Manufacturing Systems Technology

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Module - 05

Lecture - 29

Manufacturing System Technology

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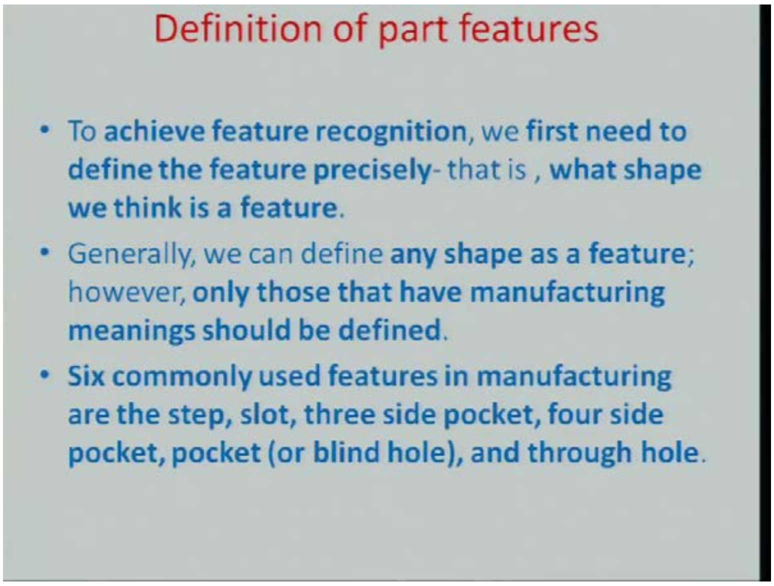

Hello and welcome to this module 29 on Manufacturing Systems Technology. In the last module, we were trying to do some features recognition and develop a kind of semi-algorithm where the computer can be able to sort of mix and match, and the requirement there was that how you basically create a featured data base. So, to achieve feature recognition, obviously what one needs is basically to define the feature precisely, what shape we think is a feature and then make a database out of it you know and we can define any shape is a feature only to those out of manufacturing meanings. Manufacturing meanings one's are the one you think are possible in particular part geometry to be manufactured, possible for manufacture.

So, there are six commonly used feature of that kind, where the creation of database is needed. So, these features include a step, slot, a three side pocket, four side pocket, a pocket or blind hole and through hole. These are all about the kind of features that are sort of corresponding to a certain part.

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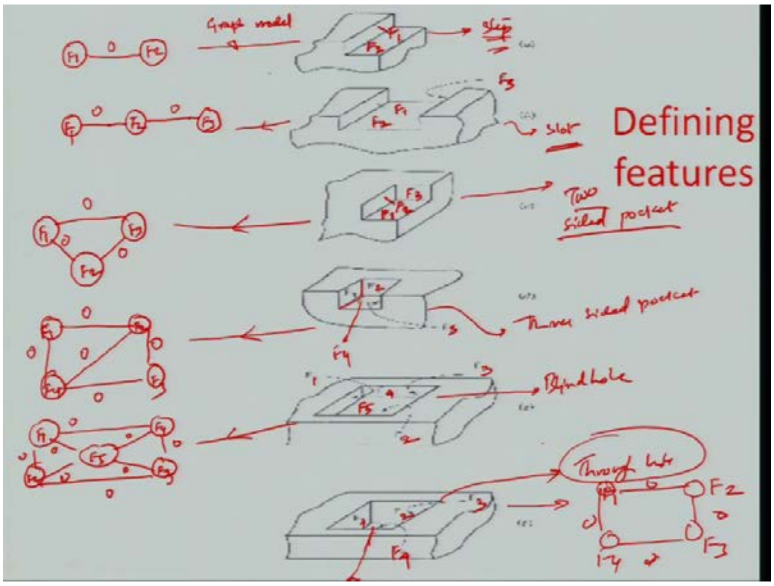

So, I have been trying to illustrate this here in this figure right here. For example, there are two surfaces f1 and f2, and this can be you can call this step. So, this is number 1. This for example is a slot and you have three phases here, f1, f2 and may be another one here f3. So, similarly you call this for example is a three sided, a two sided pocket. Similarly, you have a three sided pocket. So, the phases which are involved in these two sided pocket are f1, f2 and f3, right. This f2 is this particular phase. Similarly you have a three sided pocket which comprises of four phases. So, f1, f2, probably another phase f3 here and a phase here f4, you can have a blind hole as illustrated here where you have again five phases.

