ДОНСКОЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

УПРАВЛЕНИЕ ДИСТАНЦИОННОГО ОБУЧЕНИЯ И ПОВЫШЕНИЯ КВАЛИФИКАЦИИ

Кафедра «Научно-технический перевод и профессиональная коммуникация»

Учебное пособие

по дисциплине

«Иностранный язык в профессиональной сфере»

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Ростов-на-Дону, 2015

Аннотация

Учебное пособие предназначено для студентов направления 15.03.06 «Мехатроника и робототехника».

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Оглавление

ARTIFICIAL INTELLIGENCE

1. I am often asked: "How intelligent are robots?" – perhaps out of a sense of unease that robots shouldn`t be too intelligent. At one level it`s a difficult question to answer properly. Making meaningful comparisons between the intelligence of a particular robot and a particular animal is fraught with difficulty, not least because we only have a vague notion of how intelligent most animals are compared with each other and with us humans.

2. We have a general sense that a crocodile is smarter than an ant, and a cat smarter than a crocodile, but this notion is wrong. Intelligent is not a single measurable quality (like an IQ test) that different animals, or indeed robots, have more or less of. But setting aside this objection, where would we assess the intelligence of, say, a robot vacuum cleaner? If pressed, I would suggest right at the bottom.

3. A robot vacuum cleaner has a small number of preprogrammed (i.e. instinctive) behaviors and is not capable of any kind of learning (see Box 1 for a description). These are characteristics we would associate with very simple animals. So is our robot vacuum cleaner about as smart as a single-celled animal such as an amoeba?

4. When roboticists describe a robot as intelligent, what they mean a robot that behaves in some limited sense, as if it were intelligent. The words as if are important here. Few roboticists would claim a robot to be truly intelligent. They might claim a robot deserves to be called intelligent, in this qualified sense, because the robot is able to determine what actions it needs to take in order to behave appropriately in response to external stimuli.

5. A change in emphasis, a sensory- motor loop, the problems of intelligent behavior, the most influential position within AI, artificial flight is possible, researchers worked on computer vision, all these tasks back together again, what is known as "functional decomposition", the problems of intelligent behavior cannot be broken.

<u>I. Вопросы:</u>

1. What is compared with an intelligent robot?
2. Is a crocodile smarter than an ant?
3. What does the intelligence mean?
4. How does a robot vacuum cleaner have?
5. What helps us to un- derstand how a robot operates?

6. What purposes are suggested by roboticists when robots are created?
7. Is it easy for modern robots to take orders from scientists?
8. For what do we try to use a lot of robots in our days?
9. Do you know industrial fields where modern robots are being used now?
10. Are they able to determine what actions are suitable for various situations?

II. Перевести с русского на английский:

1) основной смысл
2) большинство животных сравнивается с …
3) одноклеточные организмы
4) это утверждение – неверное
5) они имеют в виду
6) внешнее воздействие
7) малое количество специалистов по робототехнике

III. Перевести с английского на русский:

1) making meaningful comparisons
2) a difficult question
3) in response to external stimuli
4) a robot vacuum cleaner
5) the robot is able to determine actions
6) a robot is truly intelligent
7) to take in order to behave appropriately.
8) a general sense

IV. Заполнить пропуски предлогами at, in, between, on, , to, of :

1) …the problems …intelligent behavior cannot be broken.
2) …researchers worked … computer vision
3)…a robot deserves to be called intelligent … this qualified sense
4) I would suggest right … the bottom.
5) Making meaningful comparisons … the intelligence … a particular robot

6) … it needs to take … order to behave appropriately
7) … response to external stimuli.

V.Раскройте скобки, употребляя глаголы в требующемся времени.

1. He (to fly) by tomorrow morning. 2. She already (to get) the telegram from him. 3. At that moment the clock (to strike) five. 4. She (to be proud of) having this prize. 5. She (to ask) him to help to her neighbour, when he (to return) after his business trip. 6. The delegates (to tell) that the guide (to come) in ten minutes. 8. I am sure that they (to wait) for me at the metro station. 9. I didn't know that my mum already (to come) home.

10. I was afraid that you (not to be) able to solve that problem without my help.

VI. Переведите на английский язык, используя все формы герундия и причастия.

1. Сестра любит путешествовать по сему миру каждый год .

2.Сейчас она путешествует по Европе. 3.Путешествуя по разным странам, она знакомиться с их традициями и народами. 4.Я увлекаюсь путешествием тоже, но я предпочитаю красоты своей Родины.5.После таких путешествий я люблю свою страну еще больше. 6.Санкт-Петербург стоит посетить, так как он считается самым красивым городом России. 7..Посетив Эрмитаж, я был в восторге от шедевров мирового искусства. 8.Человек, путешествующий по различным странам, должен хорошо владеть иностранными языками

9.Я горжусь своей путешествующей семьей. 10.Путешествие – это хобби нашей семьи.

VII. Закончить предложения по смыслу:

1) Few roboticists would claim a robot … .
2) It needs to take in order to behave appropriately in response … .

3) They mean a robot that behaves in … .

4) Making meaningful comparisons between the intelligence of a particular robot and … .

5) We have a general sense that a crocodile is smarter than an ant, and a cat … .

VIII. В каком абзаце дана следующая информация:

These are characteristics we would associate with very simple animals.

a) 1 b) 2

c) 3 d) 4

IX. Определить, является ли утверждение правдой или ложью (True or false).

1) We have a general sense that a crocodile is not smarter than an ant.

2) Many roboticists would claim a robot to be truly intelligent.

3) The robot cannot determine what actions it needs to take in order to behave appropriately in response to external stimuli.

4) It is no use to take in order to behave appropriately in response to external stimuli.

5) We have a general sense that a crocodile is smarter than an ant, and a cat smarter than a crocodile, and this notion is right.

X. Подготовить пересказ текста

HOLISM

Placing the robot back in real world also enables a change in emphasis which might be called "holism". Previous approaches to AI had tended to assume that the tasks an intelligent entity might perform could be separated – what is known as "functional decomposition". The situated and embodied approach puts all these tasks back together again. It stresses such things as a close coupling between sensory input and motor activity. That is to say that there should be a minimum of computational processing in such a sensory-motor loop. This is something often found in nature.

For much of the history of AI it was assumed – sometimes explicitly, sometimes implicitly – that intelligent behaviour could be tackled piecemeal. Some researchers worked on computer vision, others on planning, others on language and so on. While this still continues in some areas of AI, it has come under attack during the last ten years by researchers who believe that the problems of intelligent behaviour cannot be broken up in this way.

One of the leading exponents of this "holistic approach" is Rodney Brooks, director of the AI lab at the Massachusetts Institute of Technology (MIT) – perhaps the most influential position within AI. In an important paper published in 1991, Brooks uses what we might call the parable of the Boeing 747 to illustrate this point. Imagine, he says, a group of researchers working on the problem of artificial flight in the 1890s being taken a hundred years into the future in a time machine. There they are given a ride on a Boeing 747. They go back to their own time full of enthusiasm, for, having seen the future, they can be sure that artificial flight is possible. However, everything else they learn from their experience is a big distraction.

I.Вопросы:

1. What is called "functional decomposition"?
2. What is the main aim of this approach?
3. What does holism mean?
4. What kinds of task did researchers work to explain this phenomenon?
5. Who was the leading exponent of "holistic approach?
6. What is his role in this approach?

7. What model of plane was used in scientific tests?
8. What is the function of these flights?
9. For what "holistic approach" was designed?
10. Were scientists sure that artificial flight is possible?

II. Перевести с русского на английский:

1) предыдущий подход
2) существующий и ранее применяемый подход
3) подвергаться нападкам со стороны ученых
4) проблемы искусственного интеллекта не могут разрешаться таким образом
5) в важных документах напечатанных
6) искусственный полет
7) все – о чем они узнали в ходе эксперимента

III. Перевести с английского на русский:

1)
2)
3)
4)
5)
6)
7)

IV. Заполнить пропуски предлогами at, on in, about, by, for, to, of, up :

1) … an important paper published
2) … the Massachusetts Institute …Technology
3) … problems … intelligent behaviour cannot be broken …
4) This is something often found … nature.
5) Previous approaches … AI had tended … assume
6) a group … researchers working …the problem of artificial flight

7) the flight …the 1890s being taken a hundred years … the future
8) everything else they learn … their experience

V. Вставьте подходящие формы герундия.

1. You ... not come to help them tomorrow: the work is done. 2. You ... not change the whole text as the beginning is all right. You ... only rewrite the second part of it. 3. ... you help me now? — I am afraid not: I am in a great hurry. I shall be free in the evening. Come to my place at about eight, and I ... help you. 4. John ... not tell us the rules of the game: we know them. 5. ... I return the book to you on Friday? I am afraid I ... not finish it before. — No, that is too late. You ... bring it to me not later than Wednesday.

