

Machine with KANSEI

- Machine with Heart
- Machine with KOKORO
- “KOKORO” is an imaginary organ to generate Kansei.

Machine needs KOKORO to understand human KANSEI

The road to real Humanoid

Questions

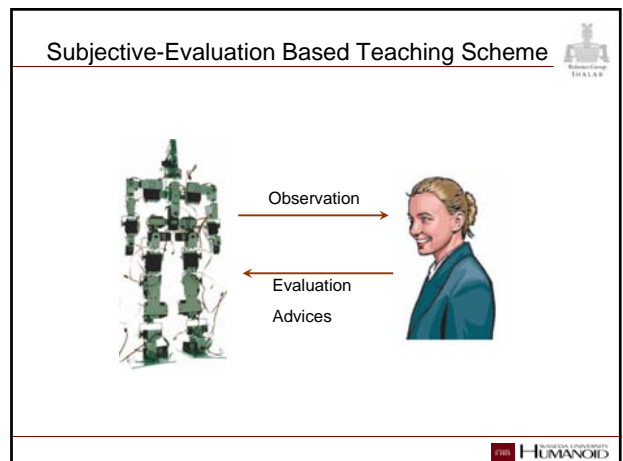
- Is it possible technically to make a robot with KOKORO ?
- Is there any problem from ethical point of view ?
- If we need a real partner, we need a robot with KOKORO.
- Real partner is not a slave.

Approaches to make a machine with a heart

- Top down
 - Imitate human/creature behavior that looks to have a heart
 - Design based on knowledge
- Bottom up
 - Make seeds and design the environment
 - Expect the growth

Future Directions – long range-

- Software: Beyond “Programming”
 - Learning in real world
 - Knowledge acquisition



Coaching a robot for motion

Before training

After Training

Beginning

Keep the Balance

Artificial Creatures

- Robot must have motivation to exist !
- Most creatures can survive guided by their own decision-making scheme with several autonomous functions and adaptation mechanisms under an unknown environment.

Evolutional robotics

Future Directions – long range-

- Software: Beyond “Program”
 - Learning in real world
 - Knowledge acquisition
- Hardware: Beyond “Metal and Si”
 - Extended materials
 - Moleculer computing

Objectives

- To realize a novel assembly method taking insights from the self-assembly mechanism of nature.

“Selectivity” of components contributes to the yield rate and the assembled structure.

3D self-assembly in liquid solder

[] [] = 6 patterns

The others

Electro-Static Self-assembly

Charged ceramic balls to combine together autonomously

Chemical Robotics

Self-Oscillating Gel with Belousov-Zhabotinsky Reaction

$$2\text{BrO}_3^- + 3\text{CH}_2(\text{COOH})_2 + 2\text{H}^+ \rightarrow 2\text{BrCH}(\text{COOH})_2 + 4\text{H}_2\text{O} + 3\text{CO}_2$$

Swell ↔ Deswell

Chemical Robotics

Swell ↔ Deswell

$\Phi = 200 \mu\text{m}$

We have to share the ethical issues with Biotechnology.

Future Directions – long range-

- Software: Beyond “Program”
 - Learning in real world
 - Knowledge acquisition
- Hardware: Beyond “Metal and Si”
 - Extended materials
 - Molecular computing
- Socialware: Beyond “Asimov ”
 - How to coexist with autonomous machine ?
 - What is better for our happiness ?

Laws of Robotics by Isaac Asimov

1. A robot may not harm a human being, or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by the human beings, except where such orders would conflict with the First Law.
3. A robot must protect its own existence, as long as such protection does not conflict the First or Second Law.

Human Centered Philosophy

Human Evolution beyond Humanism

We need a new philosophy to Reconstruct the Foundation of Ethics.

I will congratulate if my robot will oppose me because of the conscious of its ego but because not of its fault. Just as I experienced when my son was in his rebellious stage....

“Not comfortable but it should be pleased as he is going to live his own life !”

“Sooner he will be a good partner after learning morals.”

Living dog and Sony dog are similar in this sense.

Science and Engineering

- Scientific
 - Analyze to understand
 - Analysis by synthesis, analysis by analysis
 - Understand the past and forecast the future
- Engineering
 - Synthesize to know
 - Synthesis by analysis, synthesis by synthesis
 - Create the future

- It is impossible to understand KOKORO.
- It is, however, possible to create KOKORO.

“God” might know nothing but can make everything !

