Unsupervised Automatic tracking of Thermal changes in Human Body

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MIVIM Multipolar Infrared Vision Infrarouge Multipolaire

visiooimage infrared vision systems

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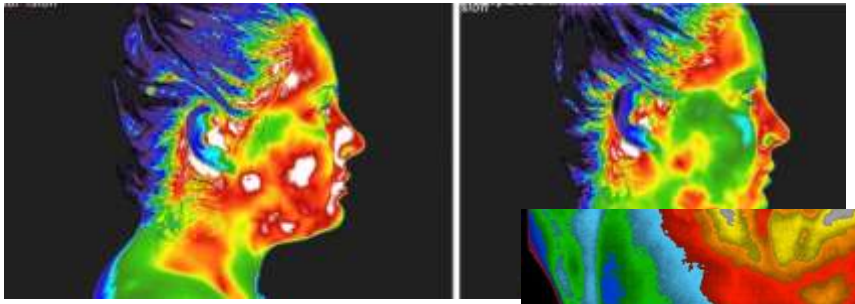
Outline

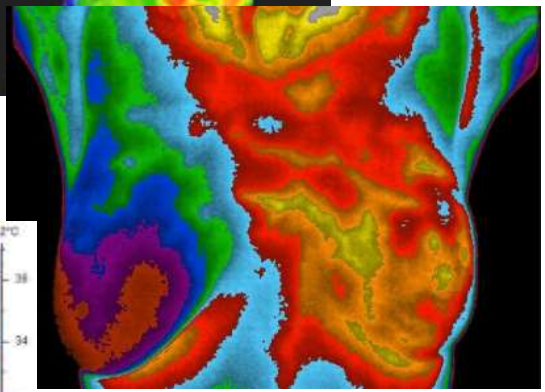
- Introduction
- Problem statement
- Finding the fabric which has good transmissivity
- Experimental setup
- Simulation results
- Conclusion

Introduction

- Some thermography medical applications:
  - Breast cancer
  - Dermatology
  - Avian flu
  - Dentistry
  - Psychology
  - Prevention



Picture adopted from: cimwellness.com



Picture adopted from: docblock.com

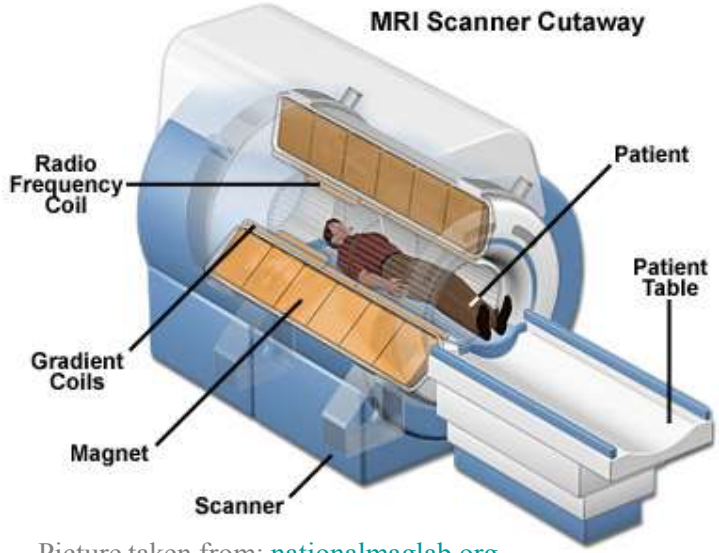
Picture taken from: www.alternavox.net
study conducted at the University of Granada
Department of Experimental Psychology

Over heating in Medical Rediology

- Nuclear Magnetic Resonance Imaging(NMR)
- Magnetic Resonance Imaging(MRI)
- Positron Emission Tomography (PET)
- ...

