Manufacturing Systems Technology

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Module- 05

Lecture- 28

Hello and welcome back to this Manufacturing Systems module 28. So, in the last module we had done the various different approaches of computer system process planning including the variant approach the generating approach and find the process knowledge based approach. And we had mentioned that there is a need of developing an intelligent algorithm for a feature recognition within a part, which we have going to continue today.

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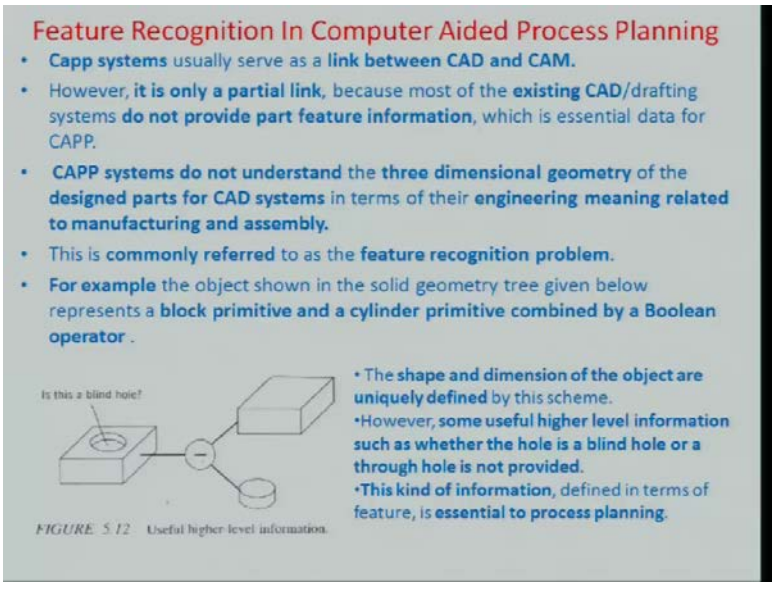

So, let us say that, just because the CAPP system is a sort of a fundamental connect between the CAM and the CAD system. Most of the CAD you know software if you look at, they will really not provide you the individual of the specific part feature information's. Like for example, in a part if there a certain feature like a whole a blind whole a locality or some kind of a you know, topology change, certain topology change. This may not be indicated as a as a sub part, you know or sub feature of the particular part. That is a job act related to a CAD, it is really about the coordinate map and nothing

beyond it. So, there is no intelligence at that level in the CAD which will be able to identify. So, intelligence has to be built in the CAPP system, because the CAPP really needs to now figure out that it has to do processing on a certain place, we are probably there is a whole which existing the machine drawing of the final part, and probably the blank does not have a hole. So, this logic that there is no hole in that region and you have to do machining operation show that the whole can be made, this comes from the CAPP system.

So, let us look at that how this three dimensional geometry for a designed CAD system can be understood in terms of their features, you know in particular drawing; and so this is also commonly referred as a feature recognition problem. For example, let us say we talk about this very good example here; there is a block with the blind hole. So, this particular portion of the block has a hole, a cylindrical hole which is a blinded hole; that means, it does not go through the whole block. There is only half way through and you want to identify that there is the blind hole in this particular region of the blocks. As of now, there is no intelligent algorithm which should be able to recognize the blind hole, in this particular box.

So, how you basically show that the or arrive at that there is existence of a blind hole, is that if you look at the split up solid geometry and make a tree out of what all components going to the solid geometry, it probably started with a continuous block something like this. Through which there was a deduction of an area equal to that of the cylinder from this block because of which it cause the feature on the block of a cylindrical type, which you also know as a blind hole. So, this on thinking process which a human being otherwise is a drawing and is able to be recognize has to be now very intelligently and smartly done in a algorithmic manner. So, that the computer is able to do the same job as a human being.

