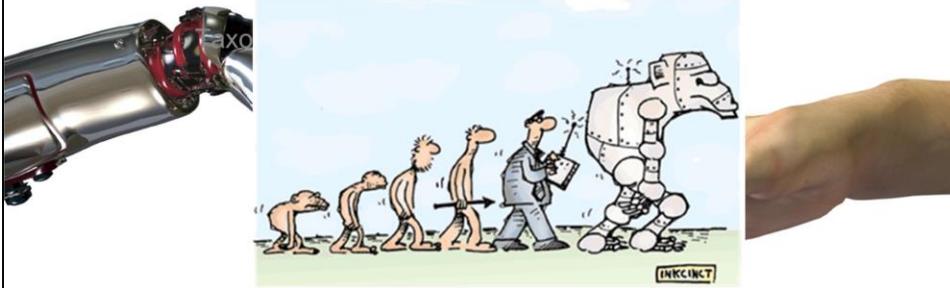


Human Robot Interaction: Robot Taxonomies



The ascent of man.

About This Class

- Source Material
 - “Classifying Human-Robot Interaction an Updated Taxonomy”
- Topics
 - What is this taxonomy thing?
 - Some ways of looking at Human-Robot relationships.



Available on the course web site. A good paper.

What is a taxonomy?

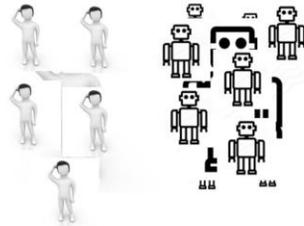
- A systematic classification of concepts
 - The organization of a particular set of information for a particular purpose.
- Down and dirty definition:
 - Naming stuff that is similar, similarly
- The term comes from biology
 - single location for a species within a complex hierarchy
- One must be careful with the naming



Lots of ways of looking at HRI taxonomy

- Start with numerical relationships

Humans	Robots
1	0
0	1
1	1
1	Many
Many	1
Team	Team



1 human == us along

1 robot == autonomous robot

1,1 == usually some form of teleoperation but not always

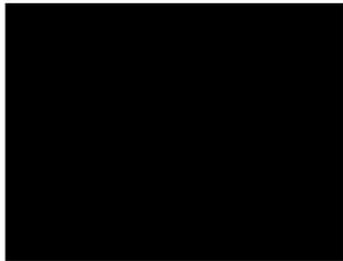
1 human, many robots == automation, some military

Many humans,1 robot == problematic robot (Canadarm)

Many humans, Many robots == ??? Life in the future? Robot soccer

One Human, One Robot

- Example: Network-Enabled Powered Wheelchair Adaptor Kit (NEPWAK)
 - Assistive device for elderly and disabled.
 - Ryerson, 2004



Classic remote control. Like flying by wire...see the commercial remote control.

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One Human, Robot Team

Unmanned Vehicle Centre

Decentralized Multi-Robot Collaboration for Field Transportation

Scenario: A team of robots needs to protect a transport in a hostile environment, by forming a defensive circular formation and avoiding enemies

Research Topics: Decentralized Multi-Robot Control, Formation Control

Funding: European Defense Agency, Networked Multi-Robot Systems

Credits: Daniela Doroftei

Citation: Doroftei, Daniela, and Eric Colon. "Multi-robot collaboration and coordination in a high-risk transportation scenario."

One Human, Robot Team

- Two AIBO robots being remotely controlled together to push a box
– 2012



Kaminka, G., & Elmaliach, Y. (2004). Towards single-operator control of tightly-coordinated robot teams. Proceedings of the Third International Joint Conference on autonomous agents and multiagent systems, 07/2004 , 31534-1535. doi:10.1109/AAMAS.2004.281

Human-Team One robot



[Space Shuttle](#)