Picture taken from: science.howstuffworks.com

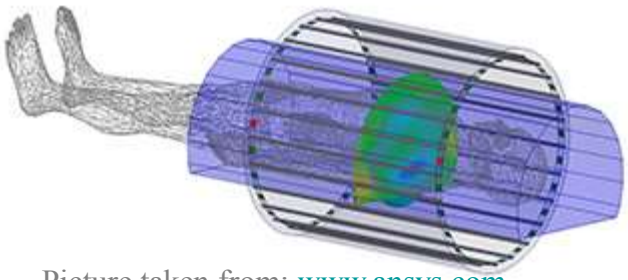
Picture adopted from: nabludedentists.blogspot.com



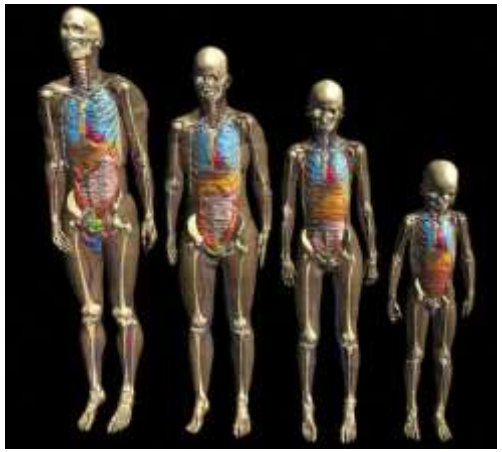
Picture taken from: nationalmaglab.org

Why Over heating Occurs

- Disparity in SAR (un-intentionally)
- High frequency of out patients (Intentionally)
- Having
  - Tattoo
  - Pierce
  - ...



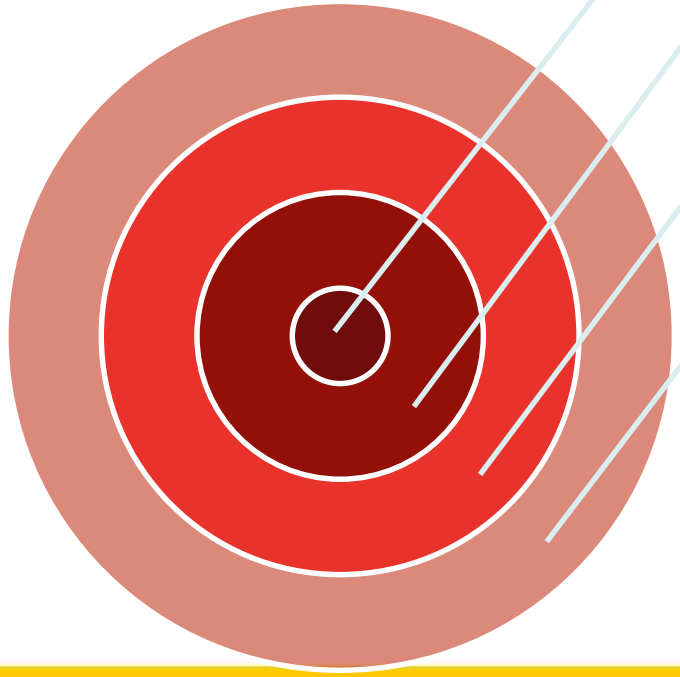
Picture taken from: www.ansys.com



Picture taken from: www.microwavejournal.com

Figure depicts burning after MRI scanning;(A) Lesion of the right hand immediately after the examination. (B) Lesion of the right hand and the skin of the right lateral pelvis 1 week after the examination.(from: Eising, EG, Hughes, J, Nolte, F, Jentzen, W, Bockisch, A (2010)Burn injury by nuclear magnetic resonance imaging, Clinical imaging 34(4), 293-297).

Objective



Implementing in the Medical field

Modelling analysis and Simulation

Finding the fabric

Analysis of Burn

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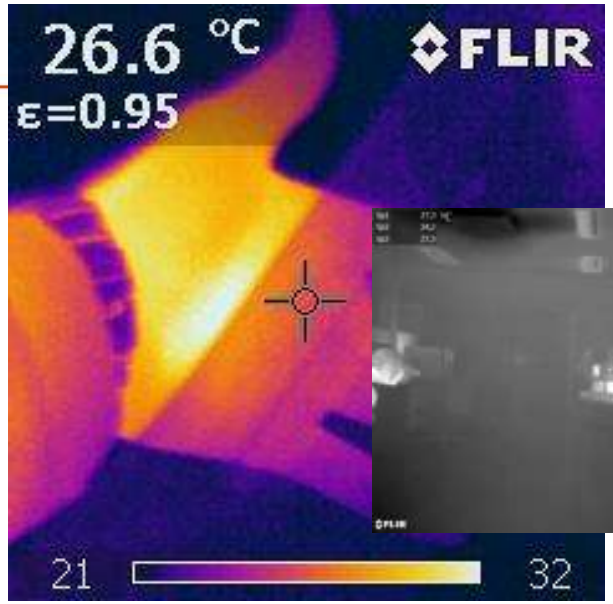
Finding the fabric

• We can thermally see the human patient body unless we can have good gown material.
• For finding suitable fabric regarding the radiology gown, many experiments with lots of different kinds of materials have been conducted.