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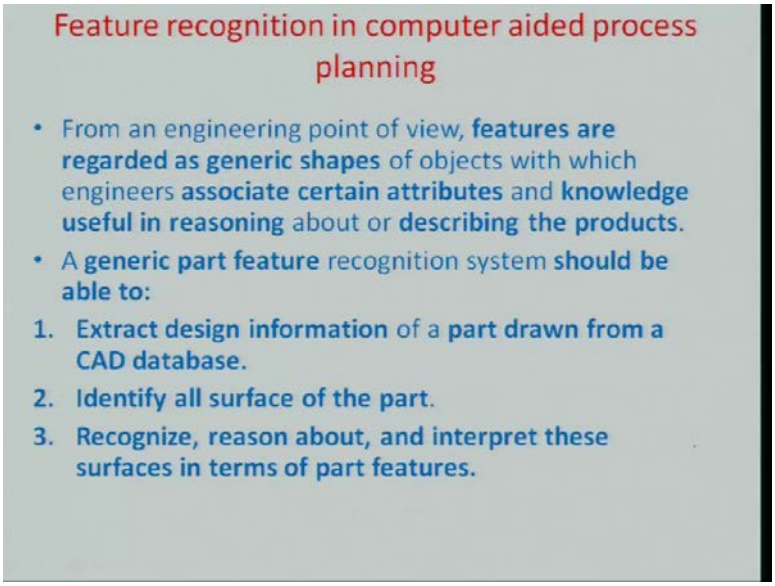

So, how do you do it, is a main question. And for doing that we develop an algorithm here. Where you know a generic part feature recognition system should be able to typically extract the design information of a part drawn from a CAD database. Design information needs the coordinate data as you are already seen in quite details in the CAD part, and then identify all surface of the part and then recognize or reason about and interpret these surfaces in terms of the part features. So, these are the three essential components which should be there in that feature recognition algorithm.

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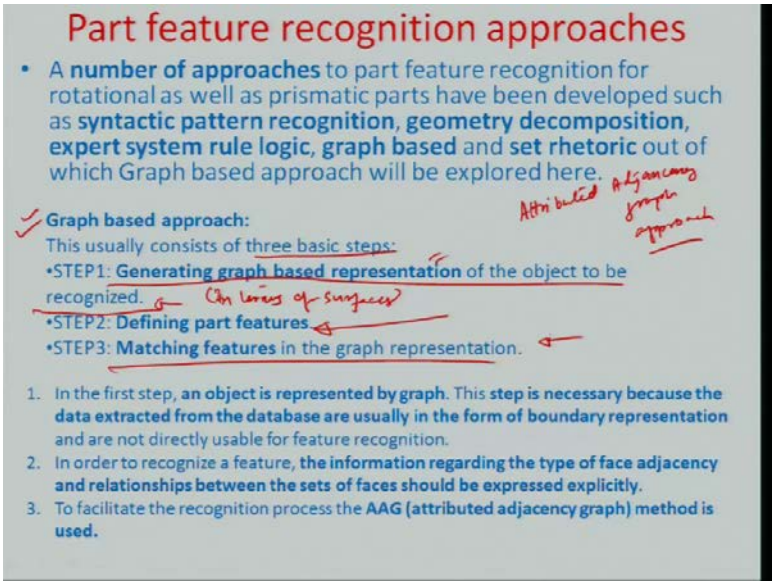

So, let us look at a approach here which we know as the attributed adjacency graph approach. For doing this feature recognition, so usually these graph based approach has

three basic steps. It starts with the step one where generating a graphical representation of the object to be recognized, and this is mostly in terms of it surfaces terms of surfaces; terms of surfaces. And then you are defining part features, by means of such representation. In the matching the features in the graph representation with the data base, that you already have. To infer about those features just to what their type or size may be. So, the first step is that an object is represented by a graph.

Now why is a necessary because these particular step, will be a able to allow some detailing about the boundaries between two or more surfaces which are actually matching at a certain place. For example, there is a surface like this and a surface like this which is formulating a corner. So, if I define this surface to be, let us say a node on that graph or you know some kind of a connect between that on that node; sorry some kind of a step on that graph and the other surface to be another step and between these two steps there is a some kind of a connect which is there. You can be able to identify whether these two are connected number one or they are far apart or things related to how they are positioned with respect to each other as regards topology.

For example, in this case the surface is positioned with respect to this surface forming concavity if you look at it from outside, because it is like bending down words and it is trying to give a concavity to the whole geometry based on that if you look it from outside. So, therefore, some logic has to be there that it is not only meeting together, but it is also producing a concavity once you look at from top like this, as I am looking right away.

