





Switzerland-Taiwan Bilateral Seminar on Mechatronics for Nanotechnology and Medical Technology

## Intelligent Cooperating Robot

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Switzerland-Taiwan Bilateral Seminar on Mechatronics for Nanotechnology and Medical Technology, Taipei, 14.1.2008

## Intelligent Cooperating Robot

**Keywords:** robotics, cognitive systems, human and social interaction

**Project Objectives**


- Target technical outcomes
  - Novel mobile integrated system, capable of autonomous action, cooperative behavior, and robot-human interaction;
  - Infrastructure suitable for assessing some specific, focused R&D results and for benchmarking alternative approaches
  - Key components to be possibly transferred to other systems
- Target socio-economical impact(s)
  - Huge potential as ageing and progress make the population less able and willing to handle many of home tasks and chores; besides, general concerns for security is also a factor making this project outcome attractive; finally, manufacturing could also benefit from these results, both as improvements in production technology and as novel goods to be produced



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## Intelligent Robot


- RH-Y Cooperating robot for domestic services
- Quantitative Cognitics



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## RH-Y Cooperating robot for domestic services

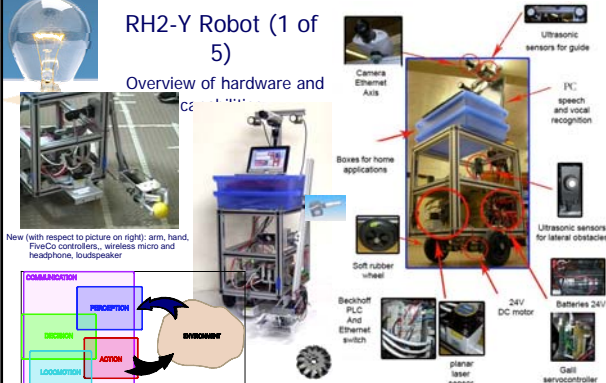
- Overview of hardware and capabilities
- Structure of main cognitive processes
- Computing resources (functions and processors)
- Control panel, with map and sensor samples
- Agile strategic programming and other aspects




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## RH2-Y Robot (1 of 5)

Overview of hardware and capabilities





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### RH2-Y Robot (2 of 5)

Structure of main cognitive processes

**PERCEPTION**

- Microphone
- Word recognition
- Camera
- Visual object recognition
- Laser Scanner
- Sensors
- Localization

**DECISION**

- Dialogue and protocols management
- Supervision and strategy
- Decision making
- Trajectory management

**ACTION**

- Speech synthesis
- Loudspeaker
- Infography
- Arm, hand
- Signale and actuators
- Light
- Motion control
- Screen
- Wheels

**LOCOMOTION**

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### RH2-Y Robot (3 of 5)

Computing resources (functions and processors)

RH2-Y Robot inherits a lot of the functionalities of our other autonomous robots.

Its architecture includes various elements:

- a laptop or tablet-PC runs the software,
- a Beckhoff API manages low-bandwidth input output signals,
- a TCP/IP AXIS camera provides low-level vision to our robot,
- motor controllers ensure adequate robot motion at joint level,
- an Ethernet switch or hub provides communication between those elements
- Real-time interaction and supervision is programmed in a proprietary multiagent environment, named Piaget.
- Laser scanner and various sensors are also used
- Novel contributions for Robocup-at-Home application include the integration of vocal communication (analysis and synthesis), wireless remote control ("chat" mode), as well as map and trajectory management, arm and hand design.

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### RH2-Y Robot (4 of 5)

Control panel, with map and sensor samples

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### RH2-Y Robot (5 of 5)

Agile strategic programming and other aspects

```

11: SleepAGN(0.05); break; case
12: if (SignalIn(NSIStart)) GoState(6); else
20: DenarrerMatchAGN(); // start 90 s timer etc. break; case
21: SignalOutAGN(NSOAspirateur, true); // start motor vacuum break; case
22: SignalOutAGN(NSORouleauIN, true); // start motor brush break; case
23: ApproAGN(HoleN1, 15); break; case
24: MoveAGN(HoleN1); break; case
25: MoveAGN(Trans(173.90,-90)); break; case
26: ObserverLigneAGN(NL, NCStart, NCStop) // Visual analysis of a row
if (N2Jaune=0) // totems are yellow; balls are white
(Position TotemOutBalle[1].TypePosition=Totem; nbTotem = nbTotem+1;
else
PositionTotemOutBalle[1].TypePosition=Balle; break; case
??: ...