• The target was finding the material which have these conditions:

- **Not very expensive:** disposable
- **Good transmissivity:** thermally can be seen through it
- **Comfortable for the patients:** keep the patient warm and good in appearance



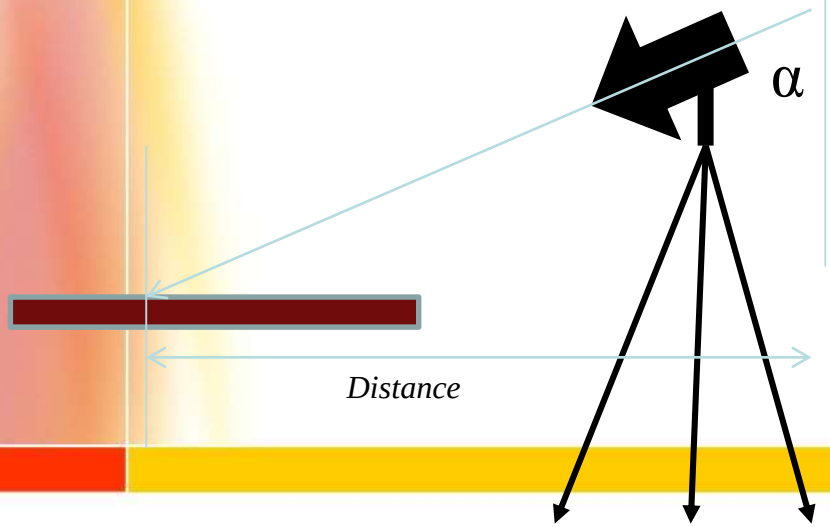
Experimental setup-Fabric

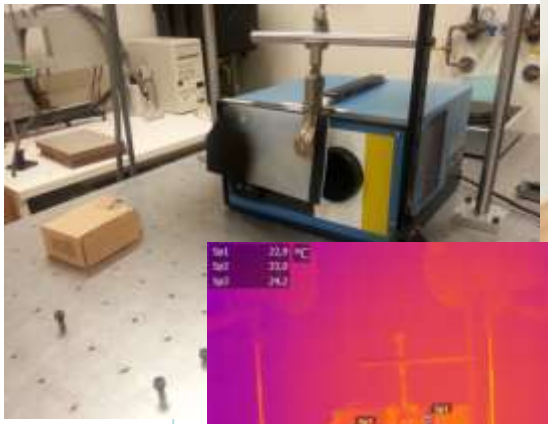
- Several different setups have been tested and the transmissivity of the fabrics have been examined even in the angular form.

$\alpha = \arctan(495/96) * 180 / \pi = 79.02 \circ$

$$\tau = \frac{\text{Temperature of the object after being covered by fabric}}{\text{Temperature of the object without being covered}}$$

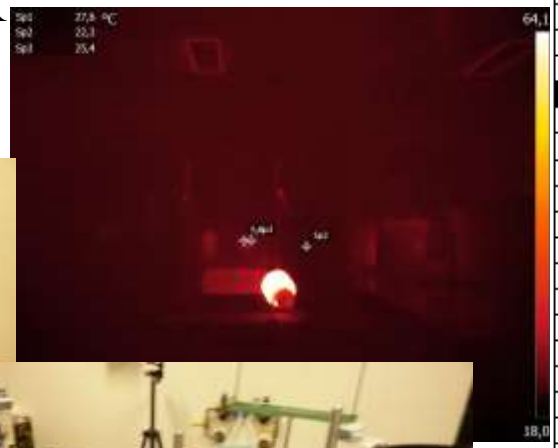
$$\text{Transmissivity}(\tau) = \frac{28.3}{34.04} = 0.83$$

