ROBOTICS
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Lecture No-5
Parallel Manipulators

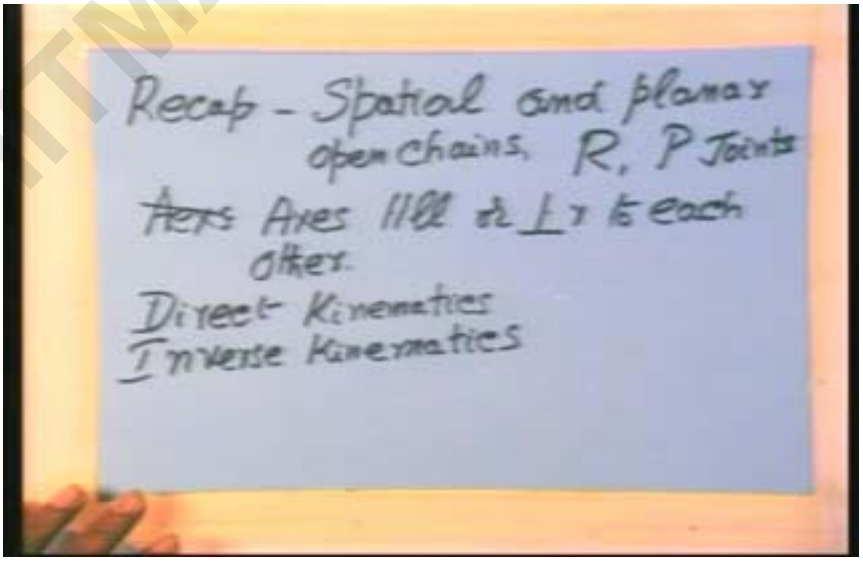
When this series i shall briefly recap late what i have to taking last previous lecturer and than i go ahead lecturer further on so let recall what we have talk in the previous lecturer okay in the previous lecturer

(refer the slide rime: 03:19)

we had seen what are know as spatial and planar open tail spatial and planar open tail yes you have look at the degrees of freedom of open tail how many degrees what area the joints

which are use open tail okay now we notices that we are using some R comma P joints that is the revolute and prismatic joints because these can be powered that what had you seen more over we notices that axes can be axes can be parallel or perpendicular to each other that what we have seen in the last class okay as 02:36 as we go on we will see much more about detail about we are also seen also direct kinematics

where if the joints angle are given joints there you know the end effectors but what you have to also we have briefly look at what is know as inverse kinematics where if have end effectors position is given you know where the what the joints angles inverse kinematics these are what we are seen in the last lecture in addition we had seen what is know as resolution accurse and reputability the most important of reputability because you know what ever robotics does if it repeat continuously with out error



you are very happy accurse yes more expend you robotics using in very small work spaces who need at a than the resolution what is minimum distance end effectors the row because of the defend on resolution of the various elements also you know linker subject to forcer consequently that the bend in the backless all these decided parameter like that resolutions accrues and reputability

we have seen that also okay you are also look at the work space we are seen that in a cartesian robotics work space you some short of cube and we have seen that is a parallel system occupies the lot of space that what you have seen yesterday there were the question as a lecturer some student ask me questions

so i briefly touch of an it before i go to what am i going to discusses today okay now let me look at that you see yesterday the question was very simple what i have told you people was there at taken a cartesian robotics okay (refer the slide time: 08:14) and than i had set that the work space of the cartesian robotics is sparely not as much one good desire in compare over all side there so the student ask me

i am not very clear about it kindly look at again so that i am visiting that i am looking again let me show draw cartesian robotics a i have got and i have got one joints like this i have got the joints here and i have gripper here i hope look like a cartesian robotics and than okay right

now i can drive this access two variously links and pneumatic cylinder there is in pneumatic cylinder with power this access the motions of this block this motions we got change cylinder the whole black up and down most some things else inward and outward of he motions when you have the pneumatic cylinder let i say cylinder length is L i have to pneumatic cylinder

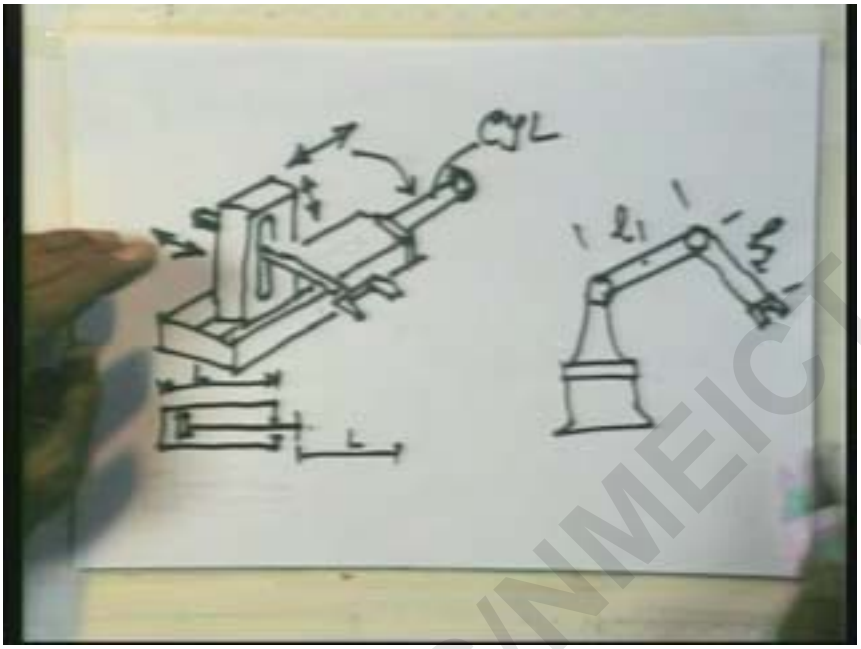
the pistil and than if this cylinder length L the stock is also approximately L so pneumatic cylinder move in and out you get cylinder length of the over all space occupies the pneumatic cylinder this two L now if i have the work space which is L into L into L and three pneumatic cylinder

