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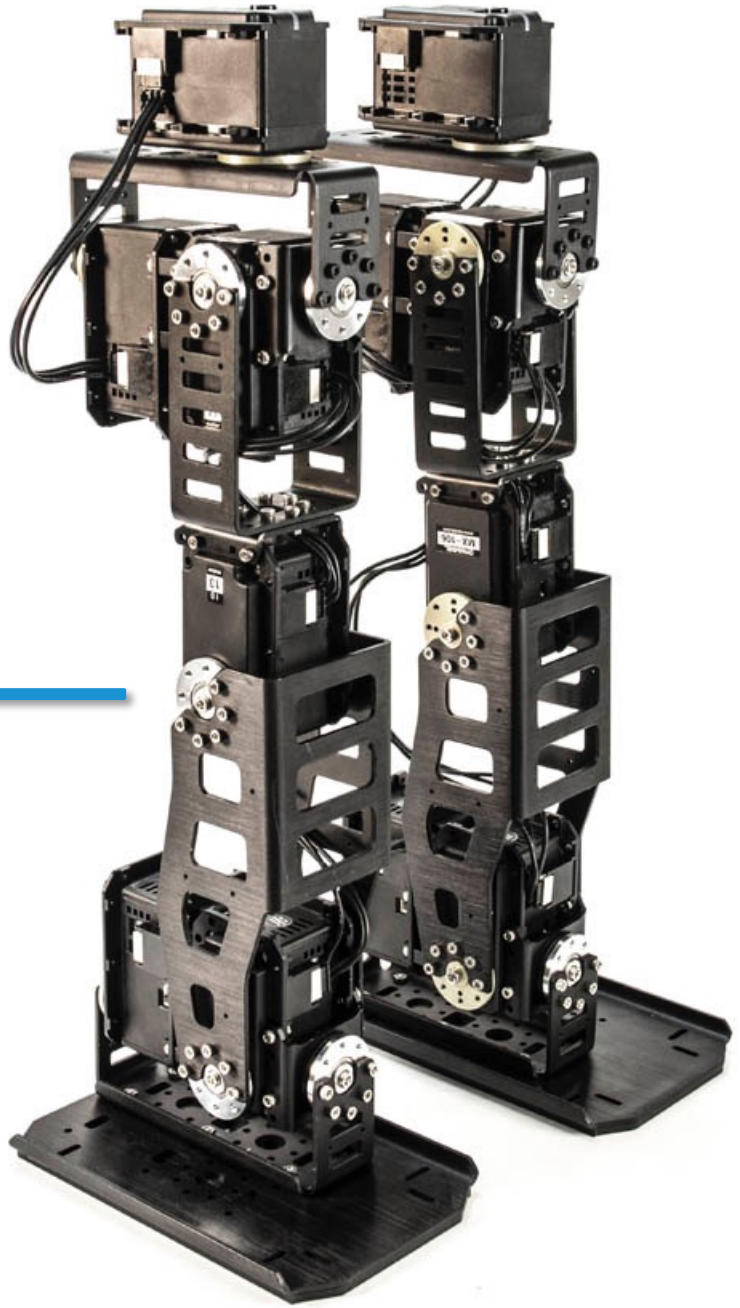
ROCO318 Mobile and Humanoid Robots



Introduction to Humanoid Robots

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Lecture Content

- What is Humanoid Robotics
- Taxonomy based on Anthropomorphism
- Why Humanoid Robots?
- Application Domains
- Challenges

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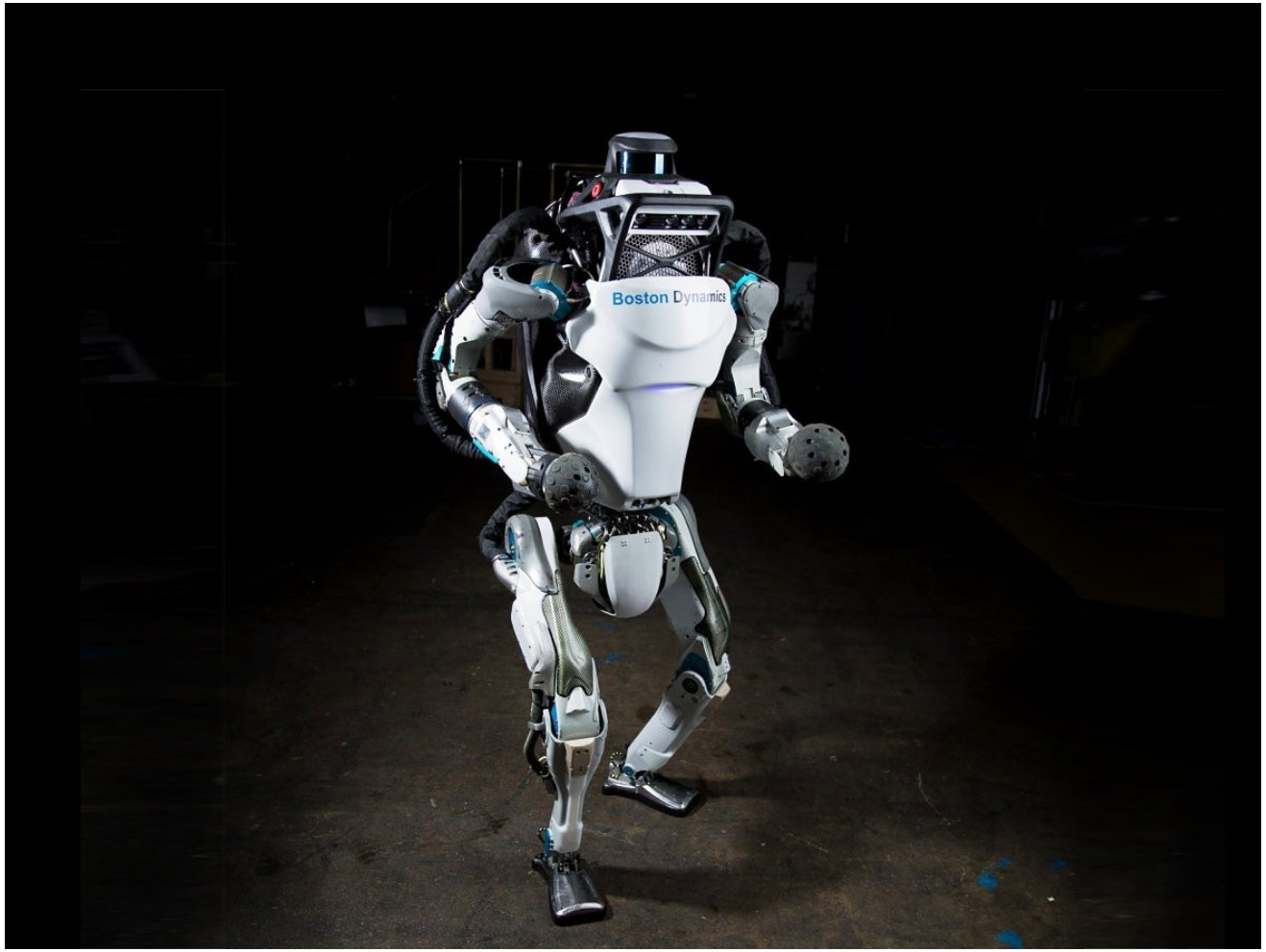
What is Humanoid Robotics

