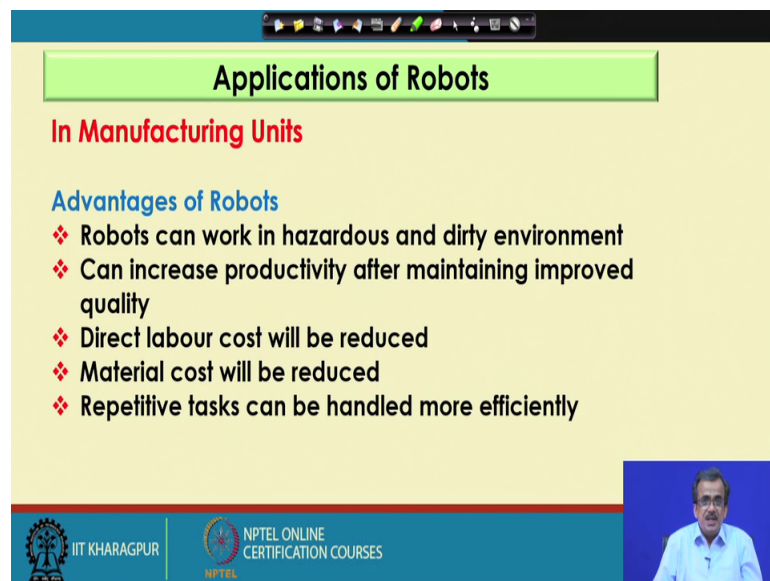


Robotics
Prof. Dilip Kumar Pratihar
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Lecture - 06
Introduction to Robots and Robotics (Contd.)

Now we have already discussed that we use robots in manufacturing unit. Now today, I am just going to discuss now, the various applications of robots and we know little bit that the robots are used in manufacturing units nowadays and there is specific requirement also that you have already discussed. Now if I use robots in manufacturing unit, we will be getting a few advantages. So, I am just going to see those advantages first. For example, say the robot can work in dirty environment and hazardous environment like the nuclear power plant.

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The slide is titled "Applications of Robots" and is divided into two main sections. The first section is "In Manufacturing Units" and the second is "Advantages of Robots". The advantages are listed as follows:

- ❖ Robots can work in hazardous and dirty environment
- ❖ Can increase productivity after maintaining improved quality
- ❖ Direct labour cost will be reduced
- ❖ Material cost will be reduced
- ❖ Repetitive tasks can be handled more efficiently

The slide also features a small video inset of Prof. Dilip Kumar Pratihar in the bottom right corner. At the bottom of the slide, there are logos for IIT Kharagpur and NPTEL Online Certification Courses.

Now, if I use robot, there is a possibility that we will be able to produce good. The good quality with less error and the productivity will be high. And if you use robots to replace the human labor. So, there is a possibility that one robot can replace a large number of worker and by doing that there will be saving of labour cost. Now if I just do some sort of repetitive job with the help of some operator, the manual operator.

So, what will happen is, those human being may not like that a repetitive task and there will be lot of mistakes, there will be lot of wastage of that particular the products. Now if

I can give this type of repetitive task particularly to the robot, there is a possibility; the chance of rejection will be less and due to that there will be some sort of saving of material cost. So, if we use robots actually, these are the advantages we will be getting and moreover as I have already mentioned that for the repetitive task, it is better to use the robots because human operator may get bored to perform the repetitive task. And that is why the robots have become very popular nowadays in modern manufacturing units. And nowadays actually the robots are used in manufacturing units to perform a variety of task.

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The slide is titled "Application Areas" and lists the following tasks:

- ❖ Arc Welding
- ❖ Spot Welding
- ❖ Spray Painting
- ❖ Pick and Place Operation
- ❖ Grinding
- ❖ Drilling
- ❖ Milling

On the right side of the slide, there is a hand-drawn diagram showing two rectangular plates, labeled "1" and "2", being joined together. The top plate is horizontal, and the bottom plate is tilted upwards. A blue line representing a weld joint connects the two plates. The diagram illustrates both a continuous arc weld and a spot weld.