VI. Переведите на английский язык, употребляя подходящие по смыслу формы герундия.

1. Я должна купить торт сегодня. 2. Мой брат не умеет говорить по-английски. 3. Моя сестра умеет говорить по-немецки. 4. Можно, я посмотрю вашу фотографию? 5. Вы можете показать мне свою фотографию? 6. Не может быть, что сорок лет: он выглядит гораздо моложе. 7. Не может быть, что он забыл прийти. Он, дол-ясно быть, был очень занят. 8. Мы, может быть, доедем за город, если будет хорошая погода. 9. Если сестра не купит мне кофе, мне придется идти в магазин самой. 10. Я не могу найти свои часы. — Может быть, вы оставили их на работе. — Нет, я не могла оставить их на работе: я никогда не снимаю их с руки.

VII. Закончить предложения по смыслу:

1)
2)
3) … .
4)
5)

VIII. В каком абзаце дана следующая информация:

IX. Определить, является ли утверждение правдой или ложью (True or false)

1)
2)
3)
4)
5)

X. Подготовить пересказ текста

ROBOTIC INSECTS COULD POLLINATE FLOWERS AND FIND DISASTER VICTIMS

Anatomy of the Robobee

Brain: Simple circuits handle basic functions, including balance and hovering. A microprocessor runs the bee's high-level functions, such as processing data from sensors. **Eyes:** Ultraviolet sensors scan for natural UV patterns on flowers. Digital cameras track objects below the bee to determine how fast and far it's flying. Light sensors follow the sun to tell if the bee is flying north or south. **Wings:** An actuator flaps two lightweight carbon-fiber wings. **Antennae:** The antennae beam data between bees and could act like whiskers to prevent the 'bot from bumping into things. **Feet:** In the hive, three pronged feet lock the bee into a docking station to recharge its micro fuel cell and upload sensor data to a computer. The feet could also help grab pollen from flowers.

Teamwork among honeybees keeps a hive running smoothly. Worker bees collect pollen, nurse bees care for larvae, and male drones spread the colony's genes. Each insect's efforts ensure the colony's success. That strategy led Gu-Yeon Wei to suggest that Rob Wood morph an almond-size robotic fly he had developed into a fleet of autonomous bees, each capable of carrying out specialized tasks. Perhaps, they speculated, the "RoboBees" could supplement the pollinating duties of bees stricken by a mysterious affliction that's killed 36 percent of America's 2.4 million hives. If you build the bee body, Wei told Wood, I can make the brain.

Wood could tweak his fly's flight system so that the RoboBee could lift off and hover in place like real bees do, but he and Wei, both electrical engineers at Harvard University, knew they would need help replicating a bee's other traits. So they recruited biologists to advise them on bee behavior and a materials scientist to develop a small rechargeable fuel cell. Computer scientists joined to write software to coordinate the colony's actions, and Wei began designing a microprocessor that can crunch data from multiple sensors. Last fall, the team earned a $10-million grant from the National Science Foundation to build a network of autonomous bees.

In five years, the group hopes to have dozens of RoboBees that fly and coordinate with one another. Down the road, the 'bots could monitor environmental hazards or search for survivors after a natural disaster. Collaboration is key for bees and the scientists, Wood says: "No one bee would be successful with these missions on its own. The same is true for us." Here, a look at how a hive of RoboBees might operate.

How RoboBees Pollinate an Orchard

STEP 1: Establish Home Base
A farmer sets up a mobile RoboBee "hive." In the future, an autonomous robot could haul the hive from field to field.

STEP 2: Survey the Landscape
Scout RoboBees leave the hive first and use their ultraviolet sensors to locate the same UV patterns on flower petals that real bees look for. Cameras on the bee's head record landmarks underneath the bee to give it a sense of where and how far it has traveled.

STEP 3: Make a Map
The scouts return to the hive to recharge and upload flower locations to a central computer, which maps the entire orchard as more scouts report in.

STEP 4: Get Pollinating
Worker bees, outfitted with fewer sensors and bigger batteries for longer trips, head directly for the flowers, picking up pollen from one and delivering it to others.

I.Вопросы:

1. What is the structure of roboBee?
2. What is the main function of roboBee?
3. How does robobee pollinate an orchard?
4. For what the scientists have developed a small rechargeable fuel cell?
5. What is the reason of the colony's success?
6. What function has antennae?
7. Describe the main functions of robobee's feet?
8. Why is it important to organize teamwork?
9. What are the main function of ultraviolet sensors?
10. What is the brain of robobee?

II. Перевести с русского на английский:

1) микросхема
2) светочувствительный датчик
3) работа в команде
4) гарантировать успех
5) топливный элемент
6) собирать пыльцу
7) проектировать микропроцессор

III. Перевести с английского на русский:

1) to pollinate an orchard
2) ultraviolet sensor
3) to get data from sensors
4) to develop a rechargeable fuel cell
5) digital camera
6) to write software
7) environmental hazard

IV. Заполнить пропуски предлогами at, on in, about, from, by, for, to, of :

1) Cameras … the bee's head record landmarks underneath the bee to give it a sense … where and how far it

has traveled.

2) The man began designing a microprocessor that can crunch data … multiple sensors.

3) To upload sensor data … a computer.

4) They could supplement the pollinating duties … bees stricken … a mysterious affliction.

5) Ultraviolet sensors scan … natural UV patterns on flowers.

6) They recruited biologists to advise them … bee behavior.

7) The feet could also help grab pollen … flowers.

V. Переведите на английский язык, употребляя модальные глаголы *can (could)* или *may (might).*

1. Не может быть, что она закончила эту работу так скоро. Она, возможно, сделала только половину. 2. Не может быть, что ты потеряла деньги. Ты могла положить их в сумку. — Нет, их нет в сумке. Я могла выронить их в магазине. 3. Не может быть, что он уже уехал. 4. Неужели он перевел всю книгу? 5. Не может быть, чтобы сейчас было холодно на улице: термометр показывает пятнадцать градусов.

VII. Вставьте модальный глагол can или could. Раскройте скобки, употребляя требующуюся форму инфинитива.

1. ... you (to ask) my sister to help you? I am very busy today. 2. ... it (to be) seven o'clock now? 3. You ... not (to see) her at the party. She was at "home working at her English. 4. He ... not (to forget) your request: he is very attentive to people. 5. I should be very happy if you ... (to visit) us in the village.

VII. Закончить предложения по смыслу:

1) The scouts return to the hive to recharge and upload flower locations to a … .

2) In five years, the group hopes to have dozens of RoboBees that fly and coordinate with … .

3) Worker bees collect pollen, nurse bees care for larvae, and male drones spread the … .

4) A microprocessor runs the bee's high-level functions, such as processing data … .

5) Digital cameras track objects below the bee to determine … .

VIII. В каком абзаце дана следующая информация:

A microprocessor runs the bee's high-level functions, such as processing data from sensors.

1) In five years, the group hopes to have dozens of RoboBees that fly and coordinate with one another. Down the road, the 'bots could monitor environmental hazards or search for survivors after a natural disaster. Collaboration is key for bees and the scientists, Wood says: "No one bee would be successful with these missions on its own. The same is true for us." Here, a look at how a hive of RoboBees might operate.

2) **Brain:** Simple circuits handle basic functions, including balance and hovering. A microprocessor runs the bee's high-level functions, such as processing data from sensors. **Eyes:** Ultraviolet sensors scan for natural UV patterns on flowers. Digital cameras track objects below the bee to determine how fast and far it's flying. Light sensors follow the sun to tell if the bee is flying north or south. **Wings:** An actuator flaps two lightweight carbon-fiber wings. **Antennae:** The antennae beam data between bees and could act like whiskers to prevent the 'bot from bumping into things. **Feet:** In the hive, three pronged feet lock the bee into a docking station to recharge its micro fuel cell and upload sensor data to a computer. The feet could also help grab pollen from flowers.

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size robotic fly he had developed into a fleet of autonomous bees, each capable of carrying out specialized tasks. Perhaps, they speculated, the "RoboBees" could supplement the pollinating duties of bees stricken by a mysterious affliction that's killed 36 percent of America's 2.4 million hives. If you build the bee body, Wei told Wood, I can make the brain.