So, this is f1, there is a phase f2, there is actually a phase f3, f4 and then there is f5 somewhere here and then, similarly you have a blind hole. So, you have a through hole. I am sorry where you don’t have a surface on the bottom and this can be called a through hole with phase f1, f2, f3 and f4 and there is nothing at the bottom here because bottom is all machined up.

So, these are the different manufacturing friendly or possible situation in manufacturing which can be recorded as a part database or a feature data base. Then, whatever on the drawing you are going to compare has to be inconsonance with the parts that are here that have been represented here. So, let us now do adjacency graph model for this part and try to understand how the part geometry goes. So, obviously you have two nodes here corresponding to the phase f1. So, let us call it f1 and f2 and there is one interconnect between the two phases which is of a concave type. Remember that the attribute which was added to the concavity in the earlier expression was t equal to 0.

So, this is the graph model for this solid. So, you can call this the graph model for this solid which represents the step. Now, it is the part of the database you have stored it somewhere. Similarly, in this particular case you are finding there are three different surfaces which are there f1, f2 and f3 and if I record the relationships between these three surfaces between f1 and f2, you have an attribute 0 and similarly between f2 and f3, you have another attribute zero which records the different concavity classification on the particular part. You also have the two sided pocket here as a combination of f1, f2 and f3, where you have a, let just resolve it in little appropriate manner, so it appears to be feasible graph model. So, you have f1 and let us say you have f2, and let us put f3 in a triangular manner. So, obviously f1 and f2 are connected, so are f1, f2 and f3 and then, also f3 and f1 in some way. All these three are concavities. So, this can be a recorded graph model for the two sided pocket.

Similarly, for the three sided pocket again you have a set of four two surfaces interacting with respect to each other. So, let us just record these surfaces as f1, f2 and then, you have probably f3 and f4. So, f1 and f2 are obviously connected and so are f1 and f4 and so are f4 and f3 and f3 and f2. What is also interconnected here is you know f2 and f3, and f2 and f4 and similarly, f1 and f4. So, that is how you interconnect in the case of you know a three sided pocket. Further, I would just like to mention here that all these relationship of interconnection are 0. For example, in this case the f1 and f2 has a concavity along this surface. Similarly, f1 and f4 has only a concavity along this surface so on and so forth. So, that is actually representing the graph model for the three sided pocket. You have a same case with the five sides or five surface models for representing a blind hole.

So, I am going to actually represent the surfaces here in a little different manner. So, you have let us say one surface f5 being connected to the other surfaces, let us say f1 f2 f3 and f4 and these are interconnected to each other through concavities and similarly connected to f5. So, f3 for example is connected to f5. So, is 4, 5 and f 2 and all these attributes again are 0's based on the concavity concentric relationship. So, f1 f5 or f4 f5 or f3 f5 or f2 f5 are all zeroes and simultaneously also are the f1 f2 f1 f4 and f3 f2 and f3 f4 so on and so forth. So, this is the graph model for the blind hole. Mind you, we are recording such models in our overall you know modeling because if any solid model comes into picture, now we want to split up that whole surface into varieties of arc and nodes in a same manner as the algorithm goes and try to compare with this recognition database that you have created there in.