one for the X motions one for the Y motion and one for the Z motions than the overall space occupies the two L into two L into two L where as work volume is L into L into now nipple the screw like in a laze in a laze feet cutting remove this way and that way across you use the screw now the spoke L you want go the distance L right from this end laze from other end than the overall length

some what L also but there will be motor gear box that position and so may be “five point five “ terms than you have to multiply if you through “one point five” L into “one point five “L into and “one point five” L into over all space occupied

where i have L into L into L into now the next than question comes of the can you contact to similar excesses for this what you called at spatial manipulators of the articulators what (itch noise) can you contact similarity no remember when you pitch this to this line up and let you length of L one pulse L two if you L one and if you L

two you will get spoke a length when you bolt it if in some back here if L one equal to L two this point will be obviously complete the sentence can you contact similar you just give feel of the work space and relation to over all sentence you can add rest also one you had a rust



once you had risk what will happen are many things you know the work space you way look at must work space seem that risk there so i have the robotics okay i have main link main bodies here than i have one and i have add a risk and put the gripper from gripper are end effectors the correct terminology is end effecter

i den to gripper now you have when this pole come here when let as this is L one and this is L two and this is L three the distance from the center will different on let fellow in line these three are in line you can pole this back here you can sketch it out the outer edges the work space will be when all this three are sketch out

when you bend this also you get are when bend all of them together what for the work space and what is there relations (some noise) as look at this just example these are things which like you do to do it on you own there obscures is vertical axes the whole things that all of you okay that what I was telling you yesterday

when i talked about work space and you know the relative size of the system as a relations okay now having a spoken this let as go head with what are know as closed chains close these manipulators to close chains as become spice important in manufacturing particular (itch noise)

what i call as what we call as closed chins you have seen so for open chains here is the example of the open chains again the spatial open chains you had also seen the example of the planar open chains okay now we will see what are know as closed chins

i will begin with the very simple what you called at planar open chins planar closed chins the simplest planar closed chins I can think of is planar fibber (it noise) i call this i name it A B C D E the five sided figure right the quadrilateral is four sided i won'd pentagon because as the second five sided task

i will call it five side five back sides then count one two three four and spice splint as the fifth and it will see there revolute pair i could have primates also i have write a revolute revolute revolue here also revolute here also revolute i will call at the five R closed chins the five R the dash is not a approximately five R are closed chins actually the remove the dash simply write the five R closed this what it is now

the question is how many degrees of freedom and have there are formula will give you is any other of way give you i fixed this link AE is already fixed once i have fixed to link how many degrees of freedom does it have try to draw five sided figure let say you fix this link okay if you want a quadrilateral there area four length available here any draw just give four link quadrilateral

what is additional information to required you need one angle so now it is the five sided five so what are addition i just give you this length AB give you BC i give you CD i give you DE and i give A now and i ask the question drive (itch noise) what you what additional information is required you need to angle unless you given two angles (noise) you can not completed okay it is two degree freedom okay these are all given now

we say way of finding out what are the number of degrees freedom given some things like that in theory which in you have the procedure it is know as the gubler's are recall the i hope i got spelling right yes no i am sorry there is no R here gubler's is called the gubler's okay

now those if you mechanical engineer are familiar with formula but i will simply touch of on it thus you need it even in the spatial closed chains we need a similar formula what the formula face it that given a set of n link number of links okay j is j suffix r number of revolute pair all is the plane

i am writing the formula for the planar chains revolute joints than j p number of prismatic joints when you connect two links we revolute pair are a revolute joints how many degrees of freedom death this links poseur the respect to this one if give this angle you know where this length so in plane

how many degrees of freedom are there we know there are three degrees of freedom in planar this is one plane this is another plane okay with respect this as long as this two links are free there three degrees of freedom relative to relative but he movement

i have put this revolute pair you have last two degrees of freedom last from three available from three available in a plane okay there is i in a put a revolute joints same logic apply the prismatic joints you do two degrees of the prismatic joints when I grist link some things another links

how many degrees of freedom though i know when I fix it in relation to other one as fix this two you know paste them together glue them together how many degrees of farm i have all three degrees of freedom so