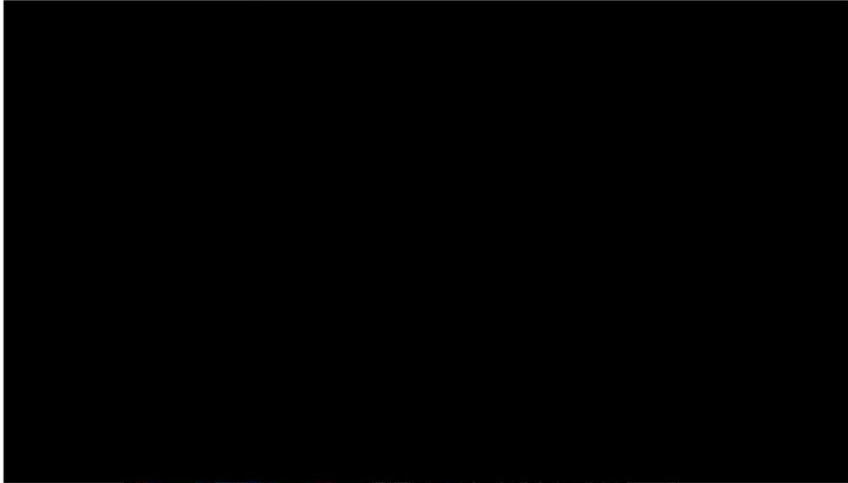
[International Space Station](#)

television camera operations.

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Human Team, Robot Team



The slide features a blue header with the Ryerson University logo and the text 'RYERSON UNIVERSITY' and 'School of Computer Science'. Below the header is the title 'Human Team, Robot Team'. The main content area is a large black rectangle. At the bottom center, there is a small inset image showing a robot on a green field. In the bottom left corner, there is a red robot icon. In the bottom right corner, there is the MDM logo with the text 'MASTER OF DIGITAL MEDIA'.

The UNSW team was defending their 2014 World Championship title, having won that year again the Leipzig University of Applied Sciences team in the final and the B-Human team from Bremen in the semi-finals.

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Spatial Relationships

Human's Role	Human's POV	Spatial Relationship with Robot
Commander	god's eye	Remote
Peer	Bystander	Beside
Teleoperator	Robot's eye	Immersion
Developer	Homunculus	inside





Homunculus: A very small “humanoid creature”: The “magic” inside the box. Microsoft “Paperclip” (“The ogre under the bridge” is a better metaphor in this case)

“Greenman” (1983-1988) – The first anthropomorphic (human configured) manipulator developed at SSC San Diego was the Remote Presence Demonstration System, nicknamed “Greenman”. It was assembled in 1983 using MB Associates arms and a SPAWAR Systems Center San Diego-developed torso and head. It had an exoskeletal master controller for the human operator’s torso, arms, and head. Its vision system consisted of two 525-line video cameras each having a 35 degree field of view and video camera eyepiece monitors mounted in an aviator’s helmet.

Homunculous

Authority Relationships

Authority Relationship	Function	Context
Supervisor	Commands "what"	Tactical
Operator	Commands "how"	Detailed Perception
Peer	Collaborator	Shared-active
Bystander	Observation	Shared-passive



Robot Morphology

- The form and structure of a robot is important because it helps to establish social expectation.
 - Anthropomorphic - human-like appearance
 - Zoomorphic - animal-like appearance
 - Original or Artistic - Form unrelated to function
 - Functional - Form closely related to function



Anthropomorphic

ASIMO was conceived to function in an actual human living environment in the near future. It is easy to operate, has a convenient size and weight and can move freely within the human living environment, all with a people-friendly design.

Zoomorphic

AIBO is one of several types of robotic dogs designed and manufactured by Sony; there have been several different models since their introduction in 1999. Able to walk, "see" its environment via camera, and recognize spoken commands, they are considered to be autonomous robots, since they are able to learn and mature based on external stimuli from their owner or environment, or from other AIBOs.

Artistic

The Helpless Robot (Norm White 1987-96). Another interactive work, except that this one has no motors, but instead must depend upon its synthesized voice to encourage people to move it as it would "like". I built it primarily as an apparatus to test out different techniques of

automatic knowledge-building; in this case, the machine attempts to assess and predict human behavior. Like [Facing Out Laying Low](#), it is essentially an unfinishable work. Materials: plywood, angle-iron, proximity sensors, modified 80386 computer, and custom electronics ([click here](#) for technical details on both hardware and software). It also speaks Spanish (click the Play button below for a sample) and French. Owned by the Agnes Etherington Art Centre.

Functional

Suitable for OEMs, educators, and DIYers, this apparatus can be the basis for a tennis trainer, a projectile teaching tool, or a cool weapon for a robot warrior. Ejects a standard size tennis ball at speeds up to 60 MPH. Features dual 24-VDC drive motors, durable 8" wheels, and transparent chute with feed control mechanism for computer or R/C control. Two design versions: floor-mount and table-mount.