```

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### Intelligent Robot

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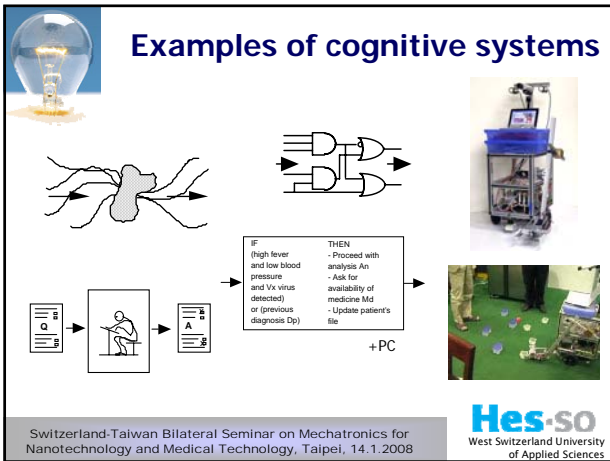
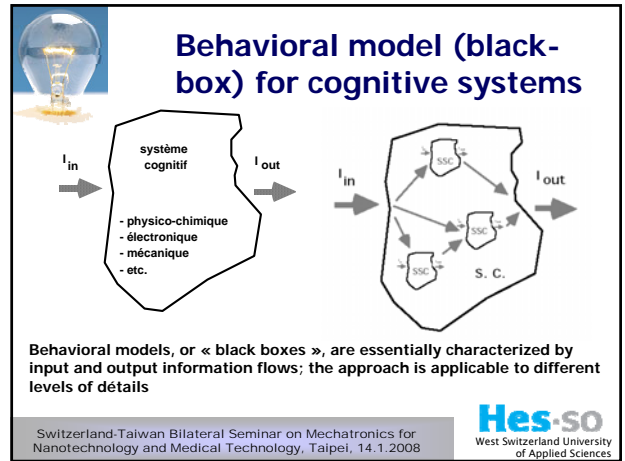
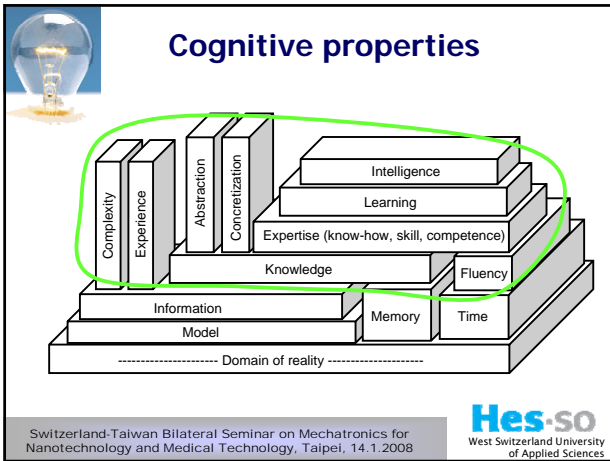
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### Quantitative Cognitics

- Cognitive properties
- Behavioral model (black-box) for cognitive systems
- Examples of cognitive systems
- Main cognitive properties
- Example of cognitive task

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### Main Cognitive Properties

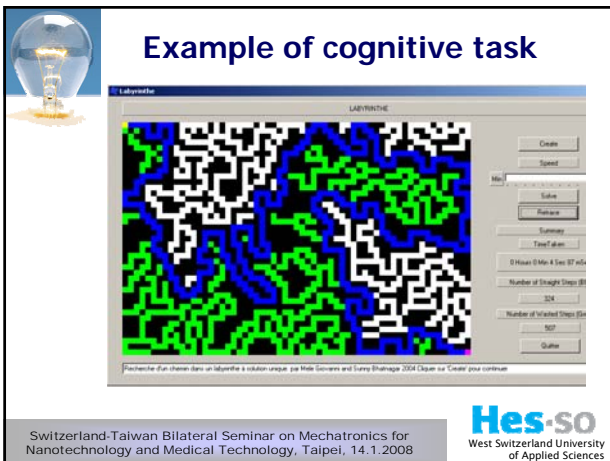
**Complexity:** « lots of information ». Unit: [bit]  
**Simplicity:** « little information ». Unit: [1/bit]  
**Knowledge:** « do it right ». Unit: [lin]  
**Expertise:** « do it right and fast ». Unit: [lin/s]  
**Abstraction:** « less information ». Unit: none, [bit/bit]  
**Concretization:** « more inform. ». Unit: none, [bit/bit]  
**Learning:** « increasing expertise ». Unit: [lin/s]  
**Intelligence:** « learning « fast » ». Unit: [lin/s/bit]  
**Reductibility:** « simpler how to do ». Unit: none, [bit/bit]  
**Etc.:** right, true, good, wisdom, sapience, and other concepts

**Context:**  
*Model:* simple, goal-driven representation

**Information:**  
*Model update:* Unit: [bit]

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### Conclusion (1 of 2)

**Keywords:** robotics, cognitive systems, human and social interaction

**Project Objectives (technical outcomes)**

- Novel mobile integrated system, capable of autonomous action, cooperative behavior, and robot-human interaction;
- Infrastructure suitable for assessing some specific, focused R&D results and for benchmarking alternative approaches
- Key components to be possibly transferred to other systems
- Methodology and web engine for objectively and quantitatively assessing cognitive properties (e.g. capabilities or requirements)

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## Conclusion (2 of 2)

### Project Objectives (socio-economical impact)

- Huge application potential:
  - ageing and social progress make the population less able and willing to handle many of home tasks and chores
  - general concern for security is another factor making this project outcome attractive
  - manufacturing could also benefit from these results, both as improvements in production technology and as novel goods to be produced
  - our quantitative approach allows for a better assessment and related decisionmaking in cognitive domains

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