when i fix to joints when I fix to links each other i need you need three of freedom when i prevent links throw revolute joints i do two degrees of freedom when i select two links prismatic joints I again know three degrees of freedom so what we do it in any mechanism when n links you have a total out three in to n degrees of freedom availability but usually fix of one links
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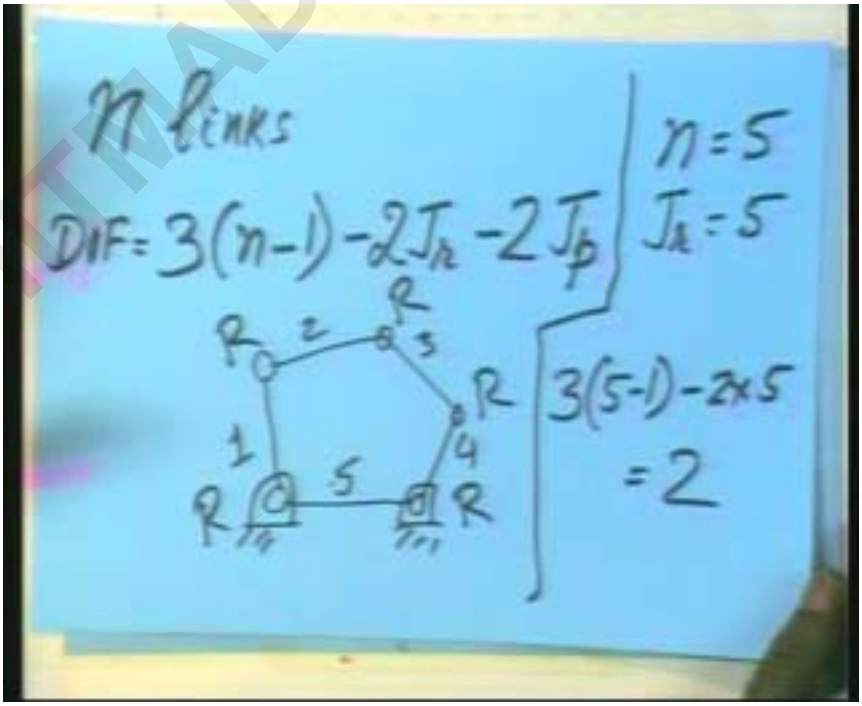
that is the reference links so end of the three n minus one and each revolute pair remove two degrees of freedom so i lu two in to j r each prismatic pair remove two degrees of freedom let i apply to the fibber links is if you have the drawn there are one two three four five links one is fix n equal to five one of them fix remember that

that is taking care of minus one then there are one two three four five revolute pair j r equal to five so when i multiply three into five minus one minus two into five I get that the number of degrees of freedom that is the number of degrees of freedom you know formula also you will give to the degrees of freedom

You can also find the degrees of freedom by drawing one of the reason I keep repeated telling to draw you give feel how many angles are required to draw the picture that because all the length are given remember that provided the length okay this a glow kinematics chins i could replace the revolute pair all these here in this particular case are revolute pair R i could also have one with prismatic joints okay in the previous lecturer



i show that just for the take up (Refer the slide Time: 27:36)
the number of links are base links is one same base links is there the guide is also base links remember that part of the space that is number one this is two this is three this four and fifth links is spider the spider is also fifth links the joints between five and one that is the prismatic joints the joints between five and four that is the revolute joints

so i have R here R here R here but i have the P here so one two three and there is R here inside by here four and five there is in R R between five and one there is a P so here also number of links this one i am sorry five the number of revolute pair equal to four the number of prismatic pair equal to this can be here also i can replace this R with see and i will get manipulators this are know as parallel manipulators and these are planar one i so for

okay any one of the links the parallel manipulator one could mount the end effectors in for example let me go back to particular picture i could mount the end effectors here on this can striper on the serials chins the serial chins hence to hanging angle series of links serial chins you have series of chains

once when you apply the port something tell to this can be port better than right series here the motors if we got two things parallel coming on holding on supporting the end effectors in this case two parallel part the end effectors to the ground there as a single part end effectors

so this knees to the strip though the work volume is parallel chins you not as much as work volume available that one of the problem you could obscures have a serial if you have the two degrees of freedom system do you have can you orient a end effectors in any directions

