11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Improved Poisson-disk Sampling for Meshing applications

Mohamed S. Ebeida[1] and Scott A. Mitchell[2]

[1] Sandia National Laboratories, P.O. Box 5800, MS 1318, Albuquerque, NM, msebeid@sandia.gov
[2] Sandia National Laboratories, P.O. Box 5800, MS 1327, Albuquerque, NM, samitch@sandia.gov

Key Words: *Maximal Poisson-disk sampling, Mesh generation, Fracture Simulations*

Poisson-disk sampling is similar to sphere packings: points have a minimum separation distance and the disks cover the domain. Disk centers are randomly placed. The method is popular in computer graphics because the random distribution avoids visual artifacts. This randomness can also be useful to avoid mesh-induced non-physical phenomena in simulations. We describe several new approaches to Poisson-disk sampling and resampling to generate and improve simplicial meshes in d-dimensional spaces. We produce provably-good tessellations, with quality bounds similar to (or better) than deterministic Delaunay refinement methods. It is inherently easier for our methods to follow a sizing function because of the close connection between Poisson-disks and the local mesh size. We show results for the uniform and the non-uniform case. We show several applications to examples to demonstrate the efficiency of our methods.

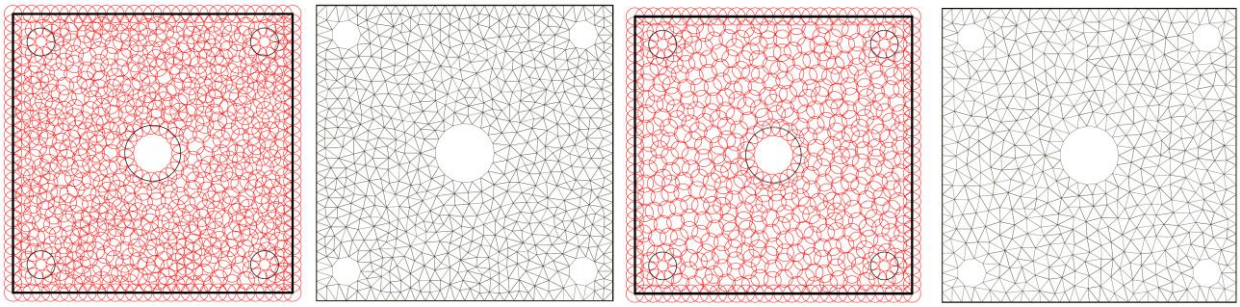

Figure 1: A disk-packing generated using a Delaunay Refinement method satisfies the packing conditions of MPS and hence the associated Delaunay mesh is associated with guaranteed quality (left). Understanding the relation between the packing condition and the desired quality allows significant reduction of the Steiner points count while preserving the quality bounds and the sizing function (right).

Acknowledgements:

This work was sponsored by the Laboratory Directed Research and Development (LDRD) Program at Sandia National Laboratories. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

REFERENCES

[1] M. S. Ebeida, A. H. Mahmoud, M. A. Awad, M. A. Mohammed, S. A. Mitchell, A. Rand, and J. D. Owens, "Sifted disks," Computer Graphics Forum (Eurographics 2013), 32(2), May 2013.

[2] M. S. Ebeida, M. A. Awad, X. Ge, A. H. Mahmoud, S. A. Mitchell, P. M. Knupp, and L.-Y. Wei, "Improving spatial coverage while preserving blue noise," Computer Aided Design, to appear

[3] M. S. Ebeida, A. Patney, S. A. Mitchell, K. R. Dalbey, A. A. Davidson, and J. D. owens, "k-d darts: sampling by k-dimensional flat searches," Transaction on Graphics, to appear

[4] S. A. Mitchell, A. Rand, M. S. Ebeida and C. Bajaj, "Variable radii Poisson-disk sampling", 24th Canadian Conference on Computational Geometry (CCCG'12), Charlottetown, August 2012.

[5] S. Tzeng, A. Patney, A. A. Davidson, M. S. Ebeida, S. A. Mitchell, and J. D. Owens, "High quality parallel depth-of-field using line samples", High Performance Graphics, Paris June 2012.

[6] M. S. Ebeida, S. A. Mitchell, A. Patney, A. A. Davidson, and J. D. Owens, "A simple algorithm for maximal Poisson-disk sampling in high dimensions", Computer Graphics Forum (Eurographics 2012), 31(2), May 2012.

[7] M. S. Ebeida, A. Patney, S. A. Mitchell, A. A. Davidson, P. M. Knupp, and J. D. Owens, "Efficient maximal Poisson-disk Sampling", ACM Transactions on Graphics *(SIGGRAPH 2011)*, 30(4), August 2011.

[8] M. S. Ebeida, S. A. Mitchell, A. A. Davidson, A. Patney, P. M. Knupp, and J. D. Owens, "Efficient and Good Delaunay meshes from random points", Computer Aided Design, 43(11): 1506-1515

[9] M. S. Ebeida, P. M. Knupp, V. J. Leung, J. E. Bishop, and M. J. Martinez, "Mesh generation for modeling and simulation of carbon sequestration processes", DOE Scientific Discovery through Advanced Computing (SciDAC) conference, July 10-14, Denver, 2011.

[10] M. S. Ebeida, S. A. Mitchell, "Uniform random Voronoi meshes", 20th International Meshing Roundtable, Paris October 23-26, 2011.