4) Wood could tweak his fly's flight system so that the RoboBee could lift off and hover in place like real bees do, but he and Wei, both electrical engineers at Harvard University, knew they would need help replicating a bee's other traits. So they recruited biologists to advise them on bee behavior and a materials scientist to develop a small rechargeable fuel cell. Computer scientists joined to write software to coordinate the colony's actions, and Wei began designing a microprocessor that can crunch data from multiple sensors. Last fall, the team earned a $10-million grant from the National Science Foundation to build a network of autonomous bees.

IX. Определить, является ли утверждение правдой или ложью (True or false).

1) Cameras on the bee's feet record landmarks underneath the bee to give it a sense of where and how far it has traveled.

2) Last fall, the team earned a $1 grant from the National Science Foundation to build a network of autonomous bees.

3) In the hive, three pronged feet lock the bee into a docking station to recharge its micro fuel cell and upload sensor data to a computer.

4) Ultraviolet sensors scan for natural UV patterns on flowers.

5) Worker bees sleep, nurse bees care for larvae, and male drones spread the colony's genes.

X. Подготовить пересказ текста.

Прочитайте текст и определите его основное содержание.

A very brief history of robotics

Although the words 'robot' and 'robotics', and the science that followed the fiction, are decidedly 20th century, robotics has a long pre-history of ideas and inventions. Perhaps the first known reference to the idea of an 'intelligent' tool that could replace human labour comes from Aristotle, who wrote in 320 BC that 'if every tool, when ordered, or even of its own accord, could do the work that befits it... then there would be no need either of apprentices for the master workers or of slaves for the lords'.

The practice of constructing mechanical automata dates back at least 2,000 years. Hero of Alexandria constructed a number of automata, including, in about **60 AD,** a self-powered three-wheeled cart. The cart was powered by a falling weight that pulled strings wrapped around its axles, and has recently been discovered to be programmable by means of pegs in the axles, so that the direction of winding of the string on the axle can be reversed. Thus the cart can be programmed to turn and follow a preset route.

The earliest reference to the idea of a humanoid automaton is to be found in Jewish folklore with the Golem: an animated humanoid being made of inanimate matter, normally clay, brought to life by magic. Although its true origins are controversial, one of the most famous stories relates how the 16th-century Rabbi Loew of Prague created a Golem to defend the city's ghetto from attack. A particularly interesting aspect of the mythical Golem is that it would interpret commands literally, with unintended and sometimes disastrous consequences. This is also a

property of modern robots, as we roboticists are often painfully reminded.

One of the most interesting and characteristically far-sighted automata of the Renaissance period is Leonardo da Vinci's autonomous cart. Recent research has established this as a working self-powered automaton of remarkable sophistication. Leonardo's cart is powered by clockwork springs, but most notable is the system of replaceable cams controlling both the steering and speed. These allow the cart to be programmed to follow a preset route, starting, stopping, and turning as required. The robot could also be programmed to trigger a special effect at a preset time, such as opening a door on a sculpture mounted on the cart. Leonardo might also be credited with the first design, c.1495, for a complete humanoid robot, with his robot knight. Based on biomechanical principles from his anatomical research, Leonardo's knight had cable-driven arms, head, and jaw.

During the 18th century, mechanical automata reached a high degree of sophistication (as well as fakery). Perhaps the best-known example is French inventor De Vaucanson's 1739 mechanical duck, which famously defecated after 'eating' grain. This was an illusion - the duck actually excreted a premixed preparation of dyed green breadcrumbs. (True robotic artificial digestion would not appear for another 270 years, as I describe in Chapter 3.) More significant in my view is de Vaucanson's flute-playing humanoid automaton, notable for the sophistication and bio-mimicry of its mechanisms for controlling the airflow, via the robot's lip and tongue movements, needed to successfully play the flute.

I.Ответить на вопросы :

1. Who did the first idea of "an intelligent" tool come from?
2. When was the first self-powered cart constructed?
3. Can the ides of a humanoid automation be found in folklore?
4. How was Leonardo's cart powered?
5. What operations could Leonardo's cart perform ?
6. Was Leonardo the first designer of a human robot?
7. What principles did Leonardo used to design his "knight robot" ?
8. During the 18th century, mechanical automata reached a high degree of sophistication, didn't they?
9. What is the best known example of a robot in the 18th century?
10. Were robots used to entertain people in the past?

II. Перевести с русского языка на английский

Изобретение, труд человека, механический автомат, вес, ось, гуманоид, искусственный интеллект, наиболее известный пример, биометрический, сложный, ось, Ренессанс, современные исследования, маршрут, заводить, сложный.

III. Вставить пропущенные предлоги

1. Robotics has a long pre-history ….. ideas of an inventions. 2. The practice of constructing mechanical automata dates back…..least 2,000 years. 3. The cart was powered …..a falling weight. 4. The earliest reference ….. the idea of a humanoid is to

be found in Jewish folklore. 5. One…..the most interesting automata of the Renaissance period is Leonardo da Vinci's autonomous card. 6. The robot could also be programmed to trigger a special effect ….. a present time. 7. The first known reference ….. the idea of an "intelligent" tool comes from Aristotle. 8. Based ….. biometrical principles Leonardo's robot had cable-driven arms.

IV. Определите по словообразующим элементам (суффиксам и префиксам), какой частью речи являются следующие слова, и переведите их

move – movement; store – storage; use – useful – useless; process – processing ; usual – usually – unusual; capable – capability ; simultaneous – simultaneously; similarity – similar; particular – particularity; depend – dependence – dependent – independent; require – requirement ; wide – widely; simple – simply; design – designer; locate – location; precise – precisely – precision; change – changer; manual – manually; add – addition – additional; deliver – delivery

V. Определите тип условного придаточного предложения, переведите.

1. If a scientific research is closely connected with practice, the results are always good. 2. If you looked at the equipment of 1980, you would notice, the difference with that available at present. 3. If we look around, we can see that robots are serving us in one way or another. 4. If supercomputers had not been used for calculations, designers would have spent all their lives on computations. 5. If we are to make a journey in a plane to the nearest star , we should have to travel for several thousands centuries. 6. Superconductivity can be obtained in some materials if the temperature is very low and close to absolute zero. 7. If the satellite speed is less than necessary, it will go down from the orbit and enter the atmosphere. 8. If there were no robots, space flights would be im-

possible. 9. If drivers were more attentive while driving, there would be less accidents on the road. 10. If it were possible, we should begin this work at once.

VI. Перевести с английского языка на русский

Robotics, fiction, invention, reference, human labour, mechanical automata, three-wheeled, weight, axle, wind, route, humanoid, Renaissance period, recent research, sophistication, trigger, biometrical, jaw, high degree, best-known example, artificial, mechanism.

VII. Закончить предложения по смыслу:

1) An interesting aspect of mythical Golem is that it…..

2) In 320 BC Aristotle wrote ….

3) During the 18th century mechanical automata …..

4) De Vaucanson's humanoid could play…..

5) A robot could be programmed …..

VIII. Укажите какой из абзацев текста содержит следующую информацию

Scientists tried to create robots in Renaissance period.

Варианты ответов

1) 1 2) 2 3) 3 4) 4

IX. Является ли утверждение правильным

1) The idea of making a robot appeared in the 20th century.

2) Leonardo da Vinci didn't take any interest in making mechanical automata.

3) Leonardo da Vince created the first complete humanoid robot.

X. Кратко перескажите текст "A very brief history of robotics".

Прочитайте текст
Robot intelligence

1) 1 am often asked, 'How intelligent are robots?' - perhaps out of a sense of unease that robots shouldn't be too intelligent. At one level it's a difficult question to answer properly. Making meaningful comparisons between the intelligence of a particular robot and a particular animal is fraught with difficulty, not least because we only have a vague notion of how intelligent most animals are compared with each other and with us humans.

2) We have a general sense that a crocodile is smarter than an ant, and a cat smarter than a crocodile, but this notion is wrong. Intelligence is not a single measurable quality (like an IQ test) that different animals, or indeed robots, have more or less of. But setting aside this objection, where would we assess the intelligence of, say, a robot vacuum cleaner to be? If pressed, I would suggest right at the bottom.

3) A robot vacuum cleaner has a small number of preprogrammed (i.e. instinctive) behaviours and is not capable of any kind of learning (see Box 1 for a description). These are characteristics we would associate with very simple animals. So is our robot vacuum cleaner about as smart as a single-celled animal such as an amoeba?