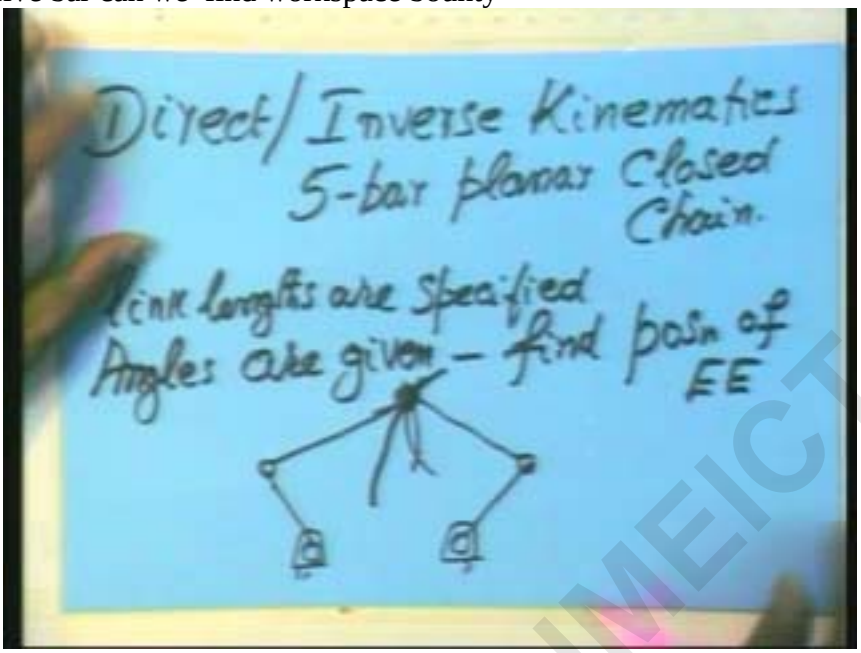
you like when you have the two degrees of planar system can you orient end effect which ever you like the plane you require three degrees with go for the three degrees of freedom system flow chins i will draw one may not be best in the world one two three four five and (noise) six this is link one link two link three link four link five

let the right the formula three in to n minus one minus two j revolute you don’t have any primitive for any degrees degrees freedom formula n equal to six how many revolute pair are there R one two three four five j r equal to six am i right six three into six minus one minus two into six this hind in orientation in object suppose put my end effectors here not only can position where you in want but i can remember in work space here in kantrably smaller then what you get the period it would be instruct

if you could work space by are planar see you straight work out by drawing work space how will you know the boundary of the work space are in the case of where are the boundaries of the work space boundaries of work space just like you know in the case of the Cartesian main bodies of a serial chins

we could find the boundaries of the work space can you find boundaries of the workspace of the planar chins five R at least size of the five R also you know look at this problem of

number of possible orientation for given position can you look at that parallel i just write here chins five bar can we find workspace bounty



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if i than six bar closed chins okay remember that number of orientation ration i should use the word range of orientations range of orientations that more appropriate word not number range of orientations for given position half end effectors will it change in the workspace these of the questions attempt to answer

if is the planar case remember i think these are the questions once the attempt one answer i think goes to i would like to try it out are own i get the feel of the workspace and other may know it is not difficulty actually work of this workspace use your compos in pencil and it yah assume assume the radius of motion

some time it may lock of an link length assume the set of link length assume the range of motions some time that the reason i am asking do that kindly find that you can go behind that particular point defining on the choice may be use the compos and the ruler undo it (itch noise) okay that is as for as the parallel planar change are concern

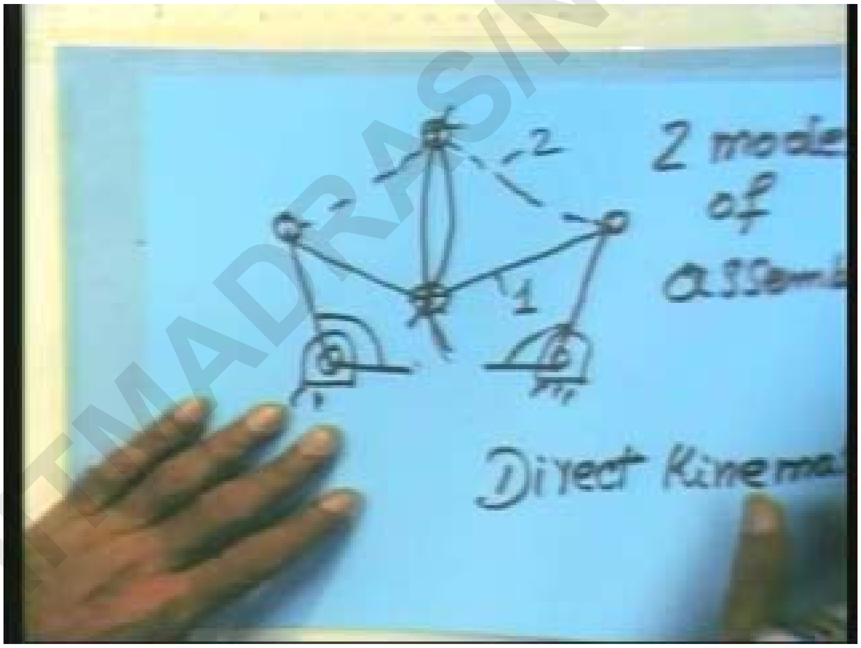
we will have the look at the we had the we had the seen the repulse formula for the planar chins and seen that now let must just look at the direct inverse kinematics it is the wheel of okay direct inverse i will give a feel of this here also now direct kinematics of the five bar planar change closed are parallel you know i can is both in the direct kinematics

what do you say the angle are given and you have to find the position of the end effectors just try to drive links length are given that is assume link lengths are given link lengths are specified there is the correct word I should used angles are given are find where the end effectors is positions of end effectors and i call it E not a electrical engineering end effectors okay what do you to how to go about you first will draw the base links than