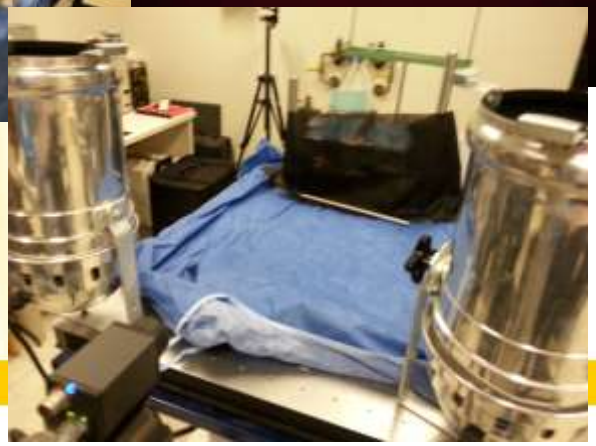




Fabric experiments

- We have tested more than 50 different possible materials to find the gown.
- The IR cameras we have used in the experiments were:
- A65
- JEOPTIK
- I60





Fabric name	Temperature before being covered	Temperature after being covered	Transmissivity of the fabric
1	31.3◦C	24.7◦C	0.789
2	31.3◦C	24.5◦C	0.783
3	31.3◦C	24.5◦C	0.783
4	31.3◦C	24.6◦C	0.786
5	31.3◦C	24.4◦C	0.779
6	31.3◦C	24.8◦C	0.792
7	31.3◦C	24.4◦C	0.779
8	31.3◦C	23.7◦C	0.757
9	31.3◦C	23.8◦C	0.7603
10	31.3◦C	24.0◦C	0.767
11	31.3◦C	24.7◦C	0.789
13	31.3◦C	24.6◦C	0.786
14	31.3◦C	24.5◦C	0.783
15	31.3◦C	27.0◦C	0.862
16	31.3◦C	26.4◦C	0.843
17	31.3◦C	26.1◦C	0.834
18	31.3◦C	25.5◦C	0.815
19	31.3◦C	25.3◦C	0.808
20	31.3◦C	24.6◦C	0.786
21	31.3◦C	25.0◦C	0.799
22	31.3◦C	28.3◦C	0.904
23	31.3◦C	25.2◦C	0.805
24	31.3◦C	25.0◦C	0.798
25	31.3◦C	24.6◦C	0.786
26	31.3◦C	24.5◦C	0.783
27	31.3◦C	25.2◦C	0.805
28	31.3◦C	24.9◦C	0.795
29	31.3◦C	24.9◦C	0.795
30	31.3◦C	24.9◦C	0.795
31	31.3◦C	24.6◦C	0.786
32	31.3◦C	25.0◦C	0.798
33	31.3◦C	24.8◦C	0.792
Targeted Fabric	31.3◦C	26.9◦C	0.85943

Only the results of very last experiment

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Modelling analysis and Simulation

There was two system pursued:

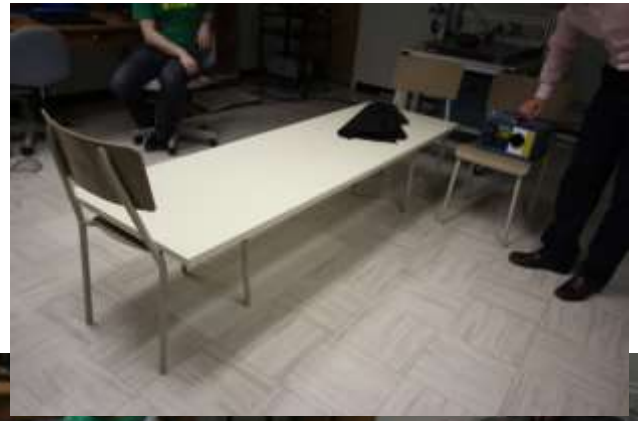
Not related to this paper

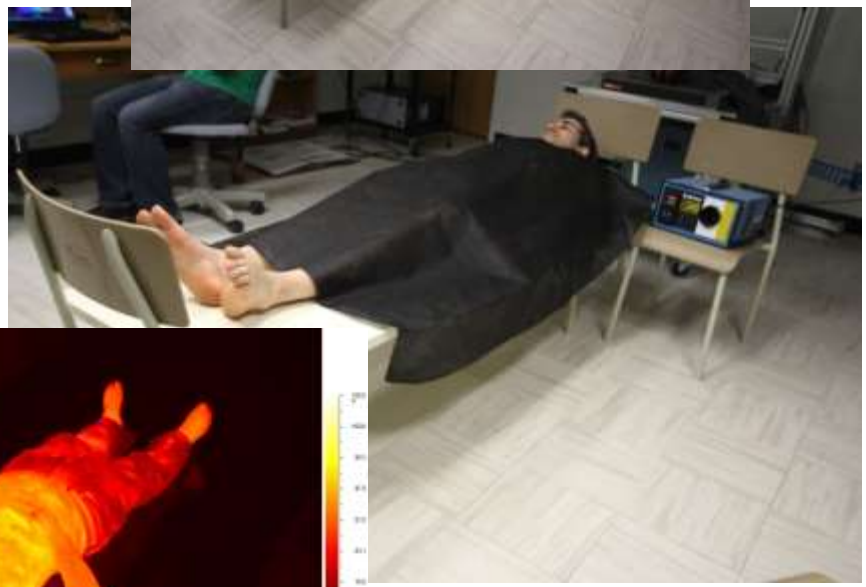
- Making 3D model of human patient: **(Kinect utilization, Applying SURF, Find most similar keypoints, Applying ICP, Accumulating point clouds and Visualization using PCL converting thermal image into it)**
- Making the overheating tracker

3D model of the human patient

Making the radiology environment

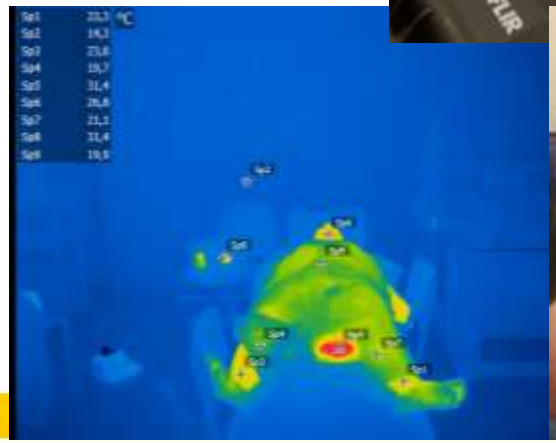
- We have created one room where strived to simulate the radiology environment i.e. Cold room, uncomfortable bed, etc.
- Six participants (co-authors) wore gown(only) and lied down on the bed for 15min.
- Then they passed comfortable test, by answering to the questionnaire prepared for them to report any uncomfortably.