4) When roboticists describe a robot as intelligent, what they mean is 'a robot that behaves, in some limited sense, as if it were intelligent'. The words as if are important here. Few roboticists would claim a robot to be truly intelligent. They might claim a robot deserves to be called intelligent, in this qualified sense, because the robot is able to determine what actions it needs to take in order to behave appropriately in response to external stimuli.

My own view is that a robot can be regarded as demonstrating a limited simulation of intelligence while, at the same time, being regarded as intelligent. By analogy, an aeroplane can be considered a simulation of flight, but no one would doubt it is also truly flying. Thus I believe it is hard to argue that a robot that behaves as if it is intelligent is not, within in the very limited scope of those behaviours, properly intelligent. I accept, however, that this view may be controversial. The question of what properties constitute intelligence remains a difficult scientific and philosophical question.

Let's think about robot intelligence a different way. I could have answered the question 'How intelligent are robots?' with the response: 'as intelligent as they need to be to do the job they are designed for'. A robot vacuum cleaner doesn't need to be very smart in order to be good at cleaning carpets, and the same is true for very many robots. But what if the job that we need a robot to do does demand much more intelligence? How can we make robots smarter, and what are the current limits on robot intelligence?

There are basically two ways in which we can make a robot behave as if it is more intelligent: preprogram a larger number of (instinctive) behaviours; and/or design the robot so that it can learn and therefore develop and grow its own intelligence.

The first of these approaches is fine, providing that we know everything there is to know about what the robot must do and all of the situations it will have to respond to while it is working, typically we can only do this if we design both the robot and its operational environment. In this way we can limit the number of unexpected things that might happen, and therefore anticipate and preprogram exactly how the robot must react to each of these events. Factory robots are a good example here - they work in a carefully engineered environment in which the work they have to do is presented in exactly the same position and orientation every time (for instance, welding parts of a car).

But what if we want a robot to be able to work in unstructured environments - anywhere that was not designed with the robot in mind? In this sense almost any outdoor or indoor environment is unstructured. Even offices, which to us seem highly structured, are a problem for robots because of the people in them. Making robots both smart and safe in human environments is a major unsolved problem for roboticists.

For unstructured environments, the first approach to robot intelligence above is infeasible simply because it's impossible to anticipate every possible situation a robot might encounter, especially if it has to interact with humans. The only solution is to design a robot so that it can learn, either from its own experience or from humans or other robots, and therefore adapt and develop its own intelligence:

in effect, grow its behavioural repertoire to be able to respond appropriately to more and more situations.

This brings us to the subject of learning robots—something I shall return to in a little more detail later in this book. Suffice it to say robot learning or, more generally, 'machine learning - a branch of AI - has proven to be very much harder than was expected in the early days of Artificial Intelligence.

Thus, although there are plenty of examples of research robots that demonstrate simple learning, such as learning to find their way out of a maze, none has so far demonstrated what we might call general problem-solving intelligence. This is the ability to learn either individually (by trial and error) or socially (by watching and learning from a human teacher or another robot), then generalize that learned knowledge and apply it to new situations. It is the kind of learning that comes naturally to human children.

I.Ответьте на следующие вопросы

1) Is it easy to answer the question, "How intelligent are robots"?
2) Is it possible to compare robots with humans?
3) Is a robot vacuum cleaner capable of any kind of learning?
4) What are the two ways in which we can make a robot behave as if it is more intelligent?
5) Is environment important for robot's work?
6) What is a major unsolved problem for robotics?
7) Why some robots are called "intelligent"?
8) Do robots need to be really intelligent?
9) Does robotics need to invent a robot which can learn from its own experience?
10) Is it easy to make a robot with the ability to learn?

II.Перевести с английского языка на русский.

Intelligent, measurable quality, objection, robot vacuum cleaner, preprogrammed, capable of any kind of learning, controversial, operational environment, factory robots, welding, unsolved problem for robotics, to interact with humans, solution, own experience, research robots.

III.Вставить пропущенные предлоги.

1.The great majority ….. humanoid robots are found among the toys. 2.Robot football provides a remarkable challenge and showcase …..robotics development. 3. I shall describe a number …..them in this chapter. 4. …..one level it's a difficult question to answer properly. 5. A robot is able to determine what actions it needs to take …..order to behave appropriately …..response to external stimuli. 6. A robot vacuum cleaner has a small number …..preprogrammed behaviours and is not capable of any kind….. learning. 7. A robot needs to take in order to behave appropriately ….. response to external stimuli. 8. …..analogy, an aeroplane can be considered a simulation of flight.

IV.Определите по словообразовательным элементам (суффиксам и префиксам), какой частью речи являются следующие слова, переведите их.

arrange – arrangement – rearrange – rearrangement, accurate – accuracy – accurately; utilize – utilization; flexible – flexibility; design – designer – designing; estimate – estimation – estimator; manufacture – manufacturing – manufacturer; determine – determination; perform – performance; differ – different – difference; interfere - interfering; account – accounting; forecast – forecasting; control – controller; tool – tooling; consider – consideration – considerable; cool - coolant

V.Найдите в предложениях причастие по его признакам и определите его функции.

1.Robot vacuum cleaner produced in 2010 is rather easy to use. 2. We need highly developed electronics and new materials to make intelligent robots. 3. New alloys have appeared during the last decades, among them a magnesium-lithium alloy developed by our scientists. 3. Having graduated from Cambridge, a young scientist worked in the field of Robotics. 4. Robots are widely used in any developed industry. 5. Having published his book about using robots, he became known all over the world. 6. Being more efficient than human beings, robots are used more and more extensively. 7. We are carried by airplanes, trains and cars with built-in electronic devices. 8. Robot components produced should be clean. 9. New industrial robots reduce the number of workers needed. 10. Being invented the digital technology solved the problems of signal transmission.

VI. Найдите в тексте английские эквиваленты следующих русских слов и словосочетаний:

Интеллект, взаимодействовать с людьми, робот-пылесос, способный к какому-либо виду обучения, заранее запрограммированный, операционная среда, промышленные роботы, сварка, неразрешимая проблема, робототехника, собственный опыт, измерять, качество.

VII. Закончить предложения по смыслу :

1) Robots should not be …
2) Intelligence is not…
3) Robots must be as intelligent as …
4) Very many robots don't need to be very smart because …
5) One way in which we can make a robot to behave as if it is more intelligent is to preprogram a large number of behavious, the other is …

VIII. Определите в каком абзаце текста содержится информация.

Scientists don't consider robots to be really intelligent.

1) 1
2) 2
3) 3
4) 4

IX. Соответствуют ли следующие утверждения тексту?

1) Intelligent can be easily measured.
2) Robots can behave only as if they are intelligent.
3) Robots need to be more intelligent than humans.

4) Science and philosophy have described properties which constitute intelligence.

5) A robot vacuum cleaner is not able to learn.

X Кратко перескажите текст “Robot Intelligence” .

Прочитайте текст

Humanoid and android robots

1. Although the vast majority of robots in the world today - including those in research labs - are not humanoid, robots made in our likeness hold a special fascination. This is perhaps not surprising given that the word ‘robot’ was first used to describe a fictional humanoid robot. But fiction aside, there are good reasons why robots that need to work with people might have to be humanoid: first, so they can use human tools and share human workspaces; and second, to be able to communicate naturally with humans (for instance, through speech, facial expressions, and gestures).

2. A robot is described as humanoid if it has a shape or structure that to some degree mimics the human form. Thus a robot head, with two vision sensors in approximately the correct place for eyes, positioned above a torso, would be regarded as humanoid. If the robot has arms, then these would similarly need to be humanoid, attached at the shoulders of the torso, with hands or grippers that approximate hands.

3. For a robot to be called humanoid, its form is more important than the detail of its components. If it has legs, for instance, it must be bipedal with some kind of hip joint, knee joint, and ankle joint - even if the legs may bear very little anatomical resemblance to their human counterparts. Most humanoid robots are decidedly mechanical in their appearance and if formed of plastic components they may appear more like cartoon people or even cartoon impressions of what robots should look like.

4. A small subset of humanoid robots does, however, attempt a greater degree of fidelity to the human form and appearance, and these are referred to as android. They have artificial skin and hair, make-up and clothes - mannequins, in fact. But like so many science fiction robots, peel away their artificial skin and underneath are the circuit boards and motors of the robot. Except that these robots are real, the closest yet to what is for many the holy grail of robotics: artificial people. Unfortunately (or per-

haps fortunately, depending on your point of view), today's android robots - although superficially impressive - are far short of that dream.