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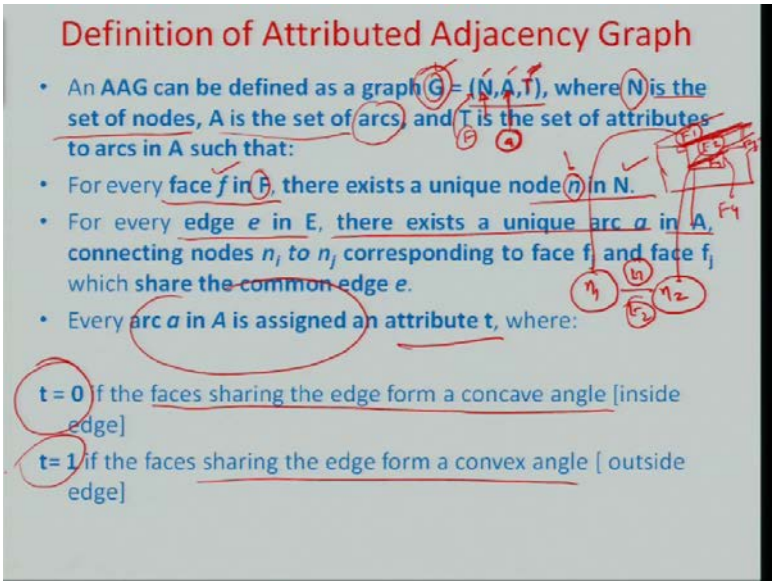

So, this representation is very well carried out by a graph G, which comprises of a set of different elements, where the surfaces would be represented by nodes N. And the arcs would be the connects or the links between such nodes. So, A is the set of arcs, N is the set of surfaces. And further the quality of the arc or the connect to be in the convex manner or concave manner. So, if I look at from the top on the whole feature may be something like this. We can see that this actually is the case where the surface is going to be formulating the concavity, but; however, if you had a feature like this, on the other direction where the surfaces perpendicular standing upright, we can actually look at these surfaces convexity which is actually trying to happen. So, this idea should has to be done somehow.

So, here we co relate this graph G by saying that for every face f there exists a unique node n, small n in the set capital N. So, these are sort of subsets of the said graph one of them is the subset n where it comprises of all the elements corresponding to a node. One node is mapped as one face, so if I had geometry like this. Where I had several faces on the surface of this particular material it is a there is a face f 1, there is a of course, a face f 2 write about here. There is a face f 3, there is a face f 4, there is a face f 5. So, so many faces are there. So, looking at these faces I can say, that if the geometry develops a convexity, concavity, or convexity. This should be somehow represented. So, here for a example if I look at this geometry here, it is a convex geometry looking from the top. But when we are talking about this edge here, this is a concave geometry like this looking from the bottom.

So, if I attribute every face to a certain node of the graph. Essentially I am talking about a node n 1, which corresponds to the face f 1; and a node n 2 corresponds to the face f 2, connected through a link which attributed based on if this face is a convexity or if this face is a concavity. For example, if this face for concavity then there would be certain attribute a 1 which I will put; sorry let us call it t 1 in the interest of the values write about here. So, the attributes are known as a set t. So, there is certain attributes to give if it is a convexity and there is a certain other attribute that you give which is a concavity. So, normally 0s and 1s are used, because of very useful to take off 0s and 1s in terms of binary logic that all the computers have.

So, here what we are doing is that, every face f in this set of faces f has a corresponding node. Meaning there by all the faces in the geometry has at least one node corresponding to one face, and every edge e in the geometry like this; this is an edge, this is an edge

something like that. There exists a unique arc a in the set a. So, the a has been designed in a manner that all the faces f are in n and all the connects between the faces are in the set of arc. So, if there are two surfaces, there is definitely going to be a connect between those two surfaces. Or if the surfaces far apart and they are disconnected, you say it is a null set. So, there is no element in the set a and you represent it as a null set. And then finally, every arc a is a is assigned attribute as I told you, based on whether the arc is a concavity or a convexity. So, if it is a convexity, then the element formulated because of faces sharing the edge with the convex concave angle are represented with an attribute t is equal to 0. And if the faces sharing the edge for a convex angle outside edge, you know these corresponds to value of t equal to 1.