- Definition:
  - The science of designing and operating robots which are human-like in their behaviour, their morphology, or both.



Atlas - The Agile Anthropomorphic Robot (Boston Dynamics).

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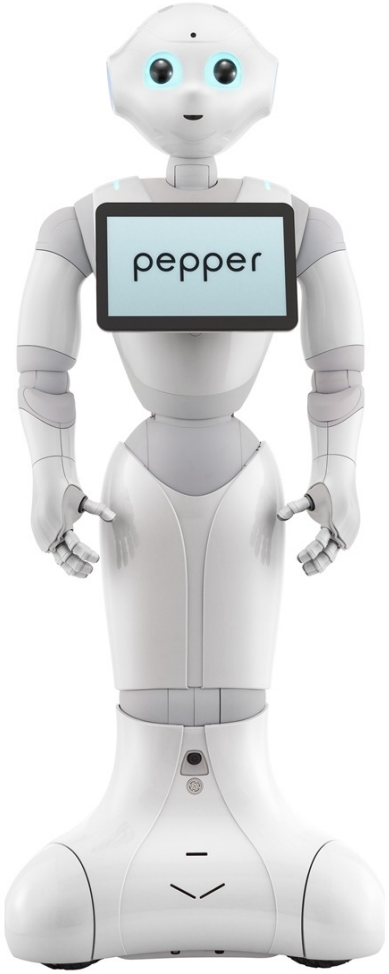

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Taxonomy based on Anthropomorphism

- **Replicant:**
  - Identical to human in every physical and behavioural aspect.
- **Android:**
  - Not quite the replicant level but very close in every aspect. Very high level of intelligence and dexterity.
- **Humanoid:**
  - Close to human in both body and brain. High levels of intelligence and dexterity. Could not be mistaken for a human (under normal conditions).
- **Inferior Humanoid (IH):**
  - Has the morphology of humans, reasonable intelligence and dexterity, stereo vision and audition.
- **Human-Inspired (HI):**
  - Has the broad morphology of humans, limited intelligence and dexterity, may even be wheeled. Limited task set.
- **Built-for-Human (BFH):**
  - Designed to operate in built-for-human environments, but does not look human at all.

Some ”humanoid” robots may not fall within this taxonomy:

- They lack locomotion ability
- They are too small

Why Humanoid Robots?

- More natural to interact with (for people), than wheeled robots.
- Built for operation in environments designed for people.
- Capable of walking in stairs.
- Testbed for theories about human cognition.
- Artificial intelligence embodiment.
- Engineering challenge.

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Application Domains

- **Technology demonstration**
  - Showcase of corporate technology, attracts public attention and strengthens the brand.
- **Scientific**
  - Test-bed for theories and models (bio-mechanics, cognition, AI)
- **Health care**
  - Prosthetics, rehabilitation, social training of autistic children.
- **Hazardous environments**
  - Exploration or work in dangerous environments, space missions.
- **Domestic helpers**
  - Household work, look after children and the elderly, security guard.
- **Edutainment**
  - Aid in teaching technology, robot competitions.
- **Other?**

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Challenges

- **Mechanics**
  - Robust, efficient locomotion, full-body movements, strength.
- **Dexterity**
  - E.g. using hands to grasp or manipulate objects.
- **Perception**
  - Sensor fusion, interpretation of sensory input.
- **Intelligence and learning**
  - Development of capable and extendable robotic brains: robotic behaviours, decision-making systems.
- ”Socially acceptable” **human-robot interaction**
- Extending the **time of operation**
  - Depends heavily on battery technology development.
- Reducing the **cost** of humanoid robots.
- **Legal issues**.
- **Other?**

Talos (PAL Robotics)