International Institute of Information Technology Bangalore

Summer Internship – 2016

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Brief:

I started my internship at International Institute of Information Technology Bangalore (IIIT B) in the field of Computational Geometry and Graphics. Dr. Amit Chattopadhyay was my mentor for the entire period of Summer Internship. The field was absolutely new for me and was quite challenging. All the tasks that were assigned to me had everything new to teach me. Dr. Amit checked my weekly progress and helped me wherever I faced a problem. This internship was a very good learning experience.

Task 1: Marching Cube and Marching Tetrahedron Algorithm

I was introduced to the well known Marching Cube and Marching Tetrahedron Algorithm. I was amazed to know that these algorithms are used widely around the globe in the extraction of isosurface from a 3 Dimensional Scalar field and the applications of these algorithms are mainly in medical visualization (CT and MRI scans), special effects and 3D modelling. I read a paper on Marching Cube algorithm – Marching Cubes : a high resolution 3D surface construction algorithm by William E. Lorensen and Harvey E. Cline. My main focus was understanding the algorithm and succesfully implement it in a simple code format and generalize it for the volumetric datasets. I read a page – Polygonizing a Scalar field writted by Paul Bourke and the code was availabe too. I modified it and stored the results in a .quad file. I took the datasets from Volvis. I didn't implement the algorithm and cast out the 3D image using openGL instead I used the code to extract the coordinates of the isosurface and use a geometric viewer (geomview) to view it. The image that I obtained had dark patches and further improvement of my work could be done by using Marching Tetrahedron Algorithm or to contruct the normals for the surfaces to direct the lighting and eradicating the dark patches. It is also very important to choose the appropriate isovalue.

Task 2: Contour Trees

I was interested in the analysis of the Scalar field so I was then introduced to a new Data Structure called Contour Tree. I read a brief about Reeb Graph and then I was given a few research papers to read on Contour Tree. I started my study by scanning through the basics of Contour Tree by reading the paper – Computing Contour Trees in All Dimensions by Hamish Carr, Jack Snoeyink and Ulrike Axen. I then understood the algorithms given as pseudo codes in the paper Parallel Computation of the Topology of Level Sets by V. Pascucci and K. Cole-McLaughlin. The steps in Contour Tree contruction are carried out by sorting the vertices according to the scalar value, forming the Join Tree and Split Tree and finally merging them together. This paper describes it quite well. I took examples and constructed Contour trees out of the given scalar fields. In a very small section I got to learn about Union-Find data structure too and then further I studied about Quick-Find, Quick-Union and path compression. Further studies could be made by studying about Branch Decomposition, parallel computation and also implementing the Contour Tree library.

I sincerely thank Dr. Amit Chattopadhyay and IIITB for providing me such an opportunity and learning experience.