



# Bio-imaging

## Laboratory

**Kyung Hee University  
Biomedical Engineering  
Room 719**

# 1

## About Professor

## Bio-imaging Lab.

### 김 태 성 교수님

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- University of Southern California, BioMedical Engineering
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- Office room: 717호



### Representative Research Field

- **3D Depth Image based Human pose recognition and Gesture Interface**
  - Application: Game, Gesture Interface , Computer Interface, Health Care and Rehabilitation
- **3D Depth Image based Hand Gesture Estimation**
  - Application: Game, Smart Home, Smart Health Care, Life logging

Representative Paper : **“Estimation of 3D Human Body Posture via Co-registration of 3D Human Body Model and Sequential Stereo Information”**, Applied Intelligence, 35, 163-177, 2011

International Paper : **“Recovering 3D Human Body Postures from Depth Maps and Its Applications in Human Activity Recognition,”** *Depth Map and 3D Imaging Applications: Algorithms and Technologies*, IGI Global, USA, 2011

Domestic patent: **Implementation Method of 3D Human Motion 인체동작의 3D 모션 구현 방법** (101193223000)



# 2

구성원

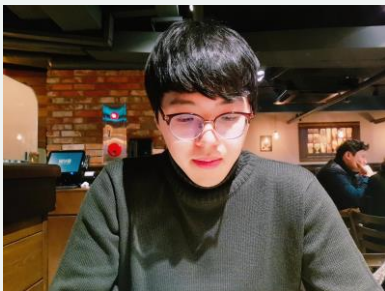
Bio-imaging Lab.



박혜민



박나현



오지현



Edwin



Patricio



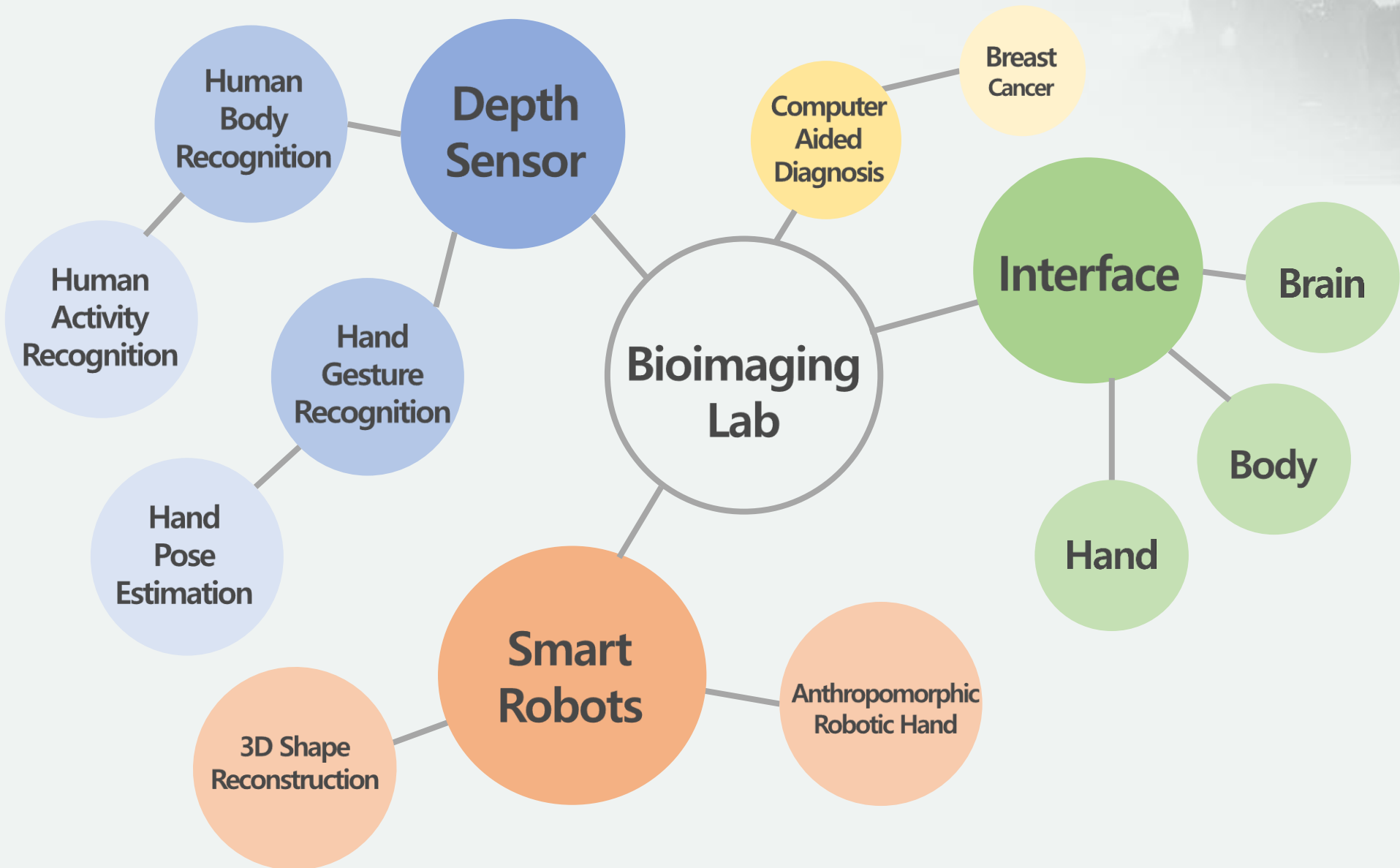
Mohammed



Mugahed

# Research

Bio-imaging Lab.