Example Anthropomorphic Robot

- Prof. Hiroshi Ishiguro, Osaka University, Japan
- Ultra-realistic looking humanoid robots



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Example Zoomorphic Robot



From Wikipedia AIBO (*Artificial Intelligence Robot*, homonymous with *aibō* (相棒?), "pal" or "partner" in Japanese) is an iconic series of [robotic pets](#) designed and manufactured by [Sony](#). Sony announced a prototype robot in mid-1998.^[1] The first consumer model was introduced on May 11, 1999.^[2] New models were released every year until 2005. Although most models were dog-like, other inspirations included lion-cubs and space explorer, and only the final ERS-7 version was explicitly a "robot dog".^[3]

AIBOs were marketed for domestic use as "Entertainment Robots". They were also widely adopted by universities for educational purposes (e.g. Robocup) and research into robotics and human-robot interaction. AIBOs have been used in many movies, music videos and advertising campaigns as futuristic icons.^[4]

On January 26, 2006 Sony announced that it would discontinue AIBO and several other products in an effort to make the company profitable. It also stopped development of the related [QRIO](#) robot.^[5] Sony's AIBO customer support was withdrawn gradually, with support for the final ERS-7M3 ending in March 2013.^[6] Some third party support is available, such as repairs and battery refurbishment.

In 2006, AIBO was added into Carnegie Mellon University's "Robot Hall

of Fame" with the description "the Sony AIBO represents the most sophisticated product ever offered in the consumer robot marketplace."[\[7\]](#)

The slide features a blue header with 'RYERSON UNIVERSITY' and 'School of Computer Science'. The MIT logo and name are centered below. The title 'Autonomous Running Jumps Over Obstacles in the MIT Cheetah 2' is prominently displayed in bold black text, followed by the authors' names: 'Hae-Won Park, Patrick Wensing, and Sangbae Kim'. The MITMECHE BIOMIMETIC ROBOTICS LAB logo is shown below the authors. In the bottom left corner, there is a small red icon of a cheetah, and in the bottom right corner, the MDM (Master of Digital Media) logo is present. A decorative background of binary code (0s and 1s) is visible in the top right area.

From Wikipedia Business Insider:

<http://www.businessinsider.com/darpa-funded-cheetah-robot-can-now-jump-over-obstacles-2015-6>

Scientists at [MIT's Biometrics Robotics Lab](#) have now trained their robotic Cheetah to see and jump over hurdles as it runs, making this the first four-legged robot to run and jump over obstacles autonomously. The cheetah's previous greatest accomplishment was that it was able to run untethered.

MIT researchers Hae Wong Park, Patrick Wensing, Sangbae Kim first tested the robot's agility on a treadmill in their lab and then let the robot off its leash to see if the robot can run and jump on its own. The Cheetah, which weighs about 70 lbs, cleared 18-inch hurdles while moving at a speed of 5 mph. The robot can run at 13 mph of a flat course.

Boston Dynamics Cheetah can do 28 MPH but this video is better.

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Example Artistic Robots



See: <https://www.davidson.edu/news/131017-parodic-machines-exhibit>

October 17, 2013

Robots are coming to Davidson College's Belk Visual Arts Center October 24 as the stars of a six-week exhibition of "absurd machines" transformed from cast-off electronic components into whimsical works of art.

Curator Paula Gaetano-Adi selected five artists whose work will be in the exhibition, which is titled "Parodic Machines." The title indicates that the works are a parody of a 1987 piece by Norman White titled Helpless Robot because it was incapable of any movement or action on its own.

Flies Piloting Blimps?!

The "Parodic Machines" will include five robotic arms mounted on a wall that employ sensors and circuit boards so that they point at people who approach, and follow the viewer until he or she smiles. Another piece responds only to the Coca-Cola label. Three balloon-blimps will float erratically around a corner of the gallery, directed by circuits affected by the flight of flies inside a small capsule the blimp supports.

Example Functional Robot

- Self-cleaning German Toilet



Proximity Relationships

- How close is/are the robot(s) to the human(s)?
 - Distant
 - Avoiding
 - Passing
 - Following
 - Approaching
 - Touching