you have given the two angle so you draw this links this links this links than other two links are know now you put your compos draw one R put your compos another R you will get two possible assembly of the this is one assembly other assembly i am sorry i didn't draw the circle properly one circle in the draw it again and another sheet (itch noise)

so i given the base i draw in the base i draw in the two crank one is here the angles is given to me is particular angle it given I draw the other crank because other angle is also given to me than i put my compose here on this revolute pair draw circle like this circle than i put my compose her take corresponding links length draw another circle

so i can two intersect i can assemble this fibber either this way are okay i call it modes this of assemble assemble that is very important you can figure of the can you fix from this modes of assemble to that immolation that one was our consign will have do find out can it fix from this modes this is let call this mode one modes two during motions as you rotations two this input to the servo may be not you figure it out these are two modes effect okay now this is direct kinematics now lets go the inverse kinematics strictly other



what is it in inverse kinematics the position of end effectors is given and you have do find the angle all the links lengths are given inverse

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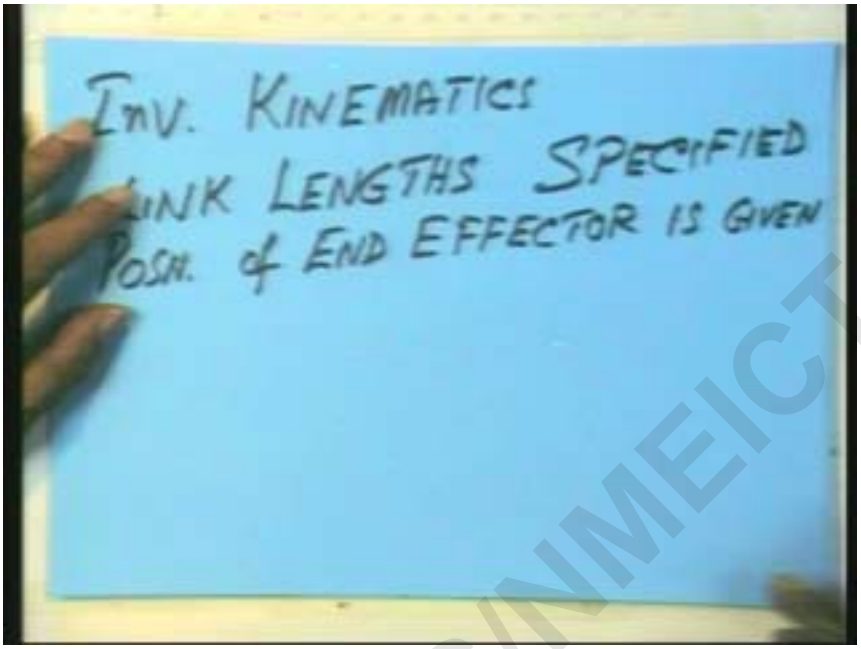
links length are specified link lengths specified okay and what is the specified the position of end effectors specified when i say position i use the word very loosely

actually what i this position and oriented is given that is i could more location with respect to base of the object now you are so ability the in the case of open chains there are multiple solutions multiple way if it is right would it be similar here figure it all you



user hard box compos in pencil and do it these are things do it compos and pencil it hardly take any time draw a few a picture and get a feel of that is very important you can't do it for the three D spatial manipulators it very to diff do draw pencil use the pencil and compos and ruler figure out all the things but it space you know you understand to the planar

i success do it select your own links length you many do it for the five bar you many do it for the six bar draw and than try to figure out what is know as request you do to okay how i have to seen the planar five and bar closed chins as well as the six bar R closed chins (itch noise) the five r closed chins allow in the position in the object six bar allow in not only in the position but also orients because three degrees let as go to the special one that is that (m noise) just like look at the special i draw the special manipulators it know as the stewart platform

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platform f o r m know this at mean use the Stewart platform i will sketch here than i can slowly sketch i will take essentially two of two of platform consist of two what you called this one of the top one of the bottom disk at the top and that disk at the bottom these are connect together there are two disk the connect get tow form liner activated and shown in the liner activator here this put view out ball screw given by a motor empted by the activator are it could by a hydraulic pneumatic cylinder difficult hydraulic cylinder to give now here it is linear access two linear activator this is the pistil rod coming out two give the cylinder to notices this particular linear activator revert at the bottom here it is different and diverter at the top

we will see what are the joints set we are not conventional revolute this is some thing like and come to that let me complete the picture here is another activator and this fellow also perverted here in some form either another access you see two pair two activator at the top both the pistil rod end are connected to the specifics joints on the top disk at the bottom separately okay this is the this is ballad jacket joints spherical joints

i call it S at the bottom what is know as the spherical joints is it so we have right now i told four activated there are two more there are six activated in last six degree of freedom in the space so you essentially need in the six axis okay these are there now there one more here

i going to connected and you got the picture know reasonable fine and top of pit and kept drill motor with a driller end effectors the could motor imagine now the top plate can still and move with respect the bottom place i have see the activator the there are six axes these six activator

i have say connected to the bottom plate spherical joints the ball and jacket at the top there are connected through hooke's joints all of you familiar with the hooke's joints the hooke's joints in founded in automobile let me drive okay the hooke's joints is found in automobile you can while you drawing that checking that i will just repeal structure hooke's joints