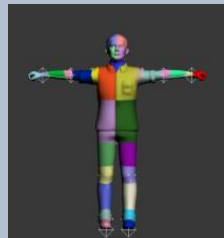


# 3 About LAB

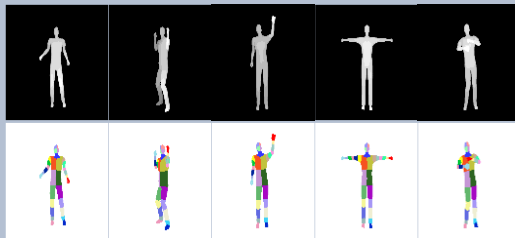
## Previous Research

### Human Body Parts Recognition from Depth Images

#### Generation of Training Data



3D Body Model



Synthetic Database

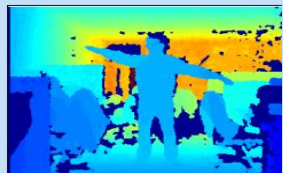
#### Training Random Forests



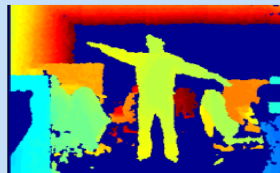
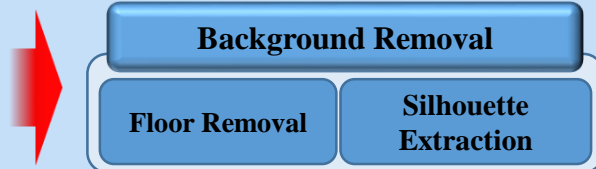
#### 3D Pose Estimation Algorithm



Prime Sense  
Depth Camera



Depth Map



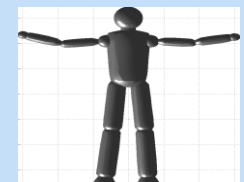
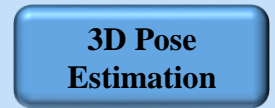
Floor Removal



Depth Silhouette



Labeled Result

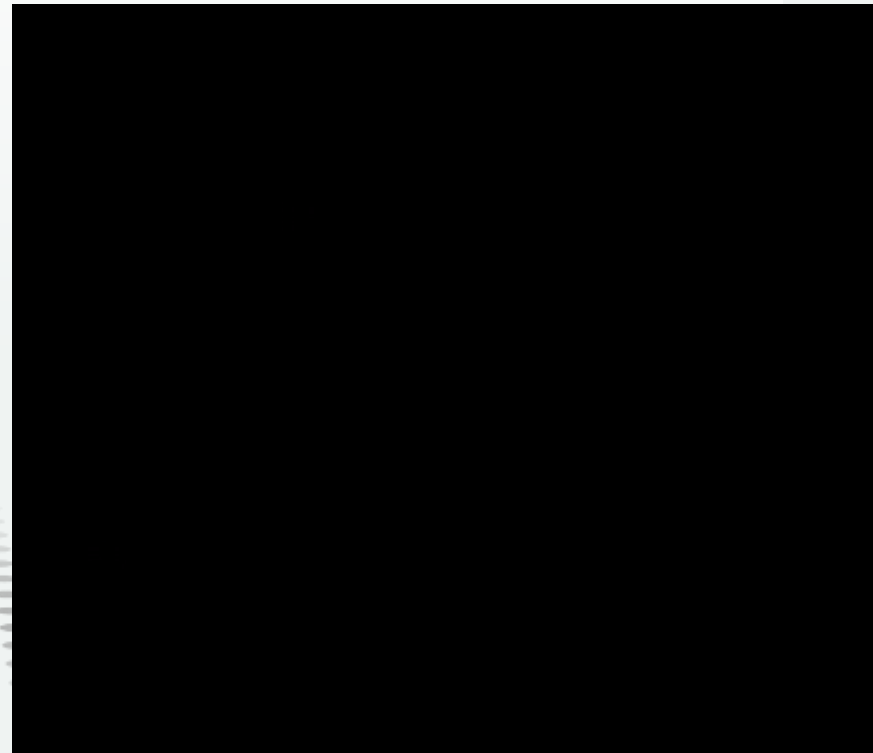
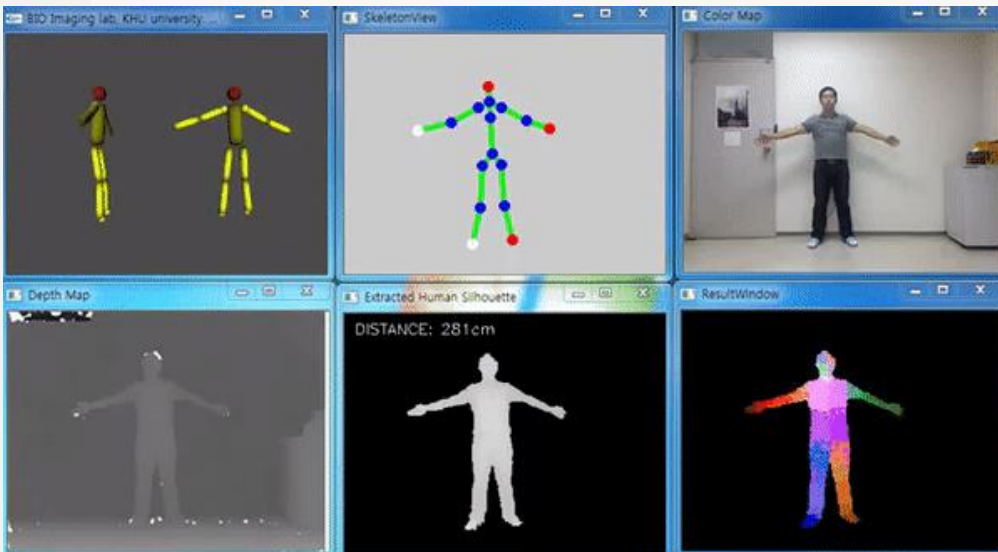


