Scientific report of Marc Glisse

Name:	Marc Glisse
Supervisor(s):	Helmut Alt
Field of Research:	Computational and combinatorial geometry
Topic:	Visibility among random spheres
PhD Fellow	at the program from April to June 2005

Field of Research

Given a set of n simple objects in space, the visibility information about these objects can have a very large complexity. The visibility graph can have size n^2, the visibility skeleton n^4, and the aspect graph is just too big to consider. However, these are worst cases and do not happen that often in practice. Our purpose is to give upper bounds on the size of these structures for certain types of random scenes. One reference paper on the subject is [1] which proves a linear upper bound on the complexity of the visibility complex of unit spheres randomly distributed with a certain density in a spherical universe.

Results

We consider an infinite universe and place objects inside according to a Poisson measure (this is the unbounded version of uniformly distributing the objects). The objects we consider are first unit spheres, but we then generalize to fat objects of approximately the same size, spheres of random radius, etc. What we prove is that the average number of objects one object can see in these circonstances is constant. We even show that the probability to see a large number of other objects decreases fast enough that the average of any $k^{th}-$power of the number of objects an object can see is still constant. This implies that all the structures previously mentionned have size linear in the size of the part of the universe we restrict ourselves to. The method used in our proof can be seen as a coupon collector problem on patches of the sphere of directions, where collecting a patch means obstructing visibility in that direction.

If now the universe is bounded, some issues appear, and we try to deal with them.

Activities

- Attendance to the lectures of the CGC program
- Participation in the CGC Spring School on Enumerative Combinatorics in Netzeband
- Participation in the "Symposium on Computational Geometry" in Pisa (Italy)
- Attendance to the "noon seminars" and one talk there

Preview

- some more work to improve our result on the case of a finite universe
- submit our results to some conference

References

[1] Olivier Devillers, Vida Dujmovic, Hazel Everett, Xavier Goaoc, Sylvain Lazard, Hyeon-Suk Na and Sylvain Petitjean, *The expected number of 3D visibility events is linear* In *SIAM Journal on Computing*, 32(6):1586-1620, 2003.