The slide footer contains the IIT KHARAGPUR logo and the text "NPTEL ONLINE CERTIFICATION COURSES". A small video inset in the bottom right corner shows a man speaking.

For example, say it can do arc welding, spot welding. It can do some sort of spray painting. For example, nowadays the spray painting on the car body particularly Maruti uses that the manipulator to do this type of task of spray painting, but we will have to be careful while doing this particular spray painting. There should not be any such discontinuity.

Now regarding this arc welding and the spot welding, the way the robot can help is as follows. Now, let me prepare a very simple sketch. We will understand, supposing that I have got the 2 plates; 2 plates, the steel plates which I am just going to join by welding. Say I am just going for some sort of continuous arc welding and I am just going for the spot welding. So, this is plate 1 and this is plate 2 and these two plates I am going to join.

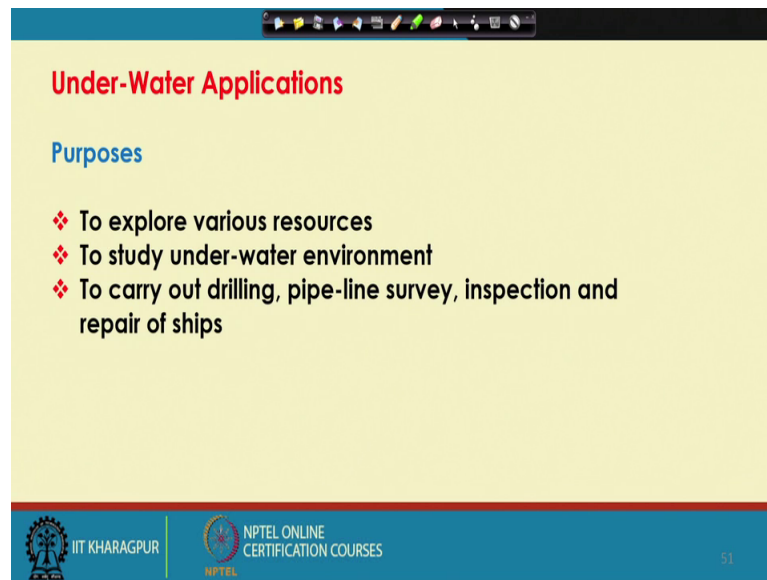
Now what I will do is, I will start from here and I will just go on doing this particular the continuous arc welding might be with the help of say 1 robot say puma. So, I am using puma just to carry out this type of arc welding. Now if I start from here; so there is a possibility. So, there will be some distortion and due to the distortion the plate may take the position something like this. So, if I start the drawing, if I start the welding here; the other side may be distorted and here I will not be able to carry out this type of the arc welding, the continuous arc welding. Then how to overcome this particular problem?.

To overcome this particular problem actually what we do is before we carry out, so this type of arc welding with the help of the manipulator. The first we do is, so this is plate 1 and plate 2. So, before we start with this particular the arc welding, we go for the spot welding. And what we do with the help of the manipulator; we just do one spot welding here, another spot welding here, another spot welding here and then we start the continuous arc welding here. So, this particular spot welding is going to erase that particular the distortion due to this welding and you will be getting very continuous welding. So, this type of task you can give it to the manipulator. The same manipulator will be able to perform the spot welding and then the continuous arc welding. So, this is one a very good application of manipulator in industry.

Then comes your Pick and Place type of operation. In the machine shop say, before the assembly the few components are to be transported from one place to another. So, we can use the robots. The robot can pick that particular object and place it to another place, then comes the Grinding. We can carry out the grinding operation and this particular grinding wheel will be attached to the end effector of the manipulator. We can do drilling which I have already discussed. We can make some drilled hole on some steel plate.