3D Pose Estimation

# 3 About LAB

## Previous Research

- Human Body Parts Recognition from Depth Images
- 3D Human Musculoskeletal Pose Reconstruction



### Robot interface using human joint information based on depth motion recognition

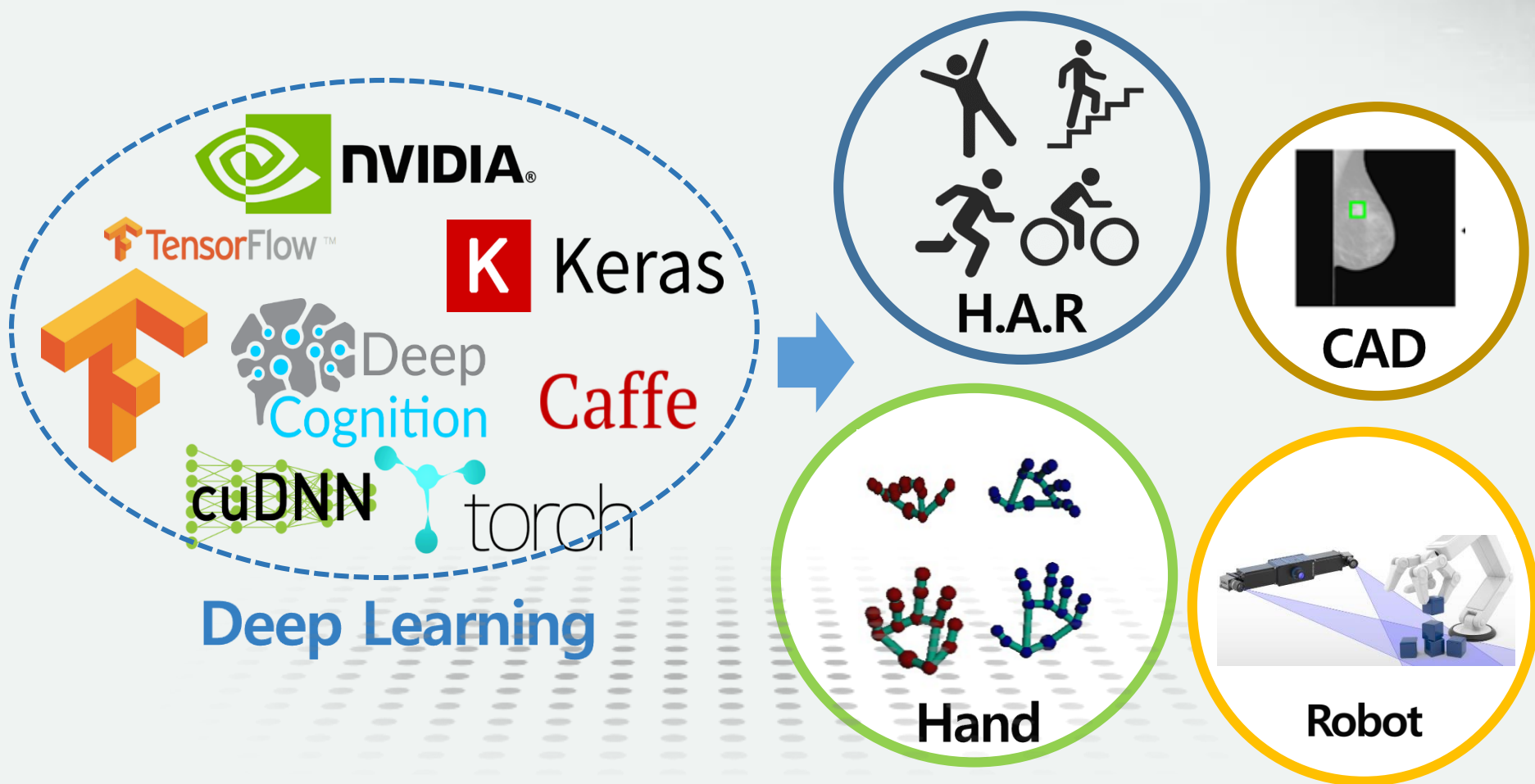


Bio-imaging/Brain Engineering Lab  
in Kyunghee Univ.