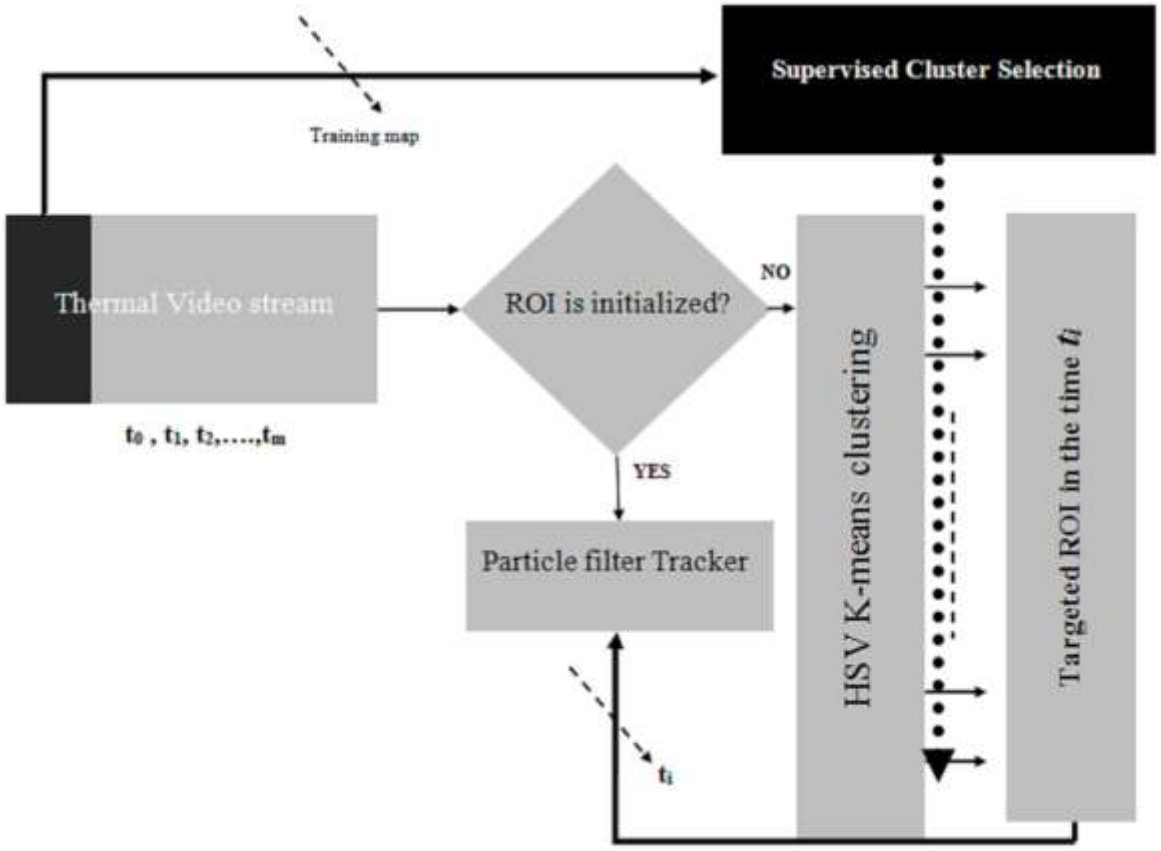


Making the overheating tracker

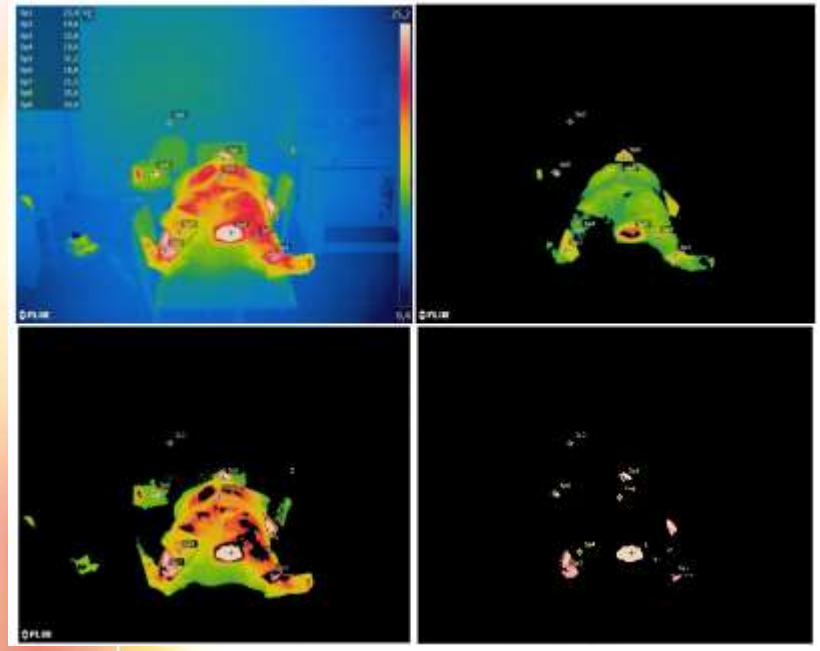
- Finding the **thermal changes** during the IR video is performing.
- For thermal changes we have used a plate that its temperature can be changed during the time.
- Gathering the **thermal video** from the subject while the **temperature increases** as input for the proposed system to track the overheating points.



