[2024-1 Robotics]
Chapter 0. Introduction to Course

Gyunghoon Park

School of ECE, University of Seoul

서울시립대학교
UNIVERSITY OF SEOUL

About the course

- Course title: 로봇공학 (Robotics)
- Lecturer: 박경훈 (Prof. Gyunghoon Park)
  - Office: 정보기술관 501호 (Rm. 501, IT bldg.)
  - Email: `gyunghoon.park@uos.ac.kr`
  - Phone number: 02-6490-2322
- Teaching assistant: None.
- Language: 한국어
- Platform: 대면강의 / 온라인강의실
- Office hour: On-demand
- Goal of the course:
  - 로봇의 해석 및 제어를 위한 기본 개념들을 숙지한다.
  - 로봇이 주어진 작업을 어떻게 수행하는지에 대한 일련의 과정을 이해하고, 이를 MATLAB/Simulink 상에서 확인한다.
- For more details, see `https://cdsl-uos-wiki.notion.site/2024-1-49-587-01-63c4e0fb97774f749f53d9dfce244fed?pvs=4`

Two representative forms of robots

- Robot arm (or robot manipulator)
  `https://www.youtube.com/watch?v=bXo68UFNyhk`

Figures: Franka Emika Panda (`https://www.franka.de/robot-system`)

Two representative forms of robots (Cont'd)

- Mobile robot

  https://www.youtube.com/watch?v=FkkZQjZ_-oM

Figure: Dilly drive (배달의 민족)

(https://biz.chosun.com/site/data/html_dir/2020/09/21/2020092101630.html)

A paradigm shift by DARPA Robotics Challenge (DRC)

- The 2011 Japan earthquake brings a question to the robotics society:

  "How can the robot help the human beings in disaster or emergency-response scenarios?"

- A robotics challenge was held from 2012 to 2015 funded by the US DARPA to answer the question.

Figure: `https://www.darpa.mil/about-us/timeline/darpa-robotics-challenge`

(Cont'd)

- The challenge considers 8 main tasks, including
  - Drive a vehicle at the site;
  - Connect a fire hose to a standpipe and turn on a valve.
  - Open a door and enter a building