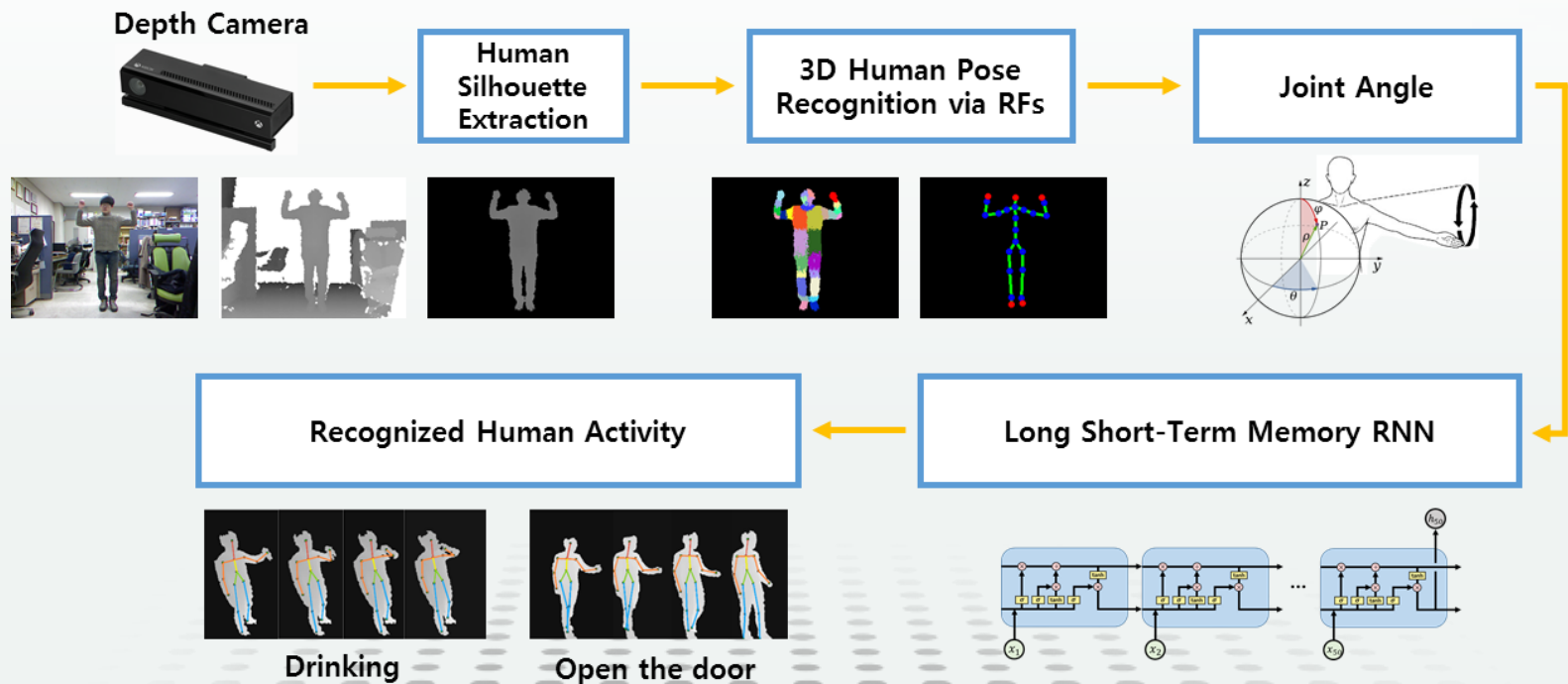
# 4 From Deep Learning

## Deep learning





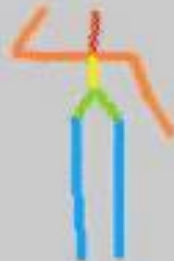
### Deep Learning – Human Activity Recognition



# 4 About LAB

## Recent Research

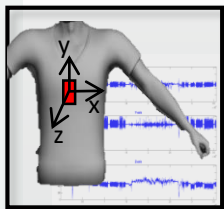
### Deep Learning - Human Activity Recognition



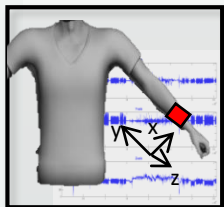
# 4 About LAB

## Recent Research

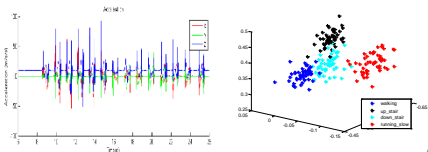
### Deep Learning - Human Activity Recognition (IMU)