how many degrees of freedom does hook's joints have hook's joints have how many degrees of freedom know joust think you seen it in he automobile how many two or three are you sure very sure he here is hooke's joints let me put that paper on top so you the hook's joints very dine one okay now this rotation is possible also this is possible that all this is not possible

i just play here otherwise this is not this rotation is not how many degrees of freedom this is one rotation of this with respect to that okay one rotation okay right and second it how many degrees of freedom let me show you the hooke's joints while you sketching (itch noise) stewart manipulations

i will draw the hook's joints here now any automobiles shop hooks' joints you going to ask them okay is a two degrees of freedom here i got the picture of hooke's joints the start like you know hole a (noise) cross you have a cross and one side of cross whole like this and other side of the cross there are four revolute pair in it way because we shown i am sorry two there are is not four if should call two actually because two are same as this like a door you don't of single kink you have one kink of the bottom one kink middle one kink of the top

still only one revolute pair between door on the wall there is the two dimension i think .. sketch four this is the hook's joints so is this space how many degrees of freedom like that two how many degrees of freedom are there in space six how many removed by the hook's joints four spherical joint how many degrees of freedom three okay

in space there are six degrees of so the spherical joints remove three degrees of freedom using this knowledge and using the same equation is same we will have to rewrite38:46 hooke's equations can we rewrite directly we rewrite now how many degrees n equal to number of joints

we will write this let me just adjust it n equal to number of joints we will write this let me adjusts this n equal to number of joints i am writing the barbules equations n equal to number of joints we will count it i am sorry number of links i am seem this r we count he number of links don't worry J s is the number of spherical joints spherical joints Js

what what is the other type of joints where is the hooke's joints is followed j h number of hooke's joints are yes that clear number of hooke's joints j h shall we write a formula now now we are working in space remember w have three into n minus one as the first team of the degrees of equation in a plane now how much we have here six into n minus one we will write six into n minus one is spherical joist removes three degrees of freedom

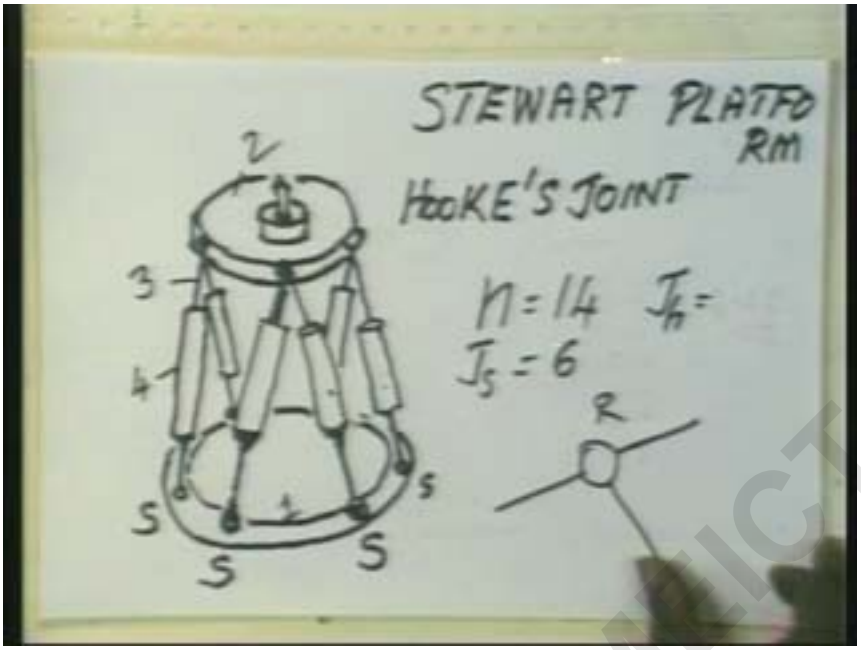
so three into j s and hooke's joints removes so it is four into j h number of okay now let is work it out for the other any other now what about revolute joints how many... 40:28 remove in space a revolute joint as five minus five into j revolute minus five into j primitives.. there are defending joints view for the degrees of freedom in space

let as i applied to the squat platform let go back to he squat platform form applied here how many links are there let a count is always better to write link number on the draw it self let as what of play there is a top play so i will call this one i will call this two okay what else there is a link connection the pistil top play pistil and pistil rod is one links there area connected two the primitives pair cylinder right cylinder and what ever mounting of the cylinder you another links you have one more links here awe will call it three we will call it four fine is it okay

now can you give the number of links well there are six cylinders in the cylinder there is on pistil and the so (itch noise) that do to twelve pulse the top plate and fourteen so n equal to fourteen i hope the formula workout other we will trouble so it will be six into n equal to fourteen what about number of spherical joints there are six place

i will call there what about the number of (ya noise) hooke's joints again six know as how can we have yes because of you have the sheet let say in a window you know have connect this here i have a revolute joints here right have connected another here have another revolute joints here you out of look okay