Robotics

In a nutshell the problem is this: we can build the bodies but not the brains. It is a recurring theme of this book that robot intelligence technology lags behind robot mechatronics - and nowhere is the mismatch between the two so starkly evident as it is in android robots. The problem is that if a robot looks convincingly human, then we (not unreasonably) expect it to behave like a human. For this reason whole-body android robots are, at the time of writing, disappointing.

Although humanoid robots are compelling subjects for research and development, they present particular technical challenges and it is not surprising that there are few in real-world use. Perhaps the first serious deployment of a humanoid robot as a robot assistant is the NASA GM Robonaut, recently installed on the International Space Station. This has a human-sized robot upper-body torso with arms and dexterous hands, and a head that looks rather like a racing driver's helmet.

The great majority of humanoid robots are found among toys (such as Wow Wee's Robosapiens), in education (such as the Aldebaran Robotics' Nao robot), or as technology demonstrators (such as Honda's ASIMO). Of particular interest is the growing use of humanoid robots in robot sports, where the robots might compete in single-competitor events (marathon running or weight lifting, for example), or in team events such as Robo Soccer. Robot football provides a remarkable challenge and showcase for robotics development, and small hobby humanoid robots are inexpensive enough that school or student teams can participate. Watching two teams of humanoid robots battling it out on a soccer pitch is a fascinating spectacle. But some of the most interesting humanoid robots are to be found in research labs, and I shall describe a number of them in this chapter.

It is important not to overstate the case for humanoid robots. Without doubt, many potential applications of robots in human work- or living spaces would be better served by non-humanoid robots. The humanoid robot to use human tools argument doesn't make sense if the job can be done autonomously. It would be absurd, for instance, to design a humanoid robot in order to operate a vacuum cleaner designed for humans. Similarly, if we want a driverless car, it doesn't make sense to build a humanoid robot that sits in the driver's seat. It seems that the case for humanoid robots is strongest when the robots are required to work alongside, learn from, and interact closely with humans.

I.Ответьте на следующие вопросы.

1.Why do some robots need to be humanoid?
2. Can a robot that has a human shape be described like a humanoid?
3. Can a robot look like a real human?
4. Today's android robots aren't artificial people, aren't they?
5. Do people expect an android robot to behave like a human?
6. Where has the NASA GM Robonaut been installed?
7. Where are humanoid robots widely used?
8. Do people need a humanoid robot to operate a vacuum cleaner?
9. Can robots compete in some team events?
10. Are robots required to work alongside and interact closely with humans?

II.Перевести с английского языка на русский.

Autonomous, similarity,vast majority of robots,research labs, fiction, shape, approximately, point of view, plastic components, artificial skin and hair, particular technical challenges, chapter, without doubts, potential application of robots, work alongside, weight lifting

III.Вставить пропущенные предлоги.

1.The vast majority….. robots are not humanoid. 2. There are some reasons why robots that need to work ….. people might have to be humanoid. 3. ….. this reason whole – body android robots are disappointing. 4. Humanoid robots are compelling subjects ….. research and development. 5. The great majority ….. humanoid robots are found among toys. 6. Robot football provides a remarkable challenge ….. robotics development. 7. I shall describe a number of them ….. this chapter. 8. …..doubt, many applications of robots in human work would be better served ….. non-humanoid robots.

IV.Определите по словообразовательным элементам (суффиксам, префиксам), какой частью речи являются следующие слова, и переведите их

Change – changer – changeable; attach – attachment; practicable – practical – practically – practice; cut – cutter – cutting; break – breakage; deliver – delivery; modify – modified – modification; move – moveable – movement; locate – location – located; protect – protective – protection; store – storage; necessary – necessity; rotate – rotary – rotation; loading – unloading; place – replace; change – exchange – interexchange; set – preset; setting – resetting

V.Найдите в предложении герундий по его признакам, определите его формы и функции.

1.On graduating from the university he began working in the field of Robotics. 2. The function of a car computer is detecting and summing up the information about the road conditions. 3. Robots are widely used in all kinds of flexible manufacturing systems (FMS). 4. Detecting an object in front of a car in the dark is the purpose of the "night vision system". 5. A new robot for monitoring air pressure has recently been developed. 6. Before starting a car one must examine it carefully. 7. Designing a robot is a very difficult task. 8. On studying for half an hour before an exam one should switch over to some other activity. 9. His having made a mistake in his calculations has no influence on his theory. 10. Having used some new ideas a Russian engineer built an assembly line.

VI.Найдите в тексте английские эквиваленты следующих русских слов и словосочетаний.

Поднятие тяжестей,
Самостоятельный,
Подавляющее большинство роботов,
Художественная литература,
Приблизительно,
Искусственная кожа и волосы,
Конкретные технические проблемы,
Пластиковые компоненты,
Потенциальное применение роботов,
Работать вместе

VII.Закончить предложения по смыслу.

1) Although the majority of robots are not humans….
2) Robots might have to be humans to be able to ….
3) Science fiction robots have artificial skin, but … .
4) A lot of robots are found … .
5) Many potential applications of robots would be better served … .

VIII.В каком абзаце текста содержится информация.

Today's android robots don't look like real humans.
1) 1
2) 2
3) 3
4) 4

IX.Соответствуют ли следующие утверждения тексту.

1)We can build the bodies and the brains.
2)If a robot looks like a human, we expect it to behave like a human.
3)A robot head with two sensors in approximately correct place for eyes can be regarded as a humanoid.

4)If we want to have a driverless car, we must build a humanoid robot that sits in the driver's seat.

5)Many applications of robots can be better served by non-humanoid robots.

X.Кратко перескажите текст "Robotics".

A

Accuracy: Accuracy is the measurement of the deviation between the command characteristic and the attained characteristic , or the precision with which a computed or calculated robot position can be attained. Accuracy is normally worse than the arm's repeatability. Accuracy is not constant over the workspace, due to the effect of link kinematics.

Active Compliant Robot: An active compliant robot is one in which motion modification during the performance of a task is initiated by the control system. The induced motion modification is slight, but sufficient to facilitate the completion of a desired task.

Actual Position: The position or location of the tool control point. Note that this will not be exactly the same as the demand position due to a multitude of un-sensed errors (such as link deflection, transmission irregularity, tolerances in link lengths, etc.)

Actuator: A power mechanism used to effect motion, or maintain position of the robot (for example, a motor which converts electrical energy to effect motion of the robot) .The actuator responds to a signal received from the control system.

Axis: A direction used to specify the robot motion in a linear or rotary mode.

Arm: An interconnected set of links and powered joints comprising a robot manipulator that supports and/or moves a wrist and hand or end-effector through space. The arm itself does not include the end-effector.

Articulated Manipulator: A manipulator with an arm that is broken into sections (links) by one or more joints. Each of the joints represents a degree of freedom in the manipulator system and allows translation and rotary motion.

Articulation: Describes a jointed device, such as a jointed manipulator. The joints provide rotation about a vertical axis, and elevation out of the horizontal plane. This allows a robot to be capable of reaching into confined spaces.

Assembly Robot: A robot designed specifically for mating, fitting, or otherwise assembling various parts or components into completed products. Primarily used for

Base: The stable platform to which a robot arm is attached.

Base Link: The stationary base structure of a robot arm that supports the first joint.

Burn-In: Burn-In is a robot testing procedure where all components of the robot are operated continuously for an extended period of time. This is done to test movement, and movement programming of the robot at early stages to avoid malfunctions after deployment.

C

CAD: Computer Aided Design. Computer graphic applications designed to allow engineering of objects (or parts), which are to be manufactured. A computer is used as a tool to design schematics and produce blueprints, which enable the accurate production of the object. The CAD system enables the three-dimensional drawings of basic figures, exact sizing and placement of components, making lines of specified length, width, or angle, as well as satisfying varying geometric shapes. This system also allows the designer to test a simulated part under different stresses, loads, etc.

Carousel : A rotating platform that delivers objects to a robot, and serves as an object queuing system. This carousel delivers the objects, or work-pieces to the loading/unloading station of the robot.

Cartesian Topology : A topology, which uses prismatic joints throughout, normally arranged to be perpendicular to each other.

Cartesian Manipulator : A Cartesian Manipulator is a robot arm with prismatic joints, which allows movement along one or more of the three- axes in the x, y, z coordinate system.