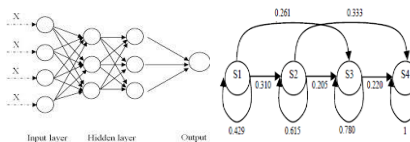
Wearable Device



특징 추출



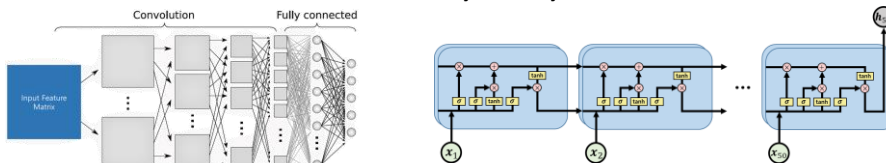
ANN, HMM, SVM



Activity 인식



딥러닝: DBN, CNN, RNN



Life/Exer. Log



Energy Expenditure



$$y(i) = |e(i) - e(i-1)|$$

$$c(i) = 2a^2(1 - \cos(y(i)))$$

$$distance = \sum_{i=step} c(i)$$

$$Speed = distance/duration$$

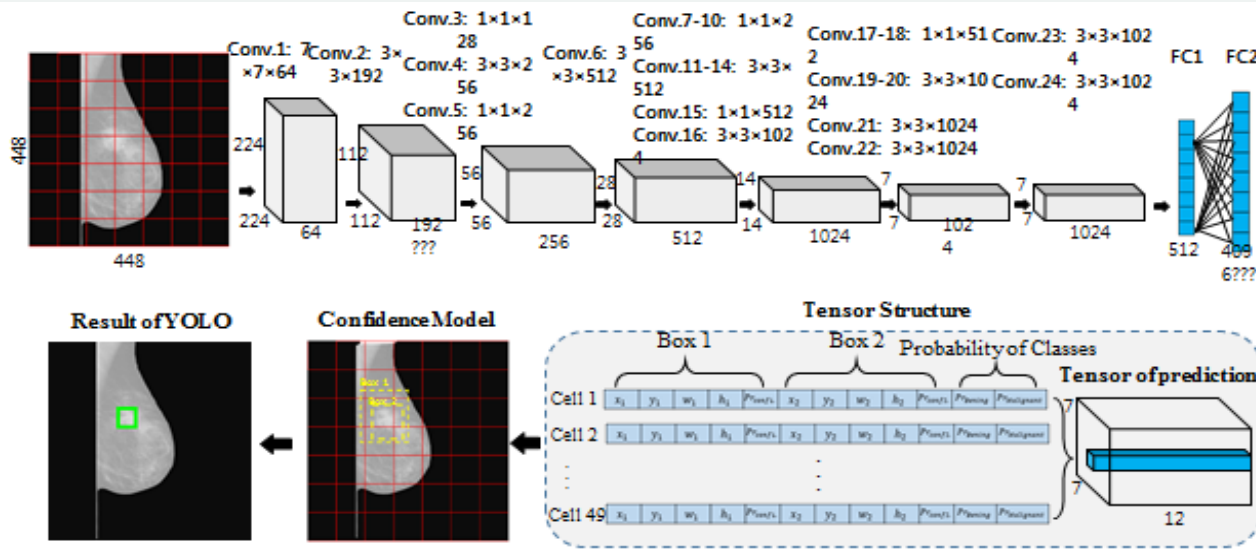
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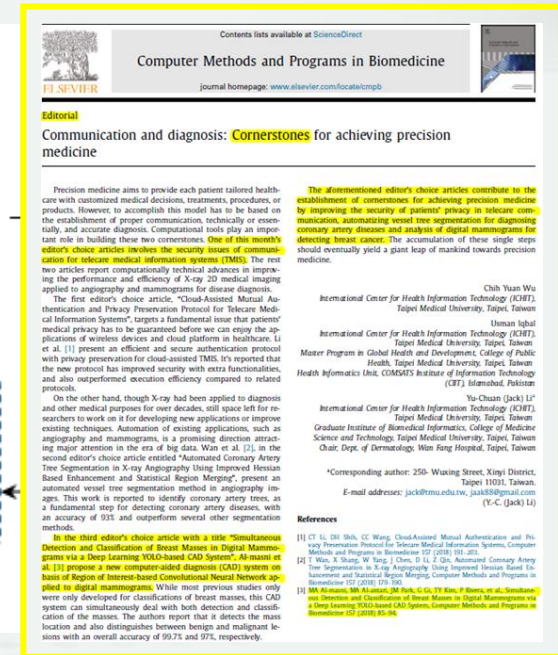
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## Recent Research

### YOLO기반의 디지털 X-ray 유방암 자동 진단 CAD 시스템 개발



유방암 조직 검출 및 진단을 위한 CAD 시스템 구조



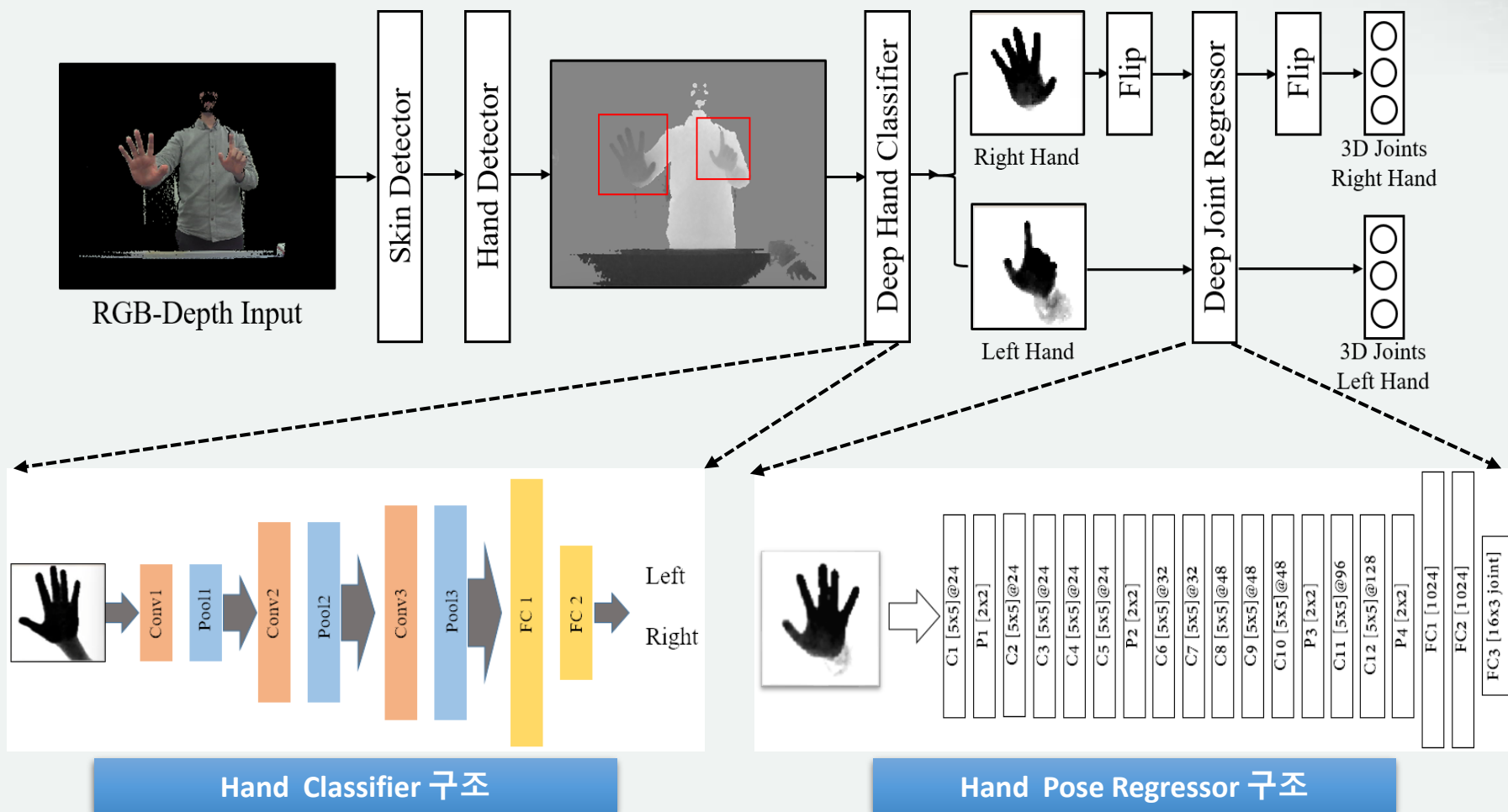
Cornerstone Paper  
for Precision Medicine of 2018