Supposing this is (a a noise) i am sorry i should had one more here okay okay let me draw I here let me draw it here yah I got one links i connected one more links here and it can an rotate with two way revolute pair okay than i have connected one more here also one more no let me better to draw completely okay



these are connected together than one of you come on says know one more links i want add here we connect one more links there are three links one two and there is what appears to the single revolute pair acquire there are two revolute pair one connect to provide accommodating the relative motions between one and two one revolute pair another accommodating relative motions between one and three similarly here in the squat platform this pistil rod of this is accommodated connected to the top plate one

which joints another system rod it also connected there are six (itch noise) are there i have exacted i have counted all the joints are there are any more joints here six primitives joints now you see weather the formula work if you doesn't when were all in trouble some things is wrong than that me go back to the formula

i have the whole things here how many degrees of there primitives is six so sorry primitives is six so how many degrees of freedom is coming to fourteen into six degrees of freedom this squat platform is gives in the so called aircraft simulated you had the aircraft simulated the pilot are train this is all six cylinders are smooth in such an passion and a computer controls and pilot get the feel of know the aircraft banking diving are going upon so the acceleration

i don't know weather you can relay feet that you know aircraft really goes you have so many acceleration in the alone as aircraft may not but some extend may be yet here but generally give this is what is use for now a day it has become very important (itch noise) because by mounting grill you know you have in you machine what you do it you have the squat platform stitching like that drill back and it going this way that way that way filling whole things like wise orientations this fellow very stripe some many connections in the base from the codling links

so it very difficult so is hydraulics' you can use the balls so all electric squat platform (itch noise)remind me show your picture of at will motion (m noise) i will I forgot

fetch it today but one of the next lecturer i will show you that squat platform motion it is become a very popular in machine tool original continue aircraft than how see there use in the know grind making dies all are these things tool may be carried on the squat platform top plate are job may be carried tool may be grinding for the exam some time the tool grinding wheel spinning on the platform skill skill like that like that so
what is know as the squat platform

we are seen in the squat platform the hooke's joints i hope i have the covert that the okay how we are seen what are know as serial manipulators what are know a s parallel manipulators in the process we have look at waves and view the finding the degrees of freedom counting the number of links and number of joints know remember the degrees of freedom equation simply of counting

we have to very carefully have to number on the links don't forget the fetch links you really what do you to particularly the prismatic pair on the six links you simply can to forget about it you don't count this spider either difficult mistake student plane For once get the angle effect nothing do it so you got just i want to things

we have how fairly good idea various kinematics structure and some of there property also learn some things about inverse kinematics direct kinematics we have the degrees of freedom some idea of industrial manipulators you have this mind before we go to the advanced topics say one more things i want to tell

i will post it as question period a robotic is sitting here on the table is a planar robot i have this you one you have okay there is an end effectors sub way here in object sitting like this okay now remember how many degrees of freedom thus the planar robotics have R three degrees of freedom now can i find out he position of orientation of object using this robotics… can i find can i use the robot of measure device can one use robot manipulators in use the word robotics manipulators that is more appropriate word don't call any things of robotics aircraft robot manipulators robot robot sit that is a better robot manipulators robot quiz robot manipulators as a measuring a device what I want to measure the position and orientations of the super cell answer can be yes or no no opinion

i don't know which answer can knows as yes what i do it i fid of the end effectors the robotics and bring it i do this I mach the end effectors with the object i push taking end effecter the and match it object (itch noise) object is stick on the table like that than what are you do next i i know the links length because when you given this robot you given with robot if definitely links length he don't change

the fix there are know as link parameter the word use for the link length is link parameter they don't change given a robotics anything any dimension of links set R even the angle R between links you know i set access are parallel the access of perpendicular the angle between one access and another should be called a link parameter because doesn't change the motion of the robot

okay what ever changes angle that changes to move the robot at the joints angles change there know as motion parameter you slowly start use these word rather than in a prismatic joints (pa noise) pair prismatic joints use when the leaner motion of the splitter to the motion parameter the motion parameter link parameter these are terminology once

i can use the robot as a measure device which i know the links parameter and i can measure the motion parameter to what to the encoder are potential meter here once i know using trigonometry i can tell you where this particular object is a very important things because you may be catching head and tong figure out where the object is i will say put i camera and all that and somebody comes and put just in case i will read the encoder i that information i hope okay

so now remember once you are match this other multiple are only one brought physical robot are there there is unique set of an angle there multiple the physical robot brought here remember unique only the equation get multiple solutions when you brought like that physically and match the object your position that yourself angle are unique where as when i solve the equation we will find

when you draw and constrict all are fine when any how what difficult robot sitting here you bring it so i can capture the information is all the object on the table simply by using the robotics measuring devices and i can say for this j particular object these a where it is i can write x y z coordinate are i can simply write this (it noise) correct

i could i need not any things more i can say that after the measurement complete i could write object one x y comma gamma angle of orientation if you recall yesterday i have used the word gamma okay as the angle of orientations remember x axis i say gamma angle of orientations is my definition you can define the way positive x axis ……gamma object one