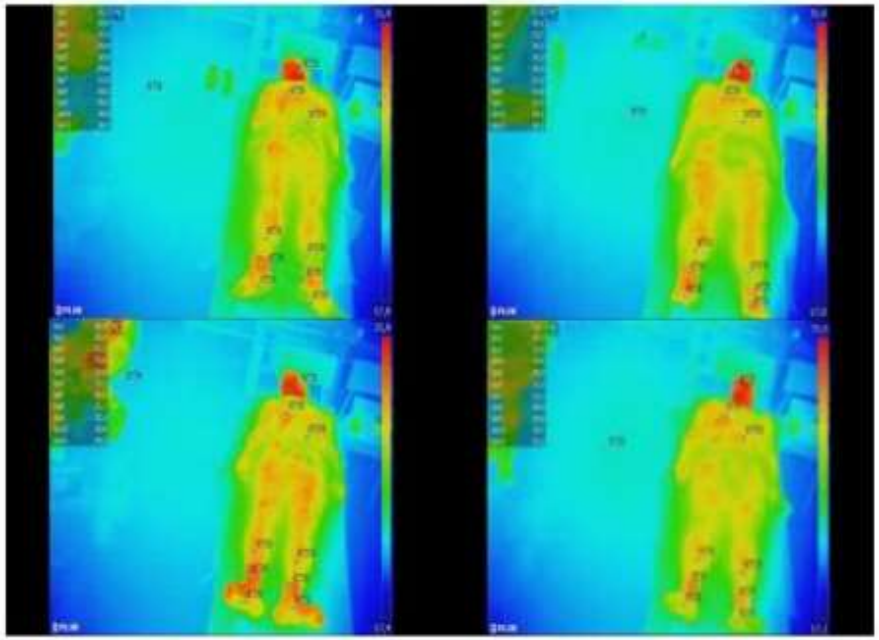
Tracking Mechanism



Results



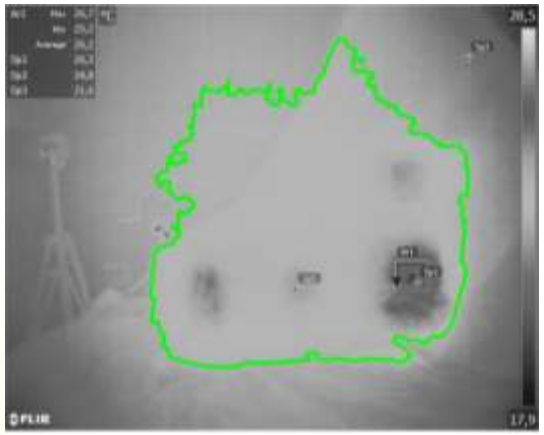
Results of the clustering, different clusters showing different temperature



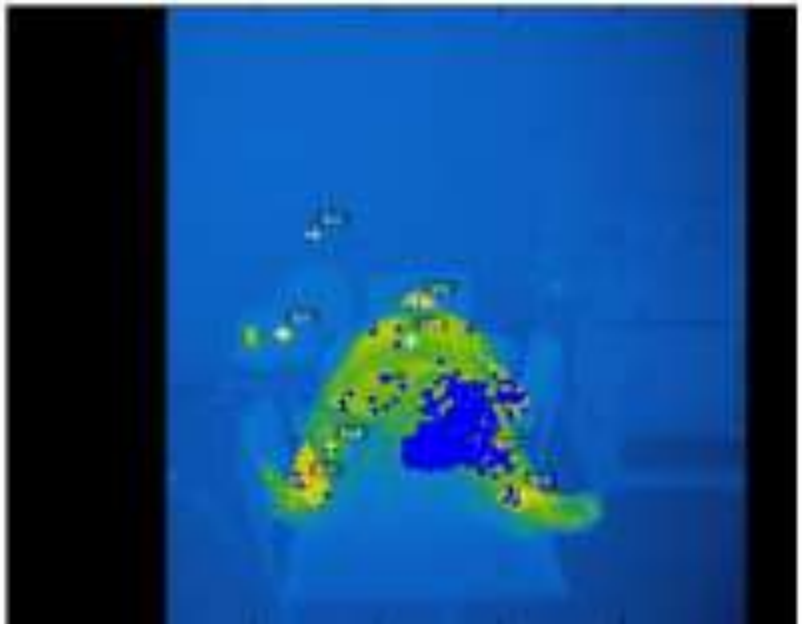
Subjects samples whom participated in the experiment