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## Recent Research

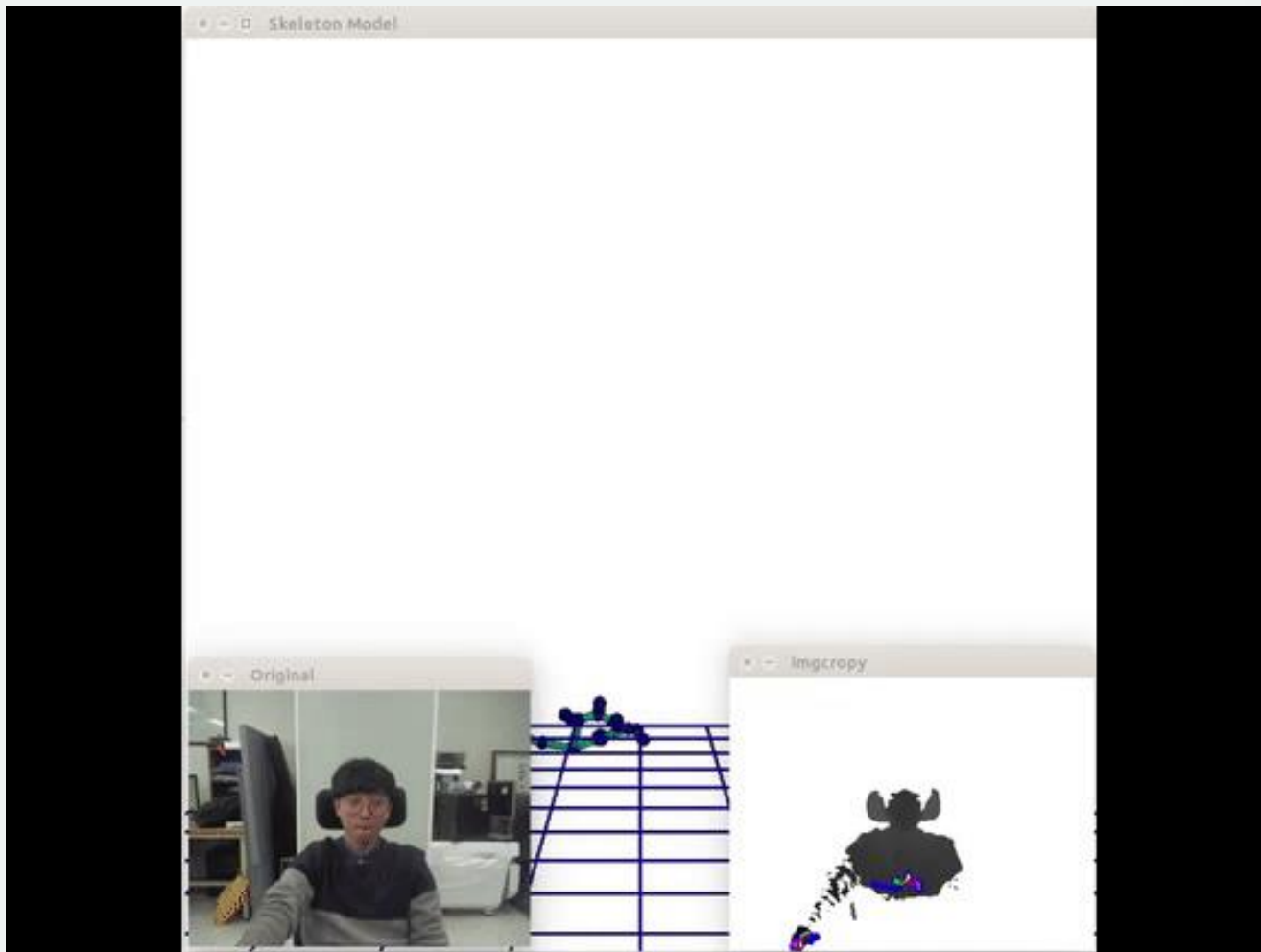
### CNN기반의 Real-time Hand Pose Recognition System