`https://www.youtube.com/watch?v=8P9geWwi9e0`

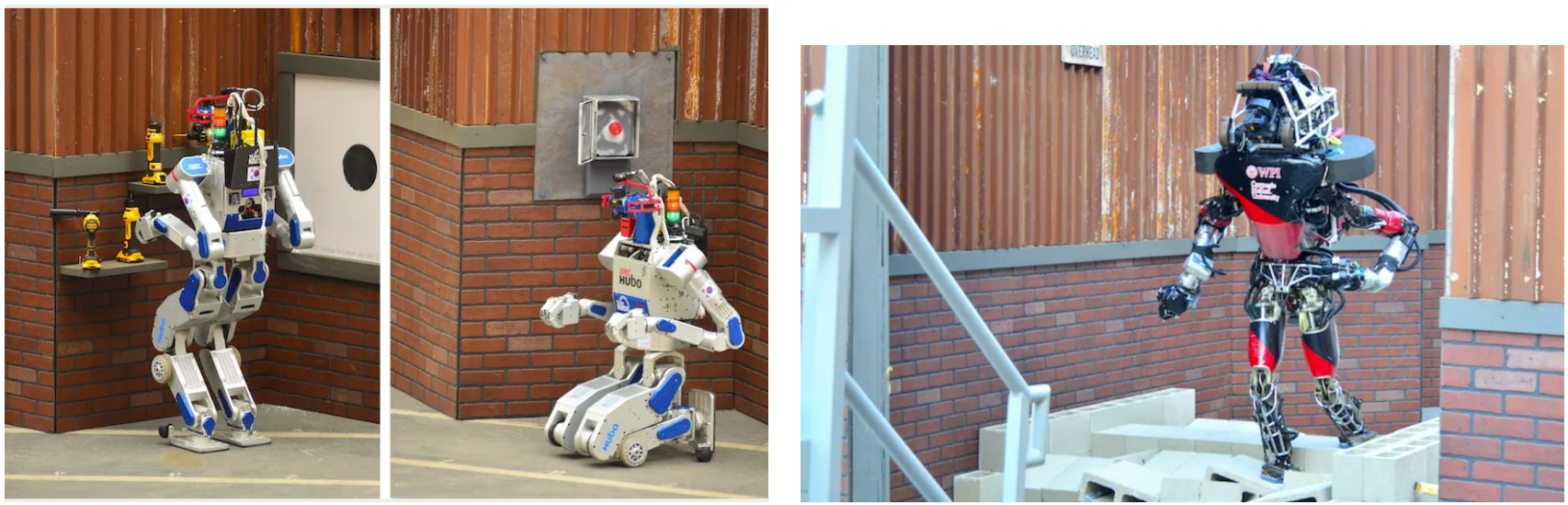


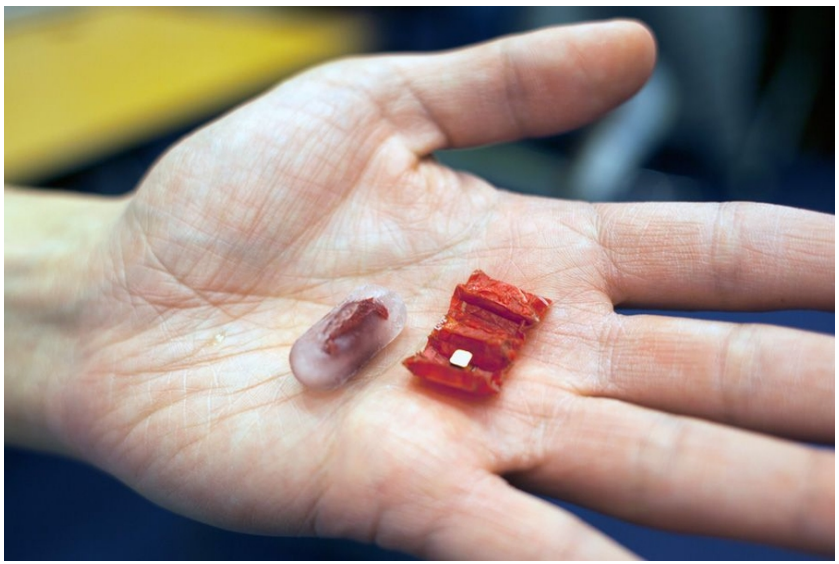
Figure: `https://www.darpa.mil/about-us/timeline/darpa-robotics-challenge`

Recent trends in robotics research

- Use of soft materials

  https://www.youtube.com/watch?v=ZVYz7g-qLjs

  https://www.youtube.com/watch?v=X0XGure7mak



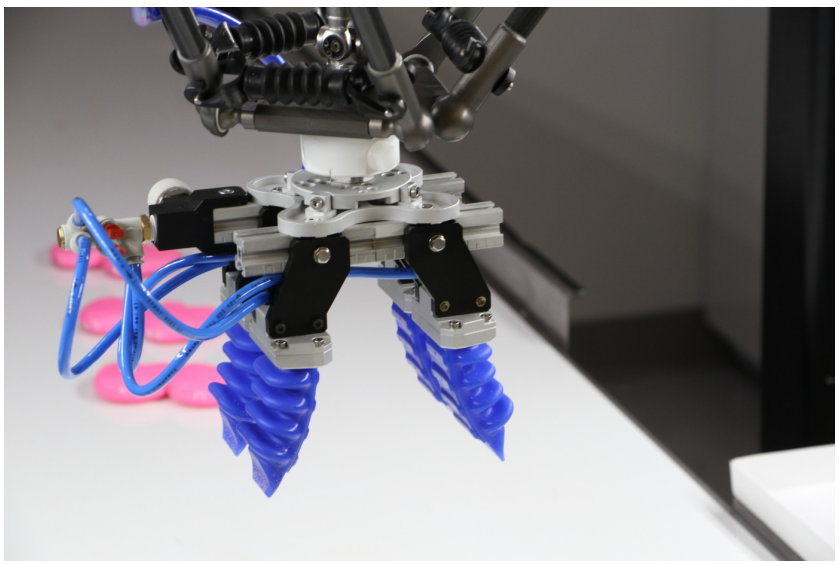


Figure (left): Robot Origami AT MIT
(https://biz.chosun.com/site/data/html_dir/2020/09/21/2020092101630.html)
Figure (right): Flexible gripper AT Soft Robotics Inc.
(https://techcrunch.com/2017/04/01/soft-robotics-grippers/)

Recent trends in robotics research (Cont'd)