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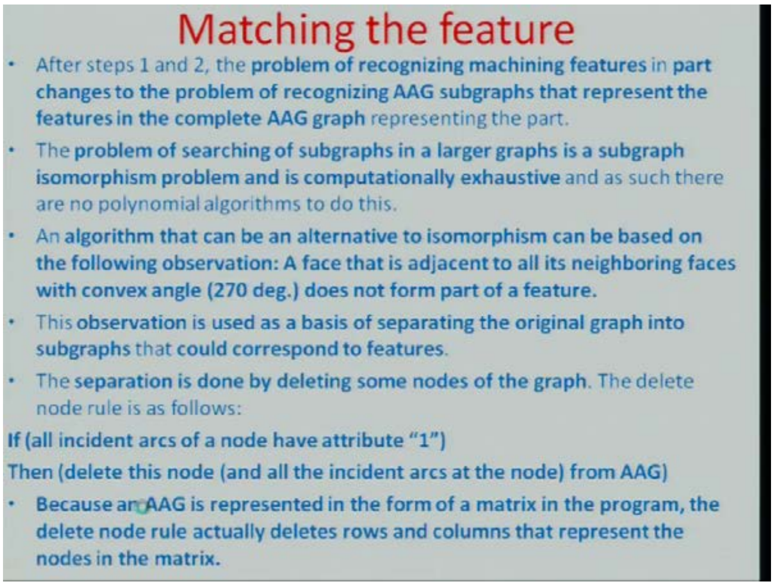

So, there is another model here which represent for example, you know if supposing there are four nodes that you can see that is being represented as you can call it, let me just use the space here, right here. So, you have a model here where you have four different phases; let us say f1 is this phase. So, you have f2 phase, then you have f3 and f4 and all the connectivity here are 0, and there is no interconnection between f1 or f3 or f2 and f4 whatsoever. This is the graph model for a through hole. So, once we have defined these features, then the question is how can you resolve a surface into the graph model and identify in that graph those zones which corresponds to one of these features, and that could in a way allow the computer to logically read what the feature is and what the non-feature is on a certain solid model.

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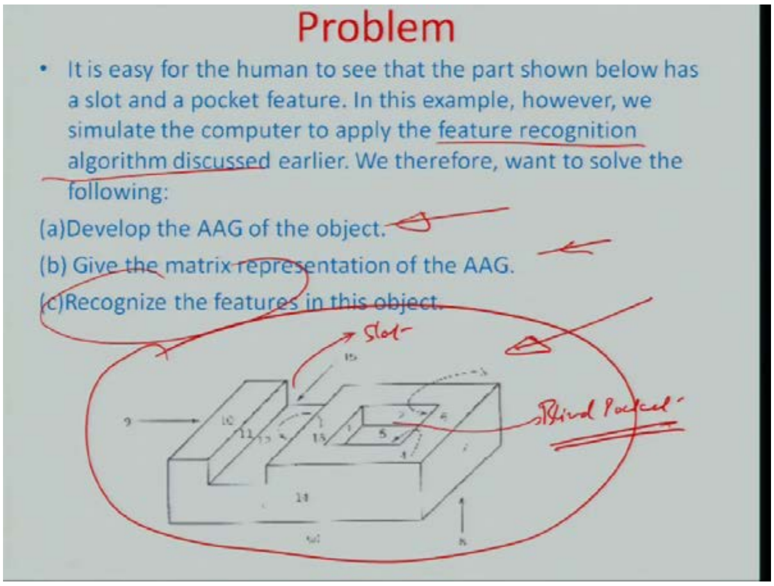

So, let us look at the problem example now, where we talk about let us say this is the surface which is actually in question where we can split up into the parts you know. I mean different surface in the graph can be potentially drawn. So, in this recognition I got them what is needed is that is to develop AAG model of this object and from the matrix representation of the AAG, you have to recognize that this right here is the slot for example, which otherwise for a human being is very easy to realize or this here for example is blind pocket. So, how do you actually do that is a big question which you have to sort a program. So, the methodology so far which has been covered as given you a very wonderful idea about how such a feature or a part can be recognized on the system. So, we will probably try to take this problem up by first of all trying to mention all the surfaces which are there on this part. Let me just draw this surface again.