Cartesian-Coordinate Robot : A Cartesian-Coordinate robot is a robot whose manipulator-arm degrees of freedom are defined by Cartesian coordinates. This describes motions that are east-west, north-south and up-down, as well as rotary motions to change orientation.

Centrifugal Force : When a body rotates about an axis other than one at it's center of mass, it exerts an outward radial force called centrifugal force upon the axis, which restrains it from moving in a straight tangential line. To offset this force, the robot must exert an opposing torque at the joint of rotation.

Circular Motion Type : A calculated path that the robot executes, and is circular in shape.

Clamp : An end-effector which serves as a pneumatic hand that controls the grasping and releasing of an object. Tactile, and feed-back force sensors are used to mange the applied force to the object by the clamp.

Closed-Loop : Control achieved by a robot manipulator by means of feed-back information. As a manipulator is in action, it's sensors continually feed-back information to the robot's controller which are used to further guide the manipulator within the given task. Many sensors are used to feed-back information about the manipulator's placement, speed, torque, applied forces, as well as the placement of a targeted moving object, etc.

Control Command : An instruction fed to the robot by means of the human-to-machine input device. This command is received by the robot's controller system and is interpreted. Then, the proper instruction is fed to the robot's actuators, which enable it to react to the initial command. Many times the command must be interpreted with the use of logic units and specific algorithms.

Command Interpreter : A module or set of modules that determines what the received command means. The command is broken down into parts (parsed) and processed.

Command Position : The endpoint position of a robot motion that the controller is trying to achieve

Compliance : Displacement of a manipulator in response to a force or torque. A high compliance means the manipulator moves a good bit when it is stressed. This is called spongy or springy. Low compliance would be a stiff system when stressed.

Compliant Robot: A robot that performs tasks, with respect to external forces, by modifying its motions in a manner that minimizes those forces. The indicated or allowed motion is accomplished through lateral (horizontal), axial (vertical) or rotational compliance.

Configuration : The arrangement of links created by a particular set of joint positions on the robot. Note that there may be several configurations resulting in the same endpoint position

Contact Sensor : A device that detects the presence of an object or measures the amount of applied force or torque applied on the object through physical contact with it. Contact sensing can be used to determine location, identity, and orientation of work-pieces.

Continuous Path : Describes the process where by a robot is controlled over the entire path traversed, as opposed to a point-to-point method of traversal. This is used when the trajectory of the end-effector is most important to provide a smooth movement, such as in spray painting etc.

Control Algorithm : A monitor used to detect trajectory deviations in which sensors detect such deviations and torque applications are computed for the actuators.

Control Device : Any piece of control hardware providing a means for human intervention in the control of a robot or robot system, such as an emergency-stop button, a start button, or a selector switch.

Control Mode : The means by which instructions are communicated to the robot.

Controlability : The property of a system by which an input signal can take the system from an initial state to a desired state along a predictable path within a predetermined period of time.

Controller: An information processing device whose inputs are both the desired and measured position, velocity or other pertinent variables in a process and whose outputs are drive signals to a controlling motor or actuator.

Controller System: The robot control mechanism is usually a computer of some type, which is used to store data (both robot and work environment), and store and execute programs, which operate the robot. The controller system contains the programs, data, algorithms; logic analysis, and various other processing activities, which enable it to perform.

CPU (Central Processing Unit) : The main circuit board and processor of the Controller System.

Cycle : A single execution of a complete set of moves and functions contained within a robot program.

Cyclic Coordinate System : A coordinate system that defines the position of any point in terms of an angular dimension, a radial dimension, and a height from a reference plane. These three dimensions specify a point on a cylinder.

D

Degrees Of Freedom : The number of independent directions or joints of the robot , which would allow the robot to move its end effector through the required sequence of motions. For arbitrary positioning, 6 degrees of freedom are needed: 3 for position (left-right, forward-backward, and up- down) and 3 for orientation (yaw, pitch and roll).

Direct-Drive : Joint actuation including no transmission elements i.e. the link is bolted onto the output of the motor.

Downtime : A period of time in which a robot, or production line is shut down due to malfunction or failure.

Drive: A speed (gear) reducer to convert high speed low torque to low speed high torque.

Drop Delivery : A method of introducing an object to the workplace by gravity. Usually, a chute or container is so placed that, when work on the part is finished, it will fall or drop into a chute or onto a conveyor with little or no transport by the robot.

Dynamics: The study of motion, the forces that cause the motion, and the forces due to motion. The dynamics of a robot arm are very complicated as they result from the kinematical behavior of all masses within the arm's structure. The robot arm kinematics are complicated in themselves.

E

Emergency Stop : The operation of a circuit using hardware-based components that overrides all other robot controls, removes drive power from the robot actuators, and causes all moving parts to stop.

Enabling Device : A manually operated device which when continuously activated, permits motion. Releasing the device shall stop robot motion and motion of associated equipment that may present a hazard.

Encoder: A feedback device in the robot manipulator arm that provides current position (and orientation of the arm) data to the controller. A beam of light passes through a rotating code disk that contains a precise pattern of opaque and transparent segments on its surface. Light that is transmitted through the disk strikes photodetectors, which convert the light pattern to electrical signals.

End-Effector : An accessory device or tool specifically designed for attachment to the robot wrist or tool mounting plate to enable the robot to perform its intended task. (Examples may include gripper, spot weld gun, arc weld gun, spray point gun, or any other application tools.)

Endpoint: The nominal commanded position that a manipulator will attempt to achieve at the end of a path of motion. The end of the distal link.

Error: The difference between the actual response of a robot and a command issued.

Expandability: Being able to add resources to the system, such as memory, larger hard drive, new I/O card, etc.

F

Feedback: The return of information from a manipulator, or sensor to the processor of the robot to provide self-correcting control of the manipulator.

Feedback Control : A type of system control obtained when information from a manipulator, or sensor is returned to the robot controller in order to obtain a desired robot effect.

Feedback Sensor: A mechanism through which information from sensing devices is fed back to the robot's control unit. The information is utilized in the subsequent direction of the robot's motion.

Flexibility: The ability of a robot to perform a variety of different tasks.

Force Feedback : A sensing, technique using electrical signals to control a robot end-effector during the task of the end-effector. Information is fed from the force sensors of the end-effector to the robot control unit during the particular task to enable enhanced operation of the end-effector.

Force Sensor : A sensor capable of measuring the forces and torque exerted by a robot and it's wrist. Such sensors usually contain strain gauges. The sensor provides information needed for force feedback.

Forward Kinematic Solution : The calculation required to find the endpoint position given the joint positions. For most robot topologies this is easier than finding the inverse kinematic solution.

Forward Kinematics: Procedures which determine where the end effector of a robot is located in space. The procedures use mathematical algorithms along with joint sensors to determine its location.

Frame: A coordinate system used to determine a position and orientation of an object in space, as well as the robot's position within its model.

G

Gantry : An adjustable hoisting machine that slides along a fixed platform or track, either raised or at ground level along the x, y, z axes.

Gantry Robot : A robot which has three degrees of freedom along the X, Y, and Z coordinate system. Usually consists of a spooling system (used as a crane) which when reeled or unreeled provides the up and down motion along the Z axis. The spool can slide from left to right along a shaft which provides movement along the Z axis. The spool and shaft can move forward and back along tracks which provide movement along the Y axis. Usually used to position it's end-effector over a desired object and pick it up.

Gravity Loading : The force exerted downward, due to the weight of the robot arm and/or the load at the end of the arm. The force creates an error with respect to position accuracy of the end-effector. A compensating force can be computed and applied bringing the arm back to the desired position.

Gripper: An end effector that is designed for seizing and holding , and "grips" or grabs an object. It is attached to the last link of the arm. It may hold an object using several different methods, such as: applying pressure between it's "fingers", or may use magnetization or vacuum to hold the object, etc.

H

Hand : A clamp or gripper used as an end-effector to grasp objects.

Harness: Usually several wires, bundled together to deliver power and/or signal communications to/from devices. For example the robot motors are connected to the controller through a wire harness.

Harmonic Drive: Compact lightweight speed reducer that converts high speed low torque to low speed high torque. Usually found on the minor axis (smaller).

Hazardous Motion : Unintended/unexpected robot motion that may cause injury.

Hold: A stopping of all movements of a robot during its sequence, in which some power is maintained on the robot. For example, program execution stops, however power to the servomotors remain on if restarting is desired.

Home Position: A known and fixed location on the basic coordinate axis of the manipulator where it comes to rest, or to an indicated zero position for each axis. This position is unique for each model of manipulator. On Motoman robots there are indicator marks that show the Home position for the respective axis.

