Some black hole exterior solutions for Quantum Graphity

S. Halayka*

January 7, 2016

Abstract

Some 2D and 3D black hole exterior solutions for Quantum Graphity are briefly presented.

1 Introduction

In Quantum Graphity [1], the black hole interior solution consists of the complete graph of a spherically symmetric shell of vertices.

See Figures $1 - 4$ for visualization of the four black hole exterior solutions presented here.

The following two measures are calculated per black hole exterior solution:

1. Pointing outward is a measure of how many red lines there are to act as a repulsion (blue lines act as an attraction). Since pointing outward is less than 0.5 for all four solutions, there is a net attraction for all four solutions (more blue lines than red lines).

2. Average dot product is the average of the dot product of the (normalized) blue and red lines and the (normalized) vector pointing outward from the origin to the corresponding vertices. Since average product dot is negative for all four solutions, there is an inward curvature to the space (spatial curvature, akin to gravity) for all four solutions.

For solutions $1 - 3$, the Mac OS compatible library dct [2] was used to make the triangulations. For solution 4, the TetGen [3] library was used on Windows to make the tetrahedra. For a Voronoi 3D solution see the library Voro++ [4].
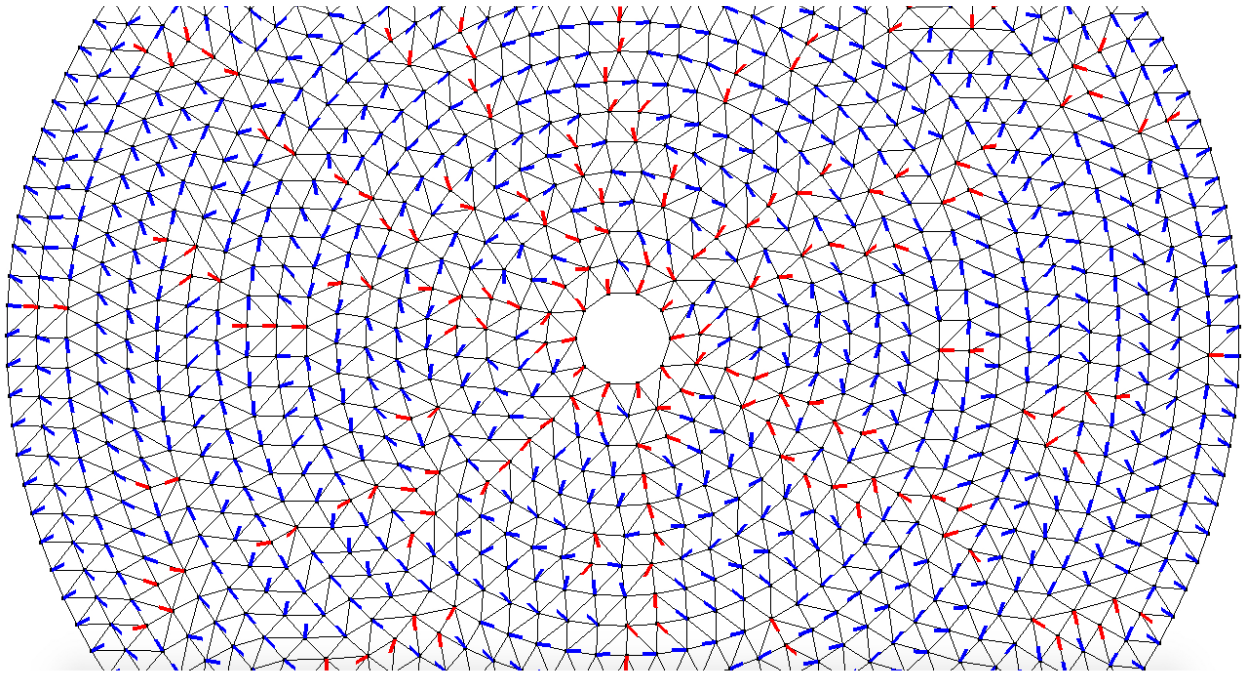
---

*sjhalayka@gmail.com

Figure 1: 2D Delaunay triangulation of black hole exterior. Pointing outward: 0.160405, average dot product: -0.237052.
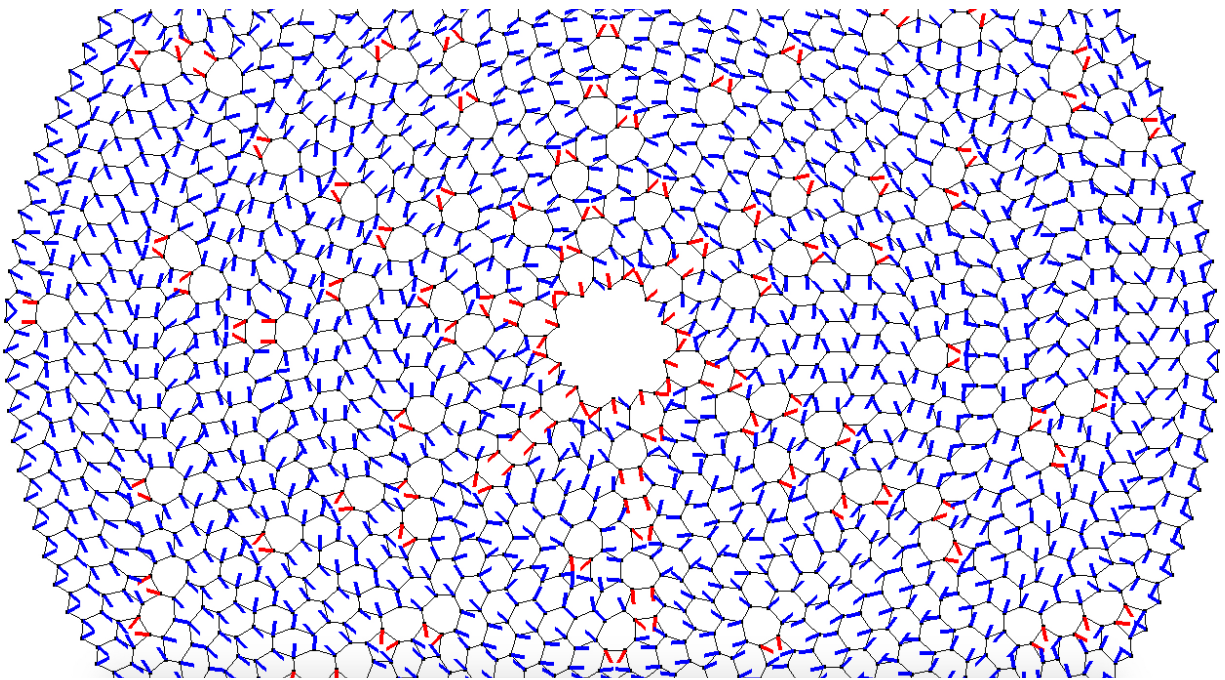

Figure 2: 2D Voronoi polygonization of black hole exterior. Pointing outward: 0.089768, average dot product: -0.28396.