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## Recent Research

### CNN기반의 Real-time Hand Pose Recognition System

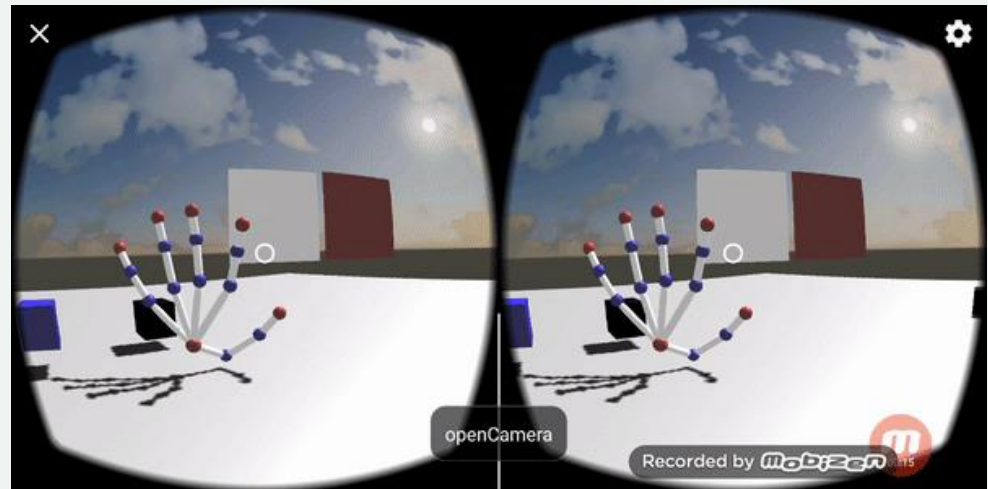
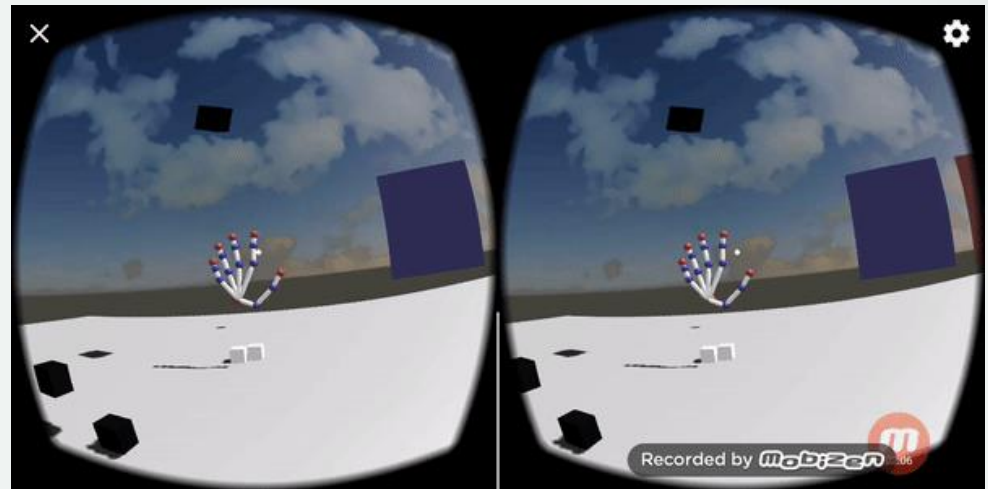
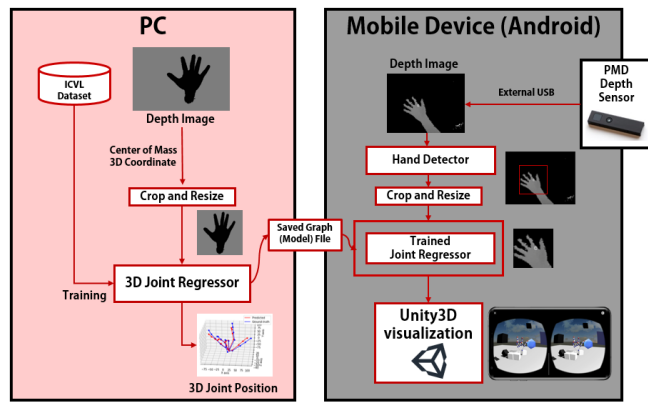


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## Recent Research

### CNN기반의 Real-time Hand Pose Recognition System (VR Hand Interface)

PMD Depth Sensor



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## Recent Research

### Smart Robots & Other Applications



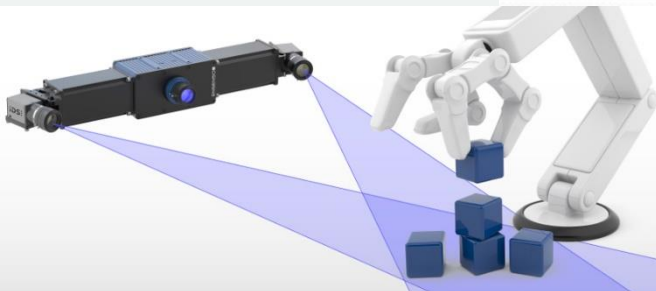
RGB Sensor



Stereo Depth Vision



TOF Depth Vision

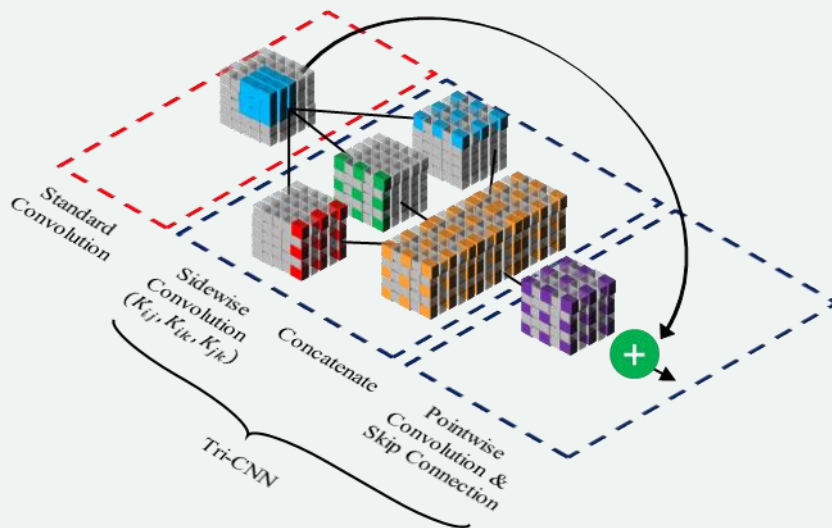
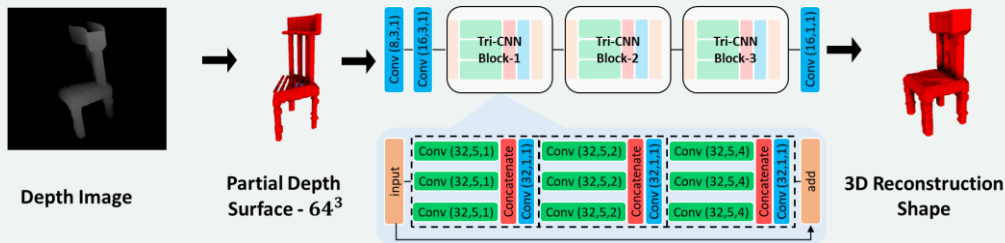


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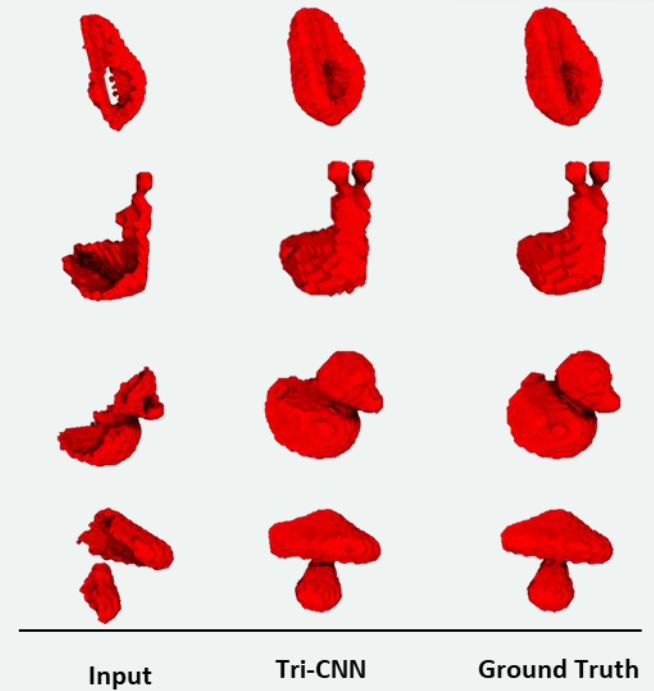
## Recent Research

### 3D Shape Reconstruction

#### • Algorithm



#### • 3D Objects





# 4 About LAB

## Recent Research

### Smart Robots & Other Applications

- Anthropomorphic Robotic Hand Algorithm

1.- Get hand states  $s_0$

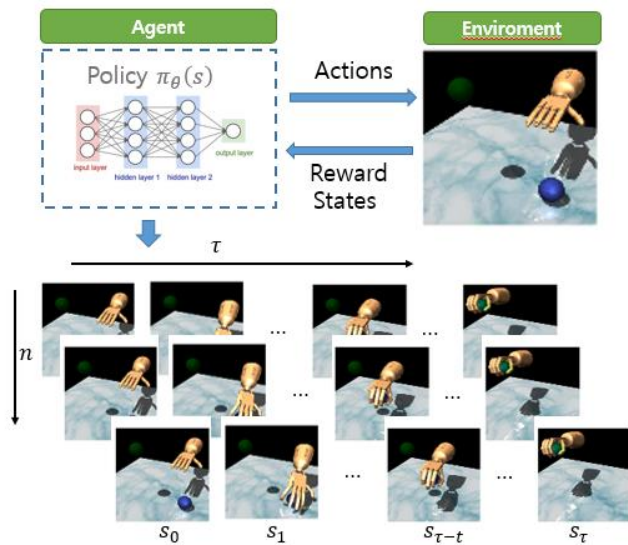
2.- Sample actions  $a_t$  and get new state  $s_t$

3.- Compute gradient

$$\nabla_{\theta} J(\pi_{\theta}) = \mathbb{E}_{\tau} \left[ \sum_{t=0}^T \nabla_{\theta} \log \pi_{\theta}(a_t | s_t) R(s_t) \right]$$

4.- Update parameters

$$\theta_{k+1} = \theta_k + \alpha \nabla_{\theta} J(\pi_{\theta}) \Big|_{\theta_k}$$



- Anthropomorphic Robotic Hand Simulation

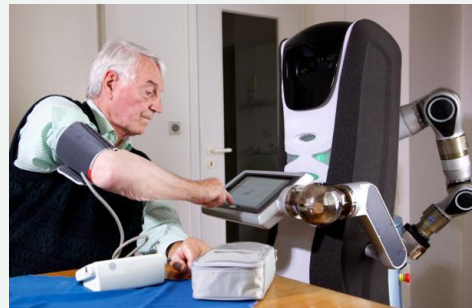
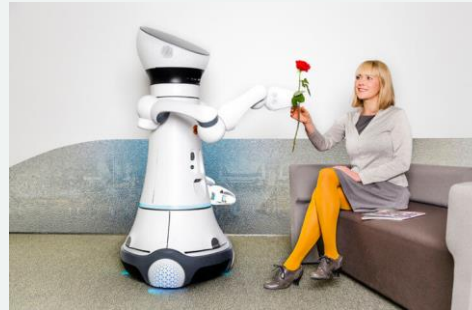
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Run speed = 0.500 x real time [S]lower, [F]aster
Render every frame On
Switch camera (#cams = 2) [Tab] (camera ID = -1)
[O]nly contact forces On
Reference frames On
[Tr]ansparent Off
Display [M]ocap bodies On
Stop [Space]
Advance simulation by one step [right arrow]
[H]ide Menu
Record [V]ideo (Off)
Cap[tu]re frame
Start [G]db
Toggle geomgroup visibility 0-4
```



# 4 About LAB

## Future Research

### Smart Robots & Other Applications







Thank you!  
Bio-Imaging Lab., KHU  
Welcome to 719!