I

Inductive Sensors : The class of proximity sensors, which has half of a ferrite core, whose coil is part of an oscillator circuit. When a metallic object enters this field, at some point the object will absorb enough energy from the field to cause the oscillator to stop oscillating. This signifies that an object is present in a given proximity.

Interpolation: The method by which endpoint paths are created. In general to specify a motion a few knot points are defined and then all the intermediate positions between them are calculated by mathematical interpolation. The interpolation algorithm used therefore has a dramatic effect of the quality of motion.

Industrial Robot: A re-programmable multifunctional manipulator designed to move material, parts, tools, or specialized devices, through variable programmed motions for the performance of a variety of tasks . The principle components are: one or more arms that can move in several directions; a manipulator; a computer controller that gives detailed movement instructions.

Input Devices : A variety of devices, which allow a human to machine interface. This allows the human to program, control, and simulate the robot. Such devices include programming pendant, computer keyboards, a mouse, joy-sticks, push buttons, operator panel, operator pedestal etc.

Instruction: A line of programming code that causes action from the System Controller.

Instruction Cycle : The time it takes for a robot controller system's cycle to decode a command or instruction before it is executed. The Instruction Cycle must be analyzed very closely by robotic programmers to enable speedy and proper reaction to varying commands.

Integrate: To fit together different subsystems, such as robots and other automation devices, or at least different versions of subsystems in the same control shell.

Intelligent Robot: A robot that can be programmed to make performance choices contingent on sensory inputs with little or no help from human intervention.

J

Jacobian Matrix : The Jacobian matrix relates the rates of change of joint values with the rates of change of endpoint co-ordinates. Essentially it is a set of algorithm calculations that are processed to control the positioning of a robot.

Joint: A part of the manipulator system, which allows a rotation and/or translational degree of freedom of a link of end-effector.

Joints: The parts of the robot arm which actually bend or move.

Joint Motion Type: Also known as Point to Point motion, is a method of path interpolation that commands the movement of the robot by moving each joint directly to the commanded position so that all axis arrive to the position at the same time. The path is predictable, however the path will not be linear.

Joint-Interpolated Motion : A method of coordinating the movement of the joints, such that all joints arrive at the desired location simultaneously. This method of servo control produces a predictable path regardless of speed and results in the fastest pick and place cycle time for a particular move.

Joint Space: The set of joint positions.

K

Kinematics: The relationship between the motion of the endpoint of a robot and the motion of the joints. For a Cartesian robot this is a set of simple linear functions (linear tracks that may be arranged in X, Y, Z directions), for a revolute topology (joints that rotate) however, the kinematics are much more complicated involving complicated combinations of trigonometry functions. The kinematics of an arm is normally split into forward and inverse solutions.

L

Ladle Gripper: An end-effector, which acts as a scoop. It is commonly used to scoop up liquids, transfer it to a mold and pour the liquid into the mold. Common for handling molten metal under hazardous conditions.

Laser: Acronym for Light Amplification by Stimulated Emission of Radiation. A device that produces a coherent monochromatic beam of light which is extremely narrow and focused but still within the visible light spectrum. This is commonly used as a non-contact sensor for robots. Robotic applications include: distance finding, identifying accurate locations, surface mapping, bar code scanning, cutting, welding etc.

Linear Motion Type: Is a method of path interpolation that commands the movement of the robot by moving each joint in a coordinated motion so that all axis arrive to the position at the same time. The path of the tool control point (TCP) is predictable and will be linear.

Link: A rigid part of a manipulator, which connects adjacent joints.

Links: The static material, which connects the joints of an arm together thereby forming a kinematical chain. In a human body, the links are the bones.

Load Cycle Time: A manufacturing or assembly line process term, which describes the complete time to unload the last work-piece and load the next one.

M

Magnetic Detectors: Robot sensors that can sense the presence of ferromagnetic material. Solid-state detectors with appropriate amplification and processing can locate a metal object to a high degree of precision.

Manipulator: A machine or robotic mechanism of which usually consists of a series of segments jointed or sliding relative to one another, for the purpose of grasping and/or moving objects (pieces or tools) usually in several degrees of freedom. The control of the manipulator may be by an operator, a programmable electronic controller, or any logic system (for example cam device, wired, etc.)

Material Handling: The process by which a robotic arm transfers materials from one place to another.

Material Processing Robot: A robot designed and programmed so that it can machine, cut, form, or change the shape, function or properties of materials it handles between the time the materials are first grasped and the time they are released in a manufacturing process.

Modularity: The property of flexibility built into a robot and control system by assembling separate units, which can be easily joined to or arranged with other parts or units.

Module: Self-contained component of a package. This component may contain sub-components known as sub-modules.

Motion Axis: The line defining the axis of motion either linear or rotary segment of a manipulator.

O

Off-Line Programming: A programming method where the task program is defined on devices or computers separate from the robot for later input of programming information to the robot.

On-Line Programming: A means of programming a robot while the robot is functioning. This becomes important in manufacturing and assembly line production due to keeping productivity high while the robot is being programmed for other tasks.

Operator: The person designated to start, monitor and stop the intended productive operation of a robot or robot system. An operator may also interface with a robot for productive purposes.

Optical Encoder: A detection sensor, which measures linear or rotary motion by detecting the movement of markings past a fixed beam of light. This can be used to count revolutions, identify parts, etc.

Optical Proximity Sensors: Robot sensors which measures visible or invisible light reflected from an object to determine distance. Lasers are used for greater accuracy.

Orientation: The angle formed by the major axis of an object relative to a reference axis. It must be defined relative to a three-dimensional coordinate system. Angular position of an object with respect to the robot's reference system.

P

Path: The continuous locus of positions (or points in three dimensional space) traversed by the tool center point and described in a specified coordinate system.

Payload - Maximum: The maximum mass that the robot can manipulate at a specified speed, acceleration/deceleration, center of gravity location (offset), and repeatability under continuous operation over a specified working space. Maximum payload is specified in kilograms.

Pendant [Teach Pendant]: A hand-held input device linked to the control system with which a robot can be programmed or moved. This enables the human operator to stand in the most favorable position to observe, control, and record the desired movements in the robot's memory.

Pendant Teaching: The mapping and recording of the position and orientation of a robot and/or manipulator system as the robot is manually moved in increments from an initial state along a path to a final goal state. The position and orientation of each critical point (joints, robot base, etc.) is recorded and stored in a database for each taught position the robot passes through on its path toward its final goal. The robot may now repeat the path on its own by following the path stored in the database.

Pick And Place Cycle: The amount of time it takes for a manipulator to pick up an object and place it in a desired location, then return to it's rest position. This includes time during the acceleration and deceleration phases of a particular task. The robots movement is controlled from one point location in space to another in a point-to-point (PTP) motion system. Each point is programmed into the robot's control memory and then played back during the work cycle.

Pick-And-Place Task: A repetitive part transfer task composed of a picking action followed by a placing action.

Pitch: Rotation of the end-effector in a vertical plane around the end of the robot manipulator arm.

Point-To-Point : Manipulator motion in which a limited number of points along a projected path of motion is specified. The manipulator moves from point to point rather than a continuous smooth path.

Pose: Alternative term for robot configuration, and describes the linear and angular position. The linear position includes the azimuth, elevation, and range of the object. The angular position includes the roll, pitch, and yaw of the object.

Position: The definition of an object's location in 3-D space, usually defined by a 3-D coordinate system using X, Y, and Z coordinates.

Presence-Sensing Safeguarding Device: A device designed, constructed, and installed to create a sensing field to detect an intrusion into such field by people, robots, or objects.

Programmable Logical Controller (PLC): A solid-state control system, which has a user programmable memory for storage of instructions to implement specific functions such as: I/O control logic, timing, counting arithmetic, and data manipulation. A PLC consists of a central processor, input/output interface, memory, and programming device, which typically uses relay equivalent symbols. The PLC is purposely designed as an industrial control system, which may perform functions equivalent to a relay panel or a wired solid-state logic control system, and may be integrated into the robot control system.

Programmable Robot: A feature that allows a robot to be instructed to perform a sequence of steps and then to perform this sequence in a repetitive manner. It can then be reprogrammed to perform a different sequence of steps if desired.

Proximity Sensor: A non-contact sensing device used to sense when objects are a short distance away, and determine the distance of the object. Several types include: radio frequency, magnetic bridge, ultrasonic, and photoelectric. Commonly used for: high speed counting, sensing metal objects, level control, reading coding marks, and limit switches.