- Emphasis on mobility & manipulability

  https://www.youtube.com/watch?v=tF4DML7FIWk

  https://www.youtube.com/watch?v=sIIUMLC3XfU

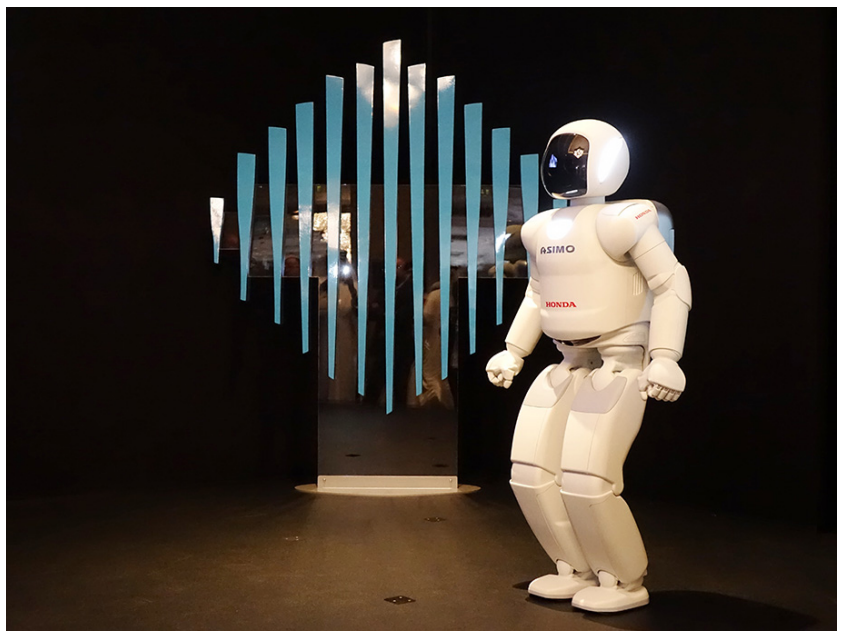


Figure (left): Atlas AT Boston Dynamics (https://www.bostondynamics.com/)

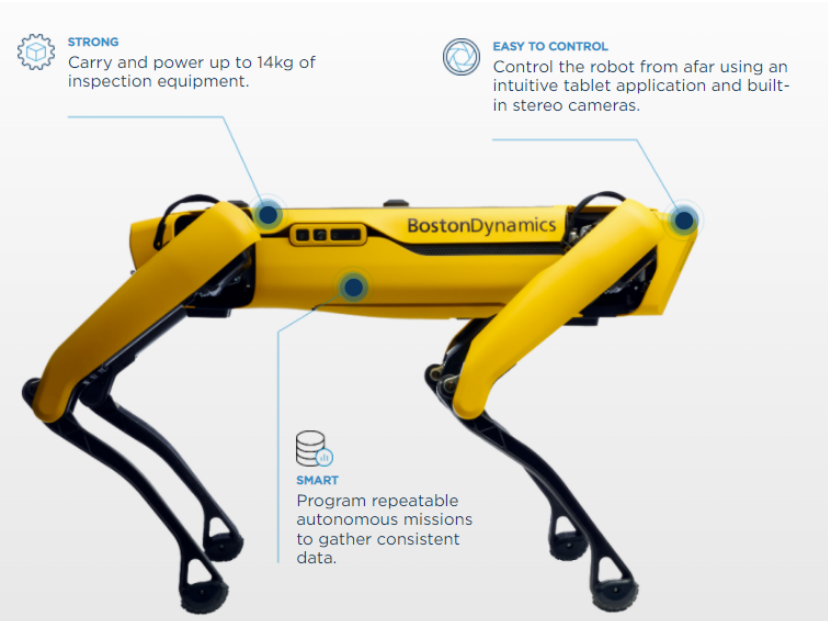
Figure (right): Asimo AT Honda (https://asimo.honda.com/)

Recent trends in robotics research (Cont'd)

- Emphasis on mobility & manipulability

  `https://www.youtube.com/watch?v=wlkCQXHEgjA`

  `https://www.youtube.com/watch?v=-RCQmaKvsL0`



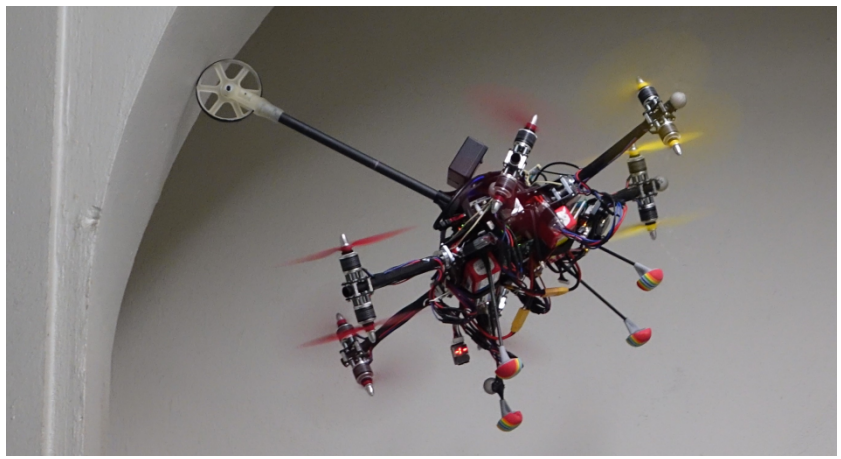


Figure (left): Spot AT Boston Dynamics (`https://www.bostondynamics.com/`)

Figure (right): Aerial manipulator AT ETH Zurich

(`https://asl.ethz.ch/research/flying-robots.html`)

What we have to do for robots completing a task

- Definition of "task(작업)"
  - Configuration space
  - Rigid-body motion
  - Trajectory generation
- Modeling of a robot
  - (For multi-body robot) Forward, velocity, and inverse kinematics
  - (For multi-body robot) Dynamics
  - (For mobile robot) Wheeled mobile robot
- Control of a robot
  - Trajectory generation
  - Robot control