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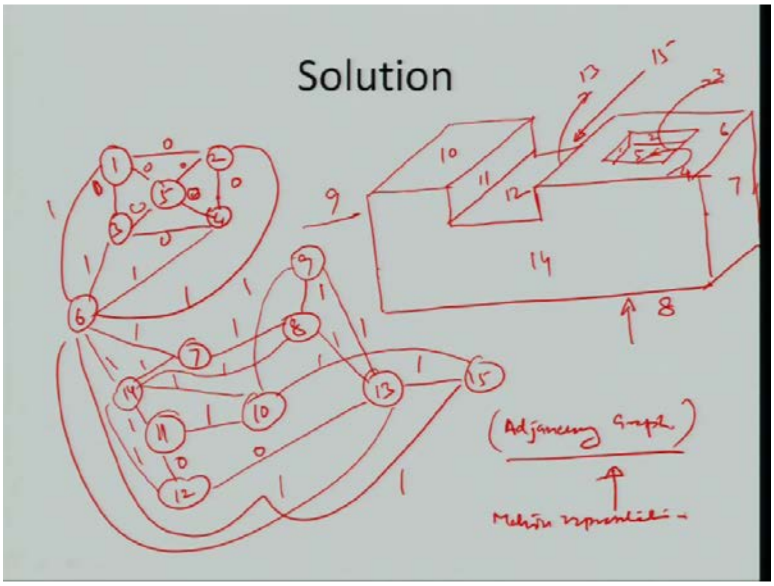

So, you have a feature of this slot which is there, probably partially we are going to do this problem today and then, may be take it up in the next module. So, this another surface which is on and basically extend the block in both the directions and you have a slot cut here, and I mention these surfaces to be starting from the surface across this blind pocket here which talks about surface 1, 2 and then, there is a surface 3, obviously your surface 4 along these and then, you can also have the fifth surface somewhere here. There is a sixth surface, there is a seventh surface here and there is also going to be eighth surface underneath. So, this surface underneath here is the eighth surface and then, there is a ninth surface on this particular side, tenth surface here, eleventh surface here, a twelfth surface here and then, obviously there is a thirteenth surface somewhere here and then, there is another surface at backend here which is the fifteenth surface.

So, first thing that we do here is to make the graph here. So, let say we start with graph 1. So, you have one as a node, then you have 2, then you have the surface 3, surface 4 and they are all interconnected. So, 1 and 2 are interconnected for example. You have the surface 5 somewhere. So, let us just write it in a little more, in a manner just you know close to what we did actually before. So, we start with let us say these four pockets, 1 2 3 4 and let us say there is a fifth pocket here. So, we do all the interconnectivity between the different pockets and mention or give the attributes 0000 so on so forth on this particular slot, right over here and then, we also try to connect with these surfaces or other surfaces which are in existence. So, obviously the sixth surface would be connected to all these surfaces by different means you know where there is convexity.

So, to the first surface, for example or the second surface for example or even the fourth and the third surface, so all are connected through convexity. The sixth surface is again connected to the seventh surface through a convexity; the seventh surface here is connected to an eighth surface through another convexity, the eighth and ninth is again interconnected through another convexity. So, the tenth surface, so if we look at let say ninth and thirteenth and the tenth surface, so you have ninth, thirteenth and you have nineteenth. So, these are both connected through convexity 10 and 11, obviously would again be connected through a convexity, but between 11 and 12, you are having a concavity and similarly between 12 and 13, you are having another concavity. Thirteenth surface finally is also connected to the fifteenth surface with the convexity and so on is the tenth surface. The tenth surface also is connected to the fifteenth surface with the convexity. Similarly, the tenth surface, the thirteenth surface is connected with fifteenth surface also with the convexity.

So, then obviously the thirteenth is also connected to the eighth surface with a convexity and thirteenth also get connected to the sixth surface with another convexity because at the backend, there is, sorry the fifteenth. Yes with thirteenth surface as a convexity with sixth surface and so as the fifteenth surface. So, if we look at the fifteenth surface also, it has the connectivity to the sixth surface with convexity. In a nutshell, that is how all the surfaces are kind of defined. There is also a fourteenth surface somewhere here, where we have to connect fourteenth to the twelfth or eleventh or tenth. So, we make the fourteenth somewhere here. So, let us connect that to the eleventh with the convexity, twelfth with the convexity, tenth with another convexity something like this and also the fourteenth is connected in a way to the sixth substrate with another convexity. So, it is connected to the seventh with another convexity and the fourteenth is again connected to the eighth with another convexity.

This is the very complex adjacency graph which has been developed and from this graph in the next step, probably in the next module we are going to find out what is the matrix representation which will lead us to actually figure out what are those areas, where there are features on the particular sub part in question. So, with this we come to the end of this particular module.

Thank you.