Q

Quality Assurance (QA): Describes the methods, policies, and procedures necessary to conduct quality assurance testing during design, manufacturing and deliver phases of creating, reprogramming, or maintaining robots.

R

Reach: The volume of space (envelope), which a robot's end-effector can reach in at least one orientation.

Real-Time System: A computer system in which the computer is required to perform its tasks within the time restraints of some process simultaneously with the system it is assisting. The computer processes system data (input) from the sensors for the purpose of monitoring and computing system control parameters (outputs) required for the correct operation of a system or process. The computer is required to do its work fast enough to keep pace with an operator interacting with it through a terminal device (such as a screen or keyboard). The operator interacting with the computer has access, retrieval, and storage capability through a database management system. System access allows the operator to intervene and alter the system's operation.

Record-Playback Robot: A manipulator for which the critical points along desired trajectories are stored in sequence by recording the actual values of the joint-position encoders of the robot as it is moved under operational control. To perform the task, these points are played back to the robot's Servo-system.

Rectangular-Coordinate Robot: A robot whose manipulator arm moves in linear motions along a set of Cartesian or rectangular axis in X, Y, and Z directions. The shape of the work envelope forms a rectangular figure.

Reliability: The probability or percentage of time that a device will function without failure over a specified time period or amount of usage .Also called the robot's uptime or the Mean Time Between Failure (MTBF).

Repeatability: A measure of how close an arm can repeatedly obtain a taught position. For instance: once a manipulator is manually placed in a particular location and this location is resolved by the robot, the repeatability specifies how accurately the manipulator can return to that exact location. The degree of resolution within the robot control system determines the repeatability. In general an arm's repeatability can never be better than its resolution.

Remanufacture: To upgrade or modify robots to the revised specifications of the manufacturer.

Resolution: The amount of robot joint motion required for the position sensing to change by 1 count. Although the resolution of each joint feedback sensor is normally constant, the resolution of the endpoint in world coordinates is not constant for revolute arms, due to the non-linearity of the arm's kinematics.

Revolute Joint : The joints of a robot, which are capable of rotary motion.

Robot: A re-programmable, multifunctional manipulator designed to move material, parts, tools, or specified devices through variable programmed motions for the performance of a variety of tasks. Common elements which make up a robot are: controller, manipulator, and end-effector.

Robot Programming Language: An interface between a human user and a robot, which relates humans commands to the robot.

Robot Simulation: A method for emulating and predicting the behavior and the operation of a robotic system based on the model (e.g. computer graphics) of the physical system.

Roll: Rotation of the robot end-effector in a plane perpendicular to the end of the manipulator arm.

Rotary Joint: A joint which twists, swings or bends about an axis

Rotary Vector Drive (RV): A brand name for a speed reduction device that converts high speed low torque to low speed high torque, usually used on the major axis (larger).

S

Safeguard: A barrier guard, device or safety procedure designed for the protection of personnel.

Sensor: Instruments used as input devices for robots, which enable it to determine aspects regarding the robot's environment, as well as the robot's own positioning. Sensors respond to physical stimuli (such as heat, light, sound, pressure, magnetism, motion) and transmit the resulting signal or data for providing a measurement, operating a control, or both.

Sensory Feedback: Variable data measured by sensors and relayed to the controller in a closed-loop system. If the controller receives feedback that lies outside an acceptable range, then an error has occurred. The controller sends an error signal to the robot. The robot makes the necessary adjustments in accordance with the error signal.

Servo Control: The process by which the control system of the robot checks if the attained pose of the robot corresponds to the pose specified by the motion planning with required performance and safety criteria. (ISO 8373)

Servo-Controlled Robot: The control of a robot through the use of a closed loop Servo-system, in which the position of the robot axis is measured by feedback devices and is stored in the controller's memory.

Servo Motor: An electrical power mechanism used to effect motion, or maintains position of the robot (for example, a motor which converts electrical energy to effect motion of the robot) . The motor responds to a signal received from the control system and often incorporates an encoder to provide feedback to the control loop.

Servo Pack: An alternating current electrical power mechanism that is controlled through logic to convert electrical supply power that is in a sine wave form to a Pulse Width Modulated (PWM) square form, delivered to the motors for motor control: speed; direction; acceleration; deceleration; and braking control.

Servo-System: A system in which the controller issues commands to the motors, the motors drive the arm, and an encoder sensor measures the motor rotary motions and signals the amount of the motion back to the controller. This process is continued many times per second until the arm is repositioned to the point requested.

Simulation: A graphical computer program that represents the robot and its environment, which emulates the robot's behavior during a simulated run of the robot. This is used to determine a robot's behavior in certain situations, before actually commanding the robot to perform such tasks. Simulation items to consider are: the 3-D modeling of the environment, kinematics emulation, path-planning emulation, and simulation of sensors.

Singularity: A configuration where two joints of the robot arm become co-axial (aligned along a common axis). In a singular configuration, smooth path following is normally impossible and the robot may loose control. The term originates from the behavior of the Jacobian matrix, which becomes singular (i.e. has no inverse) in these configurations.

Spline: A smooth, continuous function used to approximate a set of functions that are uniquely defined on a set of sub-intervals. The approximating function and the set of functions being approximated intersect at a sufficient number of points to insure a high degree of accuracy in the approximation. The purpose for the smooth function is to allow a robot manipulator to complete a task without jerky motion.

Spline Motion Type: A calculated path that the robot executes, and may be parabolic in shape. A Spline motion may also accomplish a free form curve with mixtures of circular and parabolic shapes.

T

Teach: To program a manipulator arm by manually guiding it through a series of motions and recording the position in the robot controller memory for playback.

Teach Pendant: A handheld control box, which is used by an operator to remotely guide a robot through the motions of its tasks. The motions are recorded by the robot control system for future playback.

Through-Beam: An object detection system used within a robot's imaging sensor system. A finely focused beam of light is mounted at one end and a detector at the other. When the beam of light is broken, an object is sensed.

Tool: A term used loosely to define a working apparatus mounted to the end of the robot arm, such as a hand, gripper, welding torch, screw driver, etc.

Tool Frame: A coordinate system attached to the end-effector of a robot (relative to the base frame).

Touch Sensor: Sensing device, sometimes used with the robot's hand or gripper, which senses physical contact with an object, thus giving the robot an artificial sense of touch. The sensors respond to contact forces that arise between themselves and solid objects.

Trajectory Generation (Calculation): The computation of motion functions that allow the movement of joints in a smooth controlled manner.

Transducer: A device that converts energy from one form to another. Generally, a device that converts an input signal into an output signal of a different form. It can also be thought of as a device which converts static signals detected in the environment (such as pressure) into an electrical signal that is sent to a robot's control system

U

Uptime: A period of time in which a robot, or production line is operating or available to operate, as opposed to downtime.

V

Vacuum Cup Hand: An end-effector for a robot arm which is used to grasp light to moderate weight objects, using suction, for manipulation. Such objects may include glass, plastic; etc. Commonly used because of its virtues of reduced object slide slipping while within the grasp of the vacuum cup.

Vision Guided: Control system where the trajectory of the robot is altered in response to input from a vision system.

Vision Sensor: A sensor that identifies the shape, location, orientation, or dimensions of an object through visual feedback, such as a television camera.

R

Work Envelope: The set of all points which a manipulator can reach without intrusion. Sometimes the shape of the work space, and the position of the manipulator itself can restrict the work envelope.

Workspace: The volume of space within which the robot can perform given tasks.

World Coordinates: A reference coordinate system in which the manipulator arm moves in linear motions along a set of Cartesian or rectangular axis in X, Y, and Z directions. The shape of the work envelope forms a rectangular figure.

World Model: A three dimensional representation of the robot's work environment, including objects and their position and orientation in this environment, which is stored in robot memory. As objects are sensed within the environment the robot's controller system continually updates the world model. Robots use this world model to aid in determining its actions in order to complete given tasks.

Wrist [Secondary Axis]: An interconnected set of links and powered joints between the arm and end effector, which supports, positions and orientates the end effector.

Wrist: A set of rotary joints between the arm and the robot end-effector that allow the end-effector to be oriented to the workpiece. In most cases the wrist can have degrees of freedom which enable it to grasp an object with roll, pitch, and yaw orientation.

Y

Yaw: Rotation of the end-effector in a horizontal plane around the end of the manipulator arm. Side to side motion at an axis.