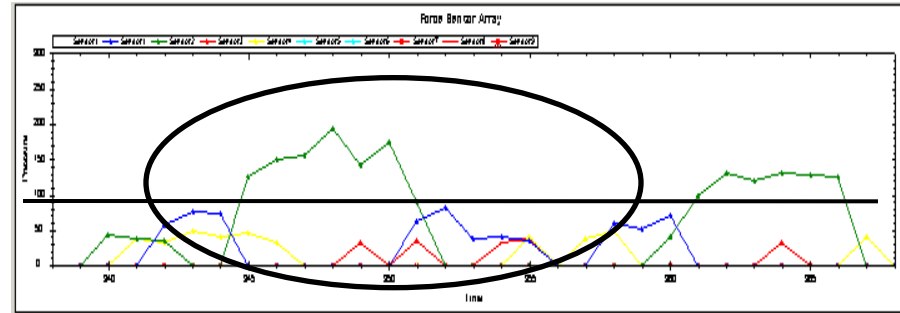
- Tumor Hardness: a) 300 kPa
- b) 297 kPa
- c) 288 kPa
- d) 142 kPa

Depth: 10mm down
Size: 15mm

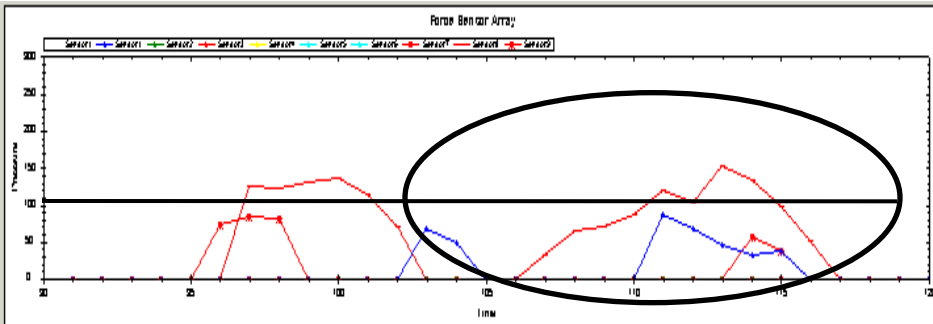
(a) 300kPa



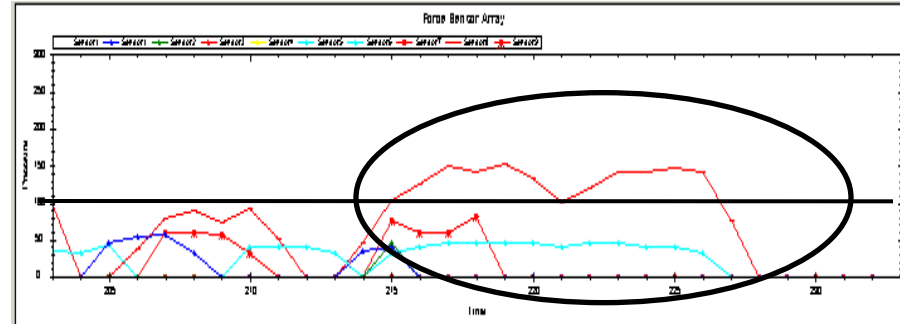
(c) 288kPa



(b) 297kPa



(d) 142kPa



* Conclusion

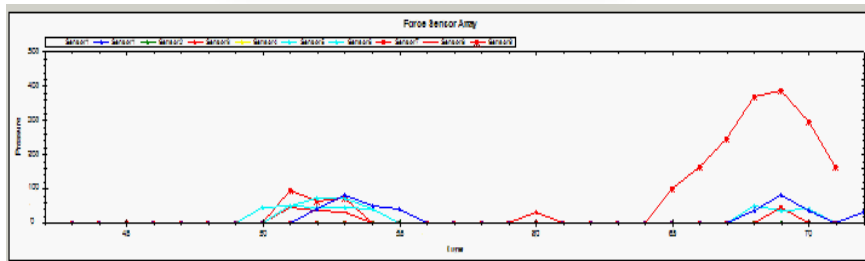
Advantages

- Wireless (Light)
- Standalone
- Real time monitoring
- Home health care purpose
- Magnified tactile feedback
- Definite detection
- Cheap

* Further Research

Practical Consideration

- Upgrade Pressure Monitoring System



- Clinical trials



Thank You

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