So, now, what you are doing is essentially in a geometry, you trying to split about the geometric in to faces and seeing the relation about faces, whether it is convex relation or a concave relation. And based on that you can attribute the values 0 if it is a concavity, this is the zero value for example. And a convexity when it is a convex value, something like that. So, it is very important to define a surface now, into the basic essential components of the surface which are actually the set of faces, which would be connecting together to formulate the whole surface. And then if you have the concavity there, the question is can we have a matching data base which with the same logic is able to build in the recognition algorithm for the concavity which is present in the particular surface.

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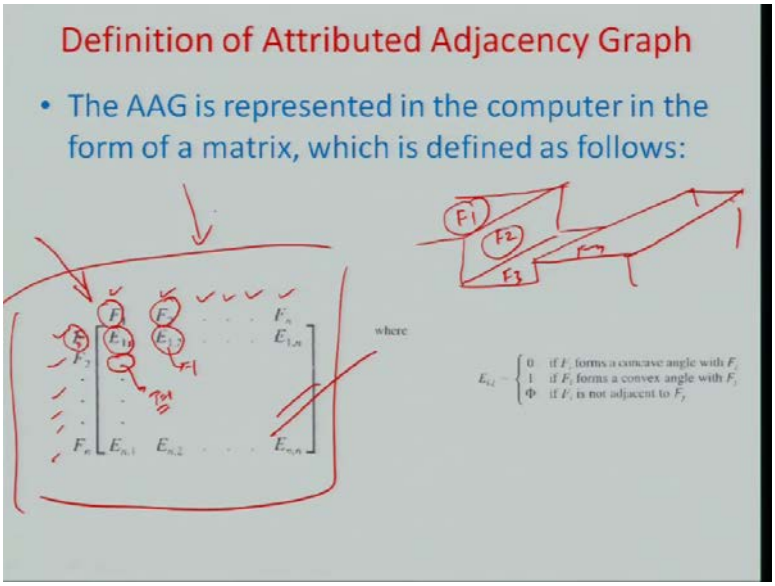

So, let us now look at that. So, here the whole surface that you are considering of the whole topology is now being represented as a combination of the different faces. Let say there are n faces in the surface, starting from f 1 to f n. So, you have a set of faces written in the columnar manner in a set of faces written in the row wise manner. And then obviously, you have to represent the attributes corresponding to the faces f 1 and f 2; or f 1 and f 3 and so on and so forth. In a case where the face f 1 is not connected to f 1 f 2, or the other face. You can say there is a null set. So, there is no belongingness to the set of the attributes to the set of arcs a. And if supposing the, it is the same face for example, you can see f 1 and f 1. So, the connectivity between that is also considered to be a null set, because it is a same face there is no connectivity or there is a need for connectivity. And then if some of the faces are connected, the question is whether we connected concavely or they are connected convexly.

If they are connected convexly, you mention the attribute figure 0; for example, in this case if f 1 and f 2 you look at the drawing again. Let us say for the example in this particular case of a surface in question. You have split up the whole sort of surface into several faces f 1, f 2, f 3, and f 4. So, between f 1 and f 2 now there is a concavity which exists. So, if I say f 1 here and f two here, this e 1 2 component should represent the attribute for a concavity which is a convexity which is actually 1.

As represented here, better represented here as you can see. So, you basically replace these 1 to 2 by 1. Similarly if you want to talk about a relationship between f 1 and f 2

which is this particular element, it will share the same concavity as before; sorry con convexity as before. So, you represent this also as 1. So, essentially this matrix here, that you are see in the combination of either null sets or zeros or ones which you finally formulate. And this is the matrix central matrix to which a computer will actually be able to identify, what is the relationship sequence between the various faces or surfaces.

So, the thing that which is left over now for us, which probably we will be able do in the next module, is that once this whole algorithmic distribution of a surface is made clear. The question is how to interpret and match as to what feature signifies, what kind of feature; for example, there can be a blind slot of square type there can be a square whole through whole. There can be some kind of edge, you can be some kind of step on a edge. So, can we have a central data base of such geometrically connected features with respect to the surfaces, the arcs, and the attributes. So, that you can now locate and co locate different regions within this matrix corresponding to some relationship and match it with those features to understand, what is the feature on that particular surface of the computer which is existing. So, we are going to take this up in more details in the next module.

Thank you.