Results

Video



Even we have used Active contour

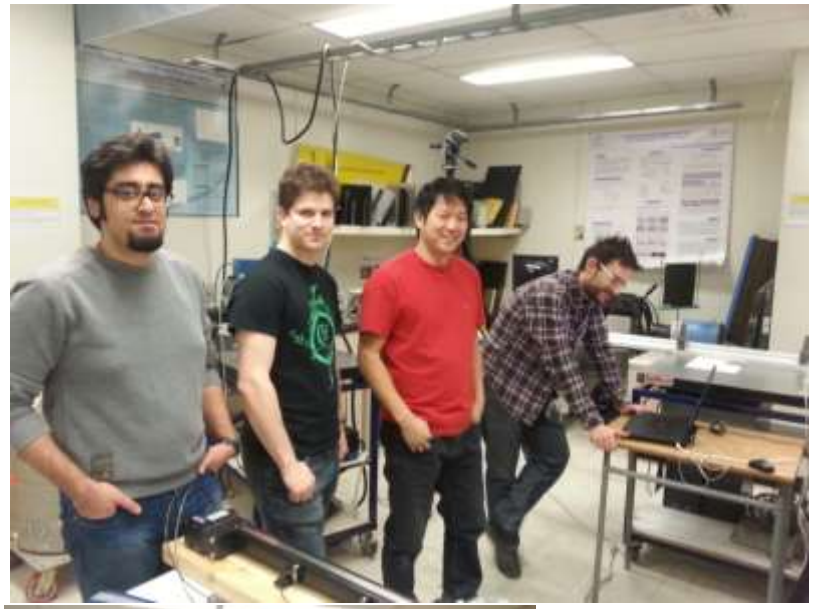


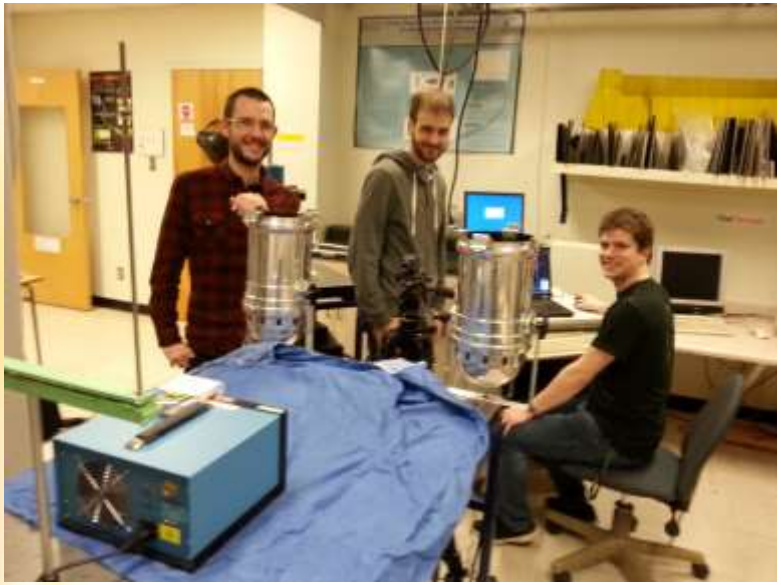
Particles during tracking the hot spots

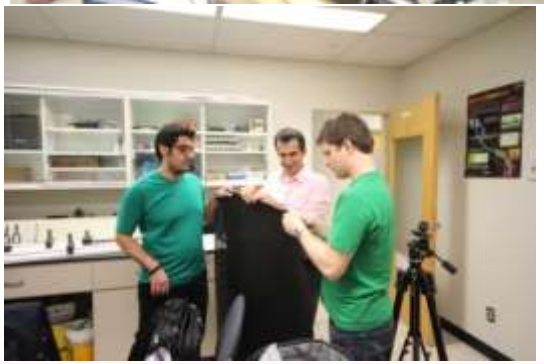
Conclusion

- Series of experiments for finding the **thermal suitable fabric** (for candidate radiological gown) have been conducted.
- Based on information gathered from the experiments **suitable fabric** has been selected by having following conditions:
  - Has significant thermal property (*i.e.* **Transmissivity**);
  - **Cheaper** as compare with other fabric materials;
  - Easily **available**;
  - Has **good comfort factors** for the patients during the MRI;
  - It does **not easily foldable** so gives good property that we show not be worry about the several layer transmittance;
  - **It is warm** while has good transmittance so the necessity of **blanket** will be **eliminated**.
- A system for tracking the hot spots have been made and performed significant and robust.

Thank you







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