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Student Intership Activity Report at the University of Stuttgart

Objectives and expectations

I was reaching the end of my undergraduate studies and I had to make the decision of what to do next. I was primarily interested in the organization and structure of the studies in Germany and the effect they have on the development of the fundamental knowledge which is required for reaching a stage high enough for managing the area of expertise. So I saw this intership at the University of Stuttgart, Faculty of Informatic, department IPVS as a good opportunity for me to make my decision for my future involvement with computer science and of course to penetrate in a new area of computer science.

Well before I came at the University and because of my previous experience with the Parallel Virtual Machine (PVM), I thought that I was going to do some investigations in the significant power of the process of parallelisation and thus expand my knowledge in this area. But professor Bungartz gave me the option on making a choice between doing something I already have worked on in parallel and doing something that is completely unknown and new for me. And I took the second alternative because I think, especially in informatics that is continuously expanding and conquering almost every area of the contemporary world, that it is crucial to pick up as much information and knowledge as you can from every field because they have lots of interesting things to offer and leave a lot of space for implying something new in the same time. So, I ended up wandering in the area of the 3D computational geometry that at the beginning was like a bolt out of the blue for me. Of course at this point I must mention the fundamental fact that I had a lot of help from Mr. Ralf-Peter Mundani who gave me precise and detailed description of the actual problem and was very cooperative. I think that with him I could actually experience the real educational surrounding in one typical German university.

The problem

As I mentioned before first I had to get acquainted with the field of 3D computational geometry because I had no previous acknowledgements in this field. My actual problem was primarily connected with the 3D object decomposition. In fact my application was suppose to build a boolean expression, a plan of how to decompose the 3D object by intersection of half-spaces.

The objects that are the input have the features of not being manifold and have flat surfaces because it was assumed that the curved surfaces would be triangulated before the further processing. The fully detailed description of the objects was given in a modified VEF file that contained the faces, the edges and the vertices of the object given with their coordinates. Also the VEF file provided the information of the existing lumps. The lumps are holes or objects standing outside the main objects' body. Lumps inside lumps were also allowed.

The basis of the algorithm at first required building the 3D convex hull of the object. Since the problem of the convex hull is quite famous and essential there are many developed algorithms which can be easily programmed. I chose the incremental algorithm that works with triangle faces. The convex hull is the measurement of the convexity of the object. So if the object is non-convex the algorithm is aware that it should be decomposed.

The lumps are processed separately from the main body, so the next step forward towards the final goal was marking the lumps with special markers from which the information about the belonging face can be retrieved. The fundamental moment was the marking of the faces because the path in constructing the boolean expression starts from this point. First I marked the faces that belong to the convex hull with the same marker and after that I marked the faces that don't belong to the hull but with different markers for the faces that are drifted apart by some face belonging to the hull i.e. the faces that are placed at different corners of the object belong to a different group and are marked with a different number. In the marking process the most difficult part was marking the faces that belong to the convex hull because it had to be solved by calculating volumes.

So at first the main body is processed; In the next stadium the lumps that belong to the actual main body are taking the role of current main body that has other lumps inside and this process is continuously repeating itself depending on how deep is the level of the lumps belonging to the object.

Well another problem arose with the case of processing the cross or the star objects. So these objects or objects that had some parts of these objects first needed to be recognized and differed from the other common objects because they acquired different process of marking. This special process included marking of the so called breaking edges of the object which were of substantial meaning for the upcoming marking of the faces of the object.

Evaluation

Overall the two previous months (July and August 2003) were a great experience for me not only from the scientific point of view. I mean I had a chance not only to see but really participate in one new and advanced working surrounding, make contacts with people from my field of interest, absorbing lots of new things about life in Germany in general. The working team on the university was very accessible for all my questions and it took me very little to accommodate and to feel like a real part of the new surrounding.

From the aspect of my scientific view as I previously mentioned I took the challenge of working in one new area for me which was pretty refreshing. I mean I had some problems at the beginning but the more I got into the problem the more my knowledge from this area emerged.

Well at the end I find that my stay at the University of Stuttgart was a good experience for me because I was working in one environment that I would like to have for my postgraduate studies with all the contemporary technical equipment and the necessary literature for my future development in the area of computer science.