We can also do milling that also I have discussed to cut some complicated profile on one side of a steel plate. So, what you can do is, we can take the help of this type of milling cutter and this milling cutter will be gripped by the gripper or the end effector of the manipulator.

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The slide is titled "Under-Water Applications" in red text. Below the title, the word "Purposes" is written in blue. There are three bullet points, each starting with a red diamond symbol. The first bullet point says "To explore various resources". The second says "To study under-water environment". The third says "To carry out drilling, pipe-line survey, inspection and repair of ships". At the bottom of the slide, there is a blue footer bar containing the IIT Kharagpur logo on the left, the NPTEL Online Certification Courses logo in the center, and the number "51" on the right.

So, in manufacturing unit nowadays the robots are used actually to solve a variety of purposes, a variety of task ok. But besides this particular the manufacturing unit, nowadays the robots are used for some other type of applications. For example say robots are nowadays used for underwater applications. For example, say inside the sea. So, we send robot just to search for the valuable stones or the gems. So, it will try to find out the possible location of the valuable stones or the gems.

Now if we want to carry out some study of the underwater environment. So, inside water we have some living creatures. So, if you want to study their lives or if you want to study that underwater environment; so we can take the help of; so, this type of underwater robots.

Now then comes your, the crude petroleum. Now our seabed could be a very good source for the crude petroleum and you will have to drill it out the crude petroleum. Now for this drilling purpose, we can use robots. Now this particular crude petroleum is to be transported. There must be some pipelines through which the crude oil will pass and it will be transported to another place.

So, we can use robots; the underwater robots to carry out some sort of inspection for this particular pipeline and if required so this underwater robots can also do little bit of repair job, maintenance job. It can do little bit of welding also that underwater welding nowadays is also possible. So, by creating the vacuum, and there with the help of the

robots; so underwater this type of welding can be carried out. So, these are the various applications of underwater the robots.

Now, these underwater robots actually are designed and developed in different ways. Different designs are available. Now we can get some sort of multi legged robot as the underwater the robots; sometimes we use tracked vehicle as your the underwater robot, but generally we do not use wheeled robots as the underwater robots because the seabed may not be very smooth. But we may have the provision that depending on the requirement, sometimes we can use as the multi legged robot or we can use it the tracked vehicle.

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Notes

- ❖ Robots are developed in the form of ROV (Remotely Operated Vehicle) and AUV (Autonomous Under-water Vehicle)
- ❖ Robots are equipped with navigational sensors, propellers/ thrusters, on-board softwares, and others

Medical Applications

- ❖ Telesurgery
- ❖ Micro-capsule multi-legged robots
- ❖ Prosthetic devices

Orthopedic
M.S
Rehabilitation

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Now, if you see these underwater robots, now these are actually developed in two different forms. Now, one is called the ROV, that is the Remotely Operated Vehicle and another is your AUV that is called Autonomous Underwater Vehicle. Now there is a basic difference between ROV and AUV.

So, ROV is actually the centralized control. So, there will be a central computer which is going to control the movement of this particular the robot and that is remotely operated vehicle. But AUV is nothing but the autonomous underwater vehicle. So, they are actually the control system which we use is decentralized. So, each of these particular robots is intelligent and they can take their own decision and they are decentralized. So, this particular the underwater robots are actually developed both in the form of ROV as

well as AUV and as usual the robot should be equipped with some sensor just to collect information of this particular the environment. And of course, there will be some propellers and thrusters; so just to control the movement of this particular that underwater the robots.

Now next is your, the medical applications. So, nowadays actually the robots are extensively used in medical science and there are several applications of robots in medical science. I am just going to discuss a few. For example, say in Telesurgery, we extensively use the robots. We generally use 2 robots, one is called the master robot and another is called the slave robot m and s.