i can list down x y gamma are i can write down theta one how many angle are there this information as to the use along with the link parameter to arrive this object two i can use the same robot figure out where that is fine x y z gamma or again i can make a table like this for each object i have don't any sophisticated reason any things just so using the robot itself measuring devices one can do we will worry about that letter you worry about that letter write now we will worry about that letter you worry about can you do it with a close chins okay that is the nice positions

i can capture the examinations can we do this with closed chins remember the physical robot it there can not draw it you must keep that in mind with a okay remember that you have got the physical system you can built it using the card board built that figure it out do that if the difficult system not it pen and pencil all can get the period pen and pencil do it because you have do robot sitting in front of you links length are knows with a parallel manipulators correct is a question ask me good figure it out

if i tell your ever things i wound't any things ask you any thing example so right (mu noise) obscures some time am not no answer so i can get away by you answer okay

this is one way of link know there are some of the terminology with we have do i introduce few more terminology some other terminology with you require go along the table on which the some object are sitting on the robotics also sitting on the same table again planar just for the set of understanding okay

we called the world of the robot we called world of the robot world table only all thing are robot one the object is pick up that is world effect now the robot fix some where on the particular table okay so its company comes and ask me where is the robot fix on the table i would like to tell obviously

what will i say i will giving this corner go up like this by can me twenty centimeter and go like this right ten centimeter together …… way of telling inside what i will say i coordinate system called a w w stand for world y w at the corner of the table i tell in the origin of the coordinate system called x w y w fixed a this corner of he table bottom left hand bottom in this coordinate system this point the base of the robot is ten comma are five comma ten centimeter are meter right than this is what i where the robot can we ask where it object robot which I scale I can measure where the object is correct and i giving that obscures

i have to specified point on object ……. okay this what i can do it i then he i tell in going bring measuring tap and measuring all these things robot obscures there so it makes scene to wave to find out way robot base is using measure the tape are looking at drawn base and robot as fix on the table but object of transfer here and there that is means ever time run around bring a measuring tap x y coordinator and still angle let out oriented

so you will say i bring rotate measuring the angle to get the oriented what you do we have the robot there use it as measure devices correct just bring it up here and find out where the object you capture x y and oriented now that x y orientation x y with capture with end effectors sincerely here is the world and here is the x w y w using the robot as a measuring the device all you have capture the information in the x robot y robot coordinate fix at do that

where am i right see you have this links length links length links length know to you and two this angle what you work out in essential to the position of the object in this part in x length base of the robot so this x word coordinate from the robot coordinate okay so you will access go i will strict coordinate change to the object also twelve job

i will call it job than ignition orientation of object is ignition x job access with the robot access i will paste paper contain two axes on the job i had done i will paste the paper on the base of the robot what this is the robot corner origin of the robot coordinate in the base base coordinate system i think i should use the word base rather than robot because base of the robot and world is here see in top floor on the table when a object are kept and there in no robots you want a install the robot you want no where the object are moving in all probability work will read drawing and say

he will give the information which coordinate system the world object he will give you he will say that is object of going to place here here here essential you giving you on he table is giving you information in you world coordinate where are the robot required information in the robot coordinate system in order approved of we called equation of where as you know the could be a transformation so we sent set a several system coordinate system in order to this is know as the terminology of various coordinate system these another coordinate system

which is use what is know as cool coordinate system i will just touch up on it as the end reflective here is base of the robot i got the base coordinate system here x base i wound it robot i will call it x base y base remember the first space of the robot doesn't turn are arrange it than what is know as tool coordinate that is surface on to the gripper i draw grippe of the plate we say it y tool x tool and i have my job sitting on the root

i have sited one coordinate system all the x job correct now obviously when i want gripper i will say you this are the gripper finger (itch noise) griper i just shown you when i want a gripper to graph the job like this obviously which coordinate align with x job x tool so align with of the parallel defending on how you are defend and some time

you know for example in this titanic movie that suffering going down and there are two arms and whole subordinate going it stop from where robot some where in robot can you catch to operate this leafs leaver is here and hand easy okay essentially what you want you supposing sitting on the hand you say if i go straight i get i will strength graph to leaf so you expressing most to in the tool coordinate system they saying that sitting on the gripper you are sitting imaginary yourself you get origin yourself tool coordinate system if i go along this axis x axis y axis what are the defining the direction

i will go.. information can we given to he robotics various coordinate in your cycling okay and you are pedaling i am in the road some body take the right hand in which coordinate system if information is given your cycle has to turn orientations ninety degrees turn ninety degrees in your own tool coordinative you are the tool tool coordinative go straight ahead if it world coordinative system your are on a cycle or in a car or in mbeki your are traveling along a road in the world coordinative system in the road is obscures

this is the road branching in to two directions in the worlds coordinative system there is some angle and all effective but supposing in a car it is moving in the directions in your own car coordinative system the tool coordinative system as may call it you have still moving straight ahead so you take left hand keep moving in the same direction that have the information start there are several type of coordinative system world you should world you should keep this terminology in your mind as go ahead in the more advance topic base tool each as show

it is the tool is the particularly very useful when you want object grip gripper approaches object gripper the approaching object the object is sitting here the come close can you simply tell it move ahead move ahead tool coordinate system along the particular access is going that we will later okay i think i close today lecturer