

SFC METRICS SUMMARY

DARYL DEFORD

This project concerns the uses of discrete space-filling curves (SFCs) for constructing efficient parallel computing implementations. There are currently two main focuses of this project: Average Communicated Distance (ACD) implementation and Average Nearest Neighbor Computations (ANN).

- (1) In our paper [1] Ananth Kalanaraman and I developed the notion of ACD to rate the efficiency of various SFCs for practical use. This was predicated on work of Xu and Tirthapura who showed that previous results about clustering metrics were insufficient to distinguish between important classes of curves [3]. Our method is algorithm independent and does distinguish between these classes.

Although we have theoretically verified our results [1] it still remains to implement the algorithm on a large scale system to verify its accuracy. I have written python/openmpi/mpiforpy code to implement this system, but tests still need to be designed and super computer time needs to be arranged. Also, it is possible that the entire structure needs to be ported to C for efficiency reasons.

- (2) A second paper of Xu and Tirthapura [2] discusses a possible alternative to clustering metrics called ANN. In that paper they show that the row curve and z-curve each lie within a constant factor of the optimal bound for all SFCs. However, in our paper, we computed empirically that for the Hilbert and Gray curves, this ranking actually gives worse results, which doesn't align with previously observed results. The next step is to show that this relationship holds in the limit by proving the asymptotic relationship of these curves under ANN. Also similar results should be proved for generalized ANN metrics as in [1].

Also, I am quite interested in the approach to networks taken in [4] that might lead towards an interesting project in between networks and graphons.

REFERENCES

- [1] D.DEFORD AND A. KALYANARAMAN: *Empirical Analysis of Space-Filling Curves for Scientific Computing Applications*, ICPP'13.
- [2] P. XU AND S. TIRTHAPURA: *A lower bound on proximity preservation by Space Filling Curves*, PODS'12.
- [3] P. XU AND S. TIRTHAPURA: *On the Optimality of Clustering Properties of Space Filling Curves*, IPDPS'12.
- [4] A. MUHKHERJEE, P. XU, AND S. TIRTHAPURA: *Mining Maximal Cliques from an Uncertain Graph*, ICDE'15.

DEPARTMENT OF MATHEMATICS, DARTMOUTH COLLEGE
E-mail address: ddeford@math.dartmouth.edu