Now, the slave robot is actually going to carry out the operation on the patient and with the help of the master robot, the doctor is going to give the instruction. Now here, there is a physical distance between the doctor and the patient might be the patient is say 5 kilometer away from the doctor. And with the help of these two robots the doctor is going to carry out, so that particular the operation. Now here the slave robot is equipped with the surgical instruments like there will be knives, scissors and all such things. And along with these knives and scissors, there will be force and the torque sensors mounted and on the other side, the doctor is having the master robot and there will be one control panel.

So, the moment the slave robot is going to carry out some operation, so during this operation with the help of that surgical instrument that the slave robot will have to put some force. If it is linear or it will have to put some torque or sometimes you will have to create some moment. And all such force, torque, moment, those things will be determined with the help of that force or the torque sensor. And with the help of this particular this wireless connection, the required torque, required force moment and all such things that information will come to the doctor who is sitting might be around 5 kilometer away from that particular the patient.

Now, after seeing that particular information on the computer screen; so, the doctor is going to give instruction to the slave robot with the help of this particular the master robot. So, this is the way actually we carry out the Telesurgery with the help of this particular the robot. So, we use two robots to carry out, this type of telesurgery.

Now next come is your the Micro-capsule Multi-legged robot. Now this is another a very good design for the robots in medical science. Now, here the robot is actually a multi legged robot, very small robot like safe and size wise could be equivalent to one capsule sort of thing; very small capsule sort of thing. And inside this particular capsule actually we have got that multi legged robot. And here this multi legged robot is equipped with the high speed camera and this particular the robot can be used just to identify whether there is any such tumor say inside the digestion system of the patient.

So, this is as I told that this is just like a tablet or a capsule, the way we take capsule. So, the patient is going to swallow. So, this particular capsule robot with the help of say water and this capsule robot will go inside the digestion system and there, so, it will start working. Now remember here actually, we do not use any motor for this type of small robot. So, instead what we do is, we control the movement of this particular small robot from outside of the body of the patient with the help of one permanent magnet; that means, here we have got one magnetic material and outside the body of the patient. So, if we move this particular permanent magnet, there is a possibility we can control the movement of this particular the small robot.

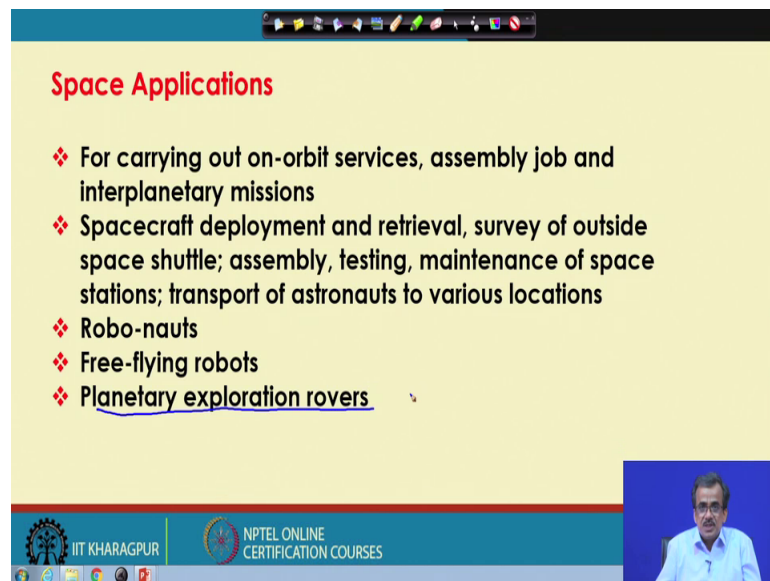
Now, the reason why we do not use any motor is your the size will become larger or the bigger, if I use some motor. So, generally we do not use any such motor for this type of robot, but it has got camera. Now the camera needs power and for that sometimes a very small a lithium battery sort of battery, we generally use along with the camera. So, that whenever this particular the robot is working inside the digestion system; so at a regular interval, it will take the snap and it will send this particular information to the doctor.

So, the doctor on the screen will be able to see the picture of what is there inside that particular the stomach and if there is any such tumor. So, the possible location of the tumor will be identified with the help of this type of micro capsule multi legged robots. So, it has got some applications.

Then comes the Prosthetic device. Now nowadays using the robots say one field of robotic research has become very prominent that is called the rehabilitation robotics. Now, this rehabilitation robotics actually what we do is, we try to take the help of different types of robots. For example, say in rehabilitation robotics we design and develop some prosthetic device. Sometimes we generally go for some sort of orthotic

device, so orthotic device. So, this prosthetic device and orthotic device are going to help the elder people, the weaker people during walking. And both this prosthetic device and the orthotic device, nowadays has become very popular and these are nothing but once again some special type of robots, some intelligent robots. So, these are the application some of the applications of robots in medical science.

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Space Applications

- ❖ For carrying out on-orbit services, assembly job and interplanetary missions
- ❖ Spacecraft deployment and retrieval, survey of outside space shuttle; assembly, testing, maintenance of space stations; transport of astronauts to various locations
- ❖ Robo-nauts
- ❖ Free-flying robots
- ❖ Planetary exploration rovers

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The slide features a yellow background with a red title. A list of five applications is shown, each preceded by a red diamond icon. The last item, 'Planetary exploration rovers', is underlined. At the bottom left, there are logos for IIT Khargapur and NPTEL. At the bottom right, there is a small video inset showing a man in a white shirt speaking.

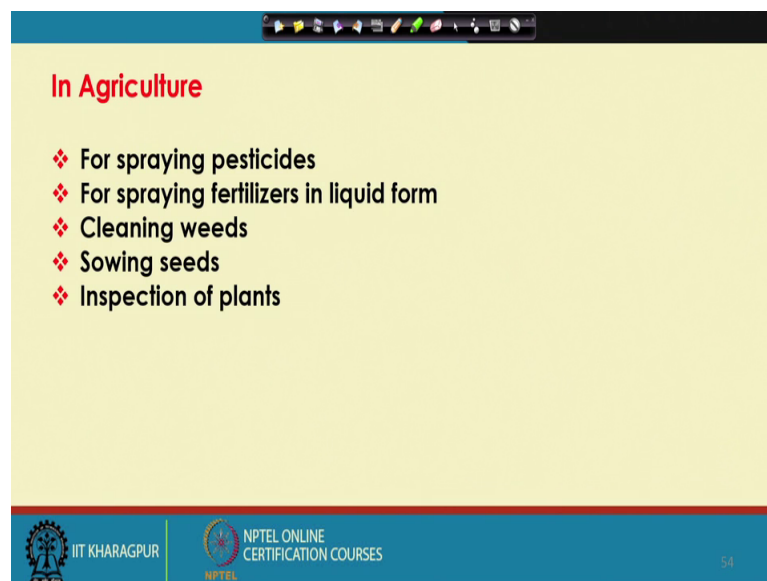
Then comes your some space applications. Now nowadays, the robots are used in space very frequently. You might have heard about your the planetary exploration robots. So, we know that curiosity, then spirit and opportunity. Those are nothing but the planetary exploration rovers. So, with the help of these planetary exploration rovers, we can collect information of the planet. We can collect information of the mars and these robots are all intelligent robots.

For example, if you talk about the curiosity which is an intelligent robots send to the mars and in that particular curiosity is having the capability to use as a multi legged robot or it can also be used as the tracked vehicle. Now there are some other applications like in space station, we can use robot just to do some sort of inspection survey maintenance job. We can carry the astronauts with the help of robots and in future, in fact, the astronauts will be replaced by this particular the Robo-nauts.

Now, in the space station, we have got a few spacecraft. Now what you can do is, we can use for deployment and retrieval of this particular spacecraft and we can do it with the

help of the robots. And nowadays, we use some small robot, very small robot and that is known as the free flying robots. Now these free flying robots are very small in size and we can also send it to the mars, we can also send it to the space to collect information and this type of free flying robots are just like a fly very small in size and this particular robots are in design and development stage. And this will be once again, little bit intelligent also. We can send it to the space to collect information of this particular the space with the help of the robot.

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The slide is titled "In Agriculture" and lists five applications of robots in agriculture, each preceded by a red diamond symbol. The slide is part of a presentation from IIT Kharagpur, NPTEL Online Certification Courses, as indicated by the footer. The slide number is 54.

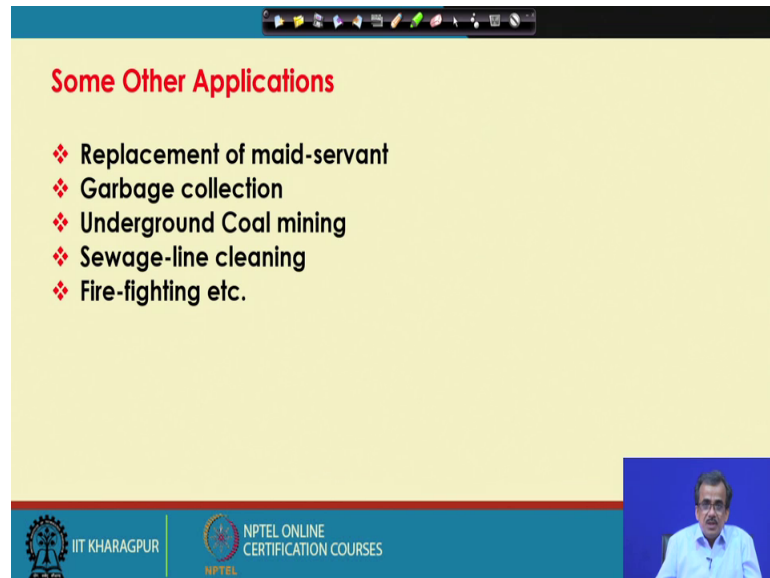
- ❖ For spraying pesticides
- ❖ For spraying fertilizers in liquid form
- ❖ Cleaning weeds
- ❖ Sowing seeds
- ❖ Inspection of plants

So, these are all some of the applications which we have in the space science. Now in agriculture, nowadays actually we are planning to use robots, different types of robots and in fact, we can use robots just for spraying pesticides in the field. We can use robots for spraying fertilizers in the form of liquid form ok. So, the fertilizers, we can mix it with water to make it liquid and then, we can we can use some sort of robot in the field just to spray that particular the fertilizer.

We can use robots for cleaning weeds. For example, in the plant you will find, there are all such unwanted small plants sort of thing in the field. Those are called weeds. Now for cleaning the weeds, nowadays we are thinking like how to use the robots. We can use robot for sowing seeds in the field. Now while sowing seeds, we follow a certain pattern and accordingly we can take the help of the robots just to actually the sow the seeds in

the field. We can use robot for inspection of the plants; the health inspection, the quality inspection of the food grain. So, we can use this type of the robots.

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Some Other Applications

- ❖ Replacement of maid-servant
- ❖ Garbage collection
- ❖ Underground Coal mining
- ❖ Sewage-line cleaning
- ❖ Fire-fighting etc.

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Now here, I am just going to mention a few other applications. Nowadays, as a household, in the house actually as a replacement of the maidservant people are thinking whether we can use robots. Then for garbage collection whether the robots can be used, then underground coal mining. There are already a few applications where robots are used for coal mining. Then comes the sewage line cleaning. This is already in use.

Now, just to clean the sewage line with the help of robots, some special type of robots can be designed and developed. And these are nowadays in fact, used just to clean the sewage line; then for firefighting, nowadays, the robots are also used and so on. So, there are many applications of the robots and in future, the robots will be used to serve a variety of purposes in more fields. The robots will be used because the robots will become more intelligent and autonomous in future and we will be able to use this robot to serve a variety of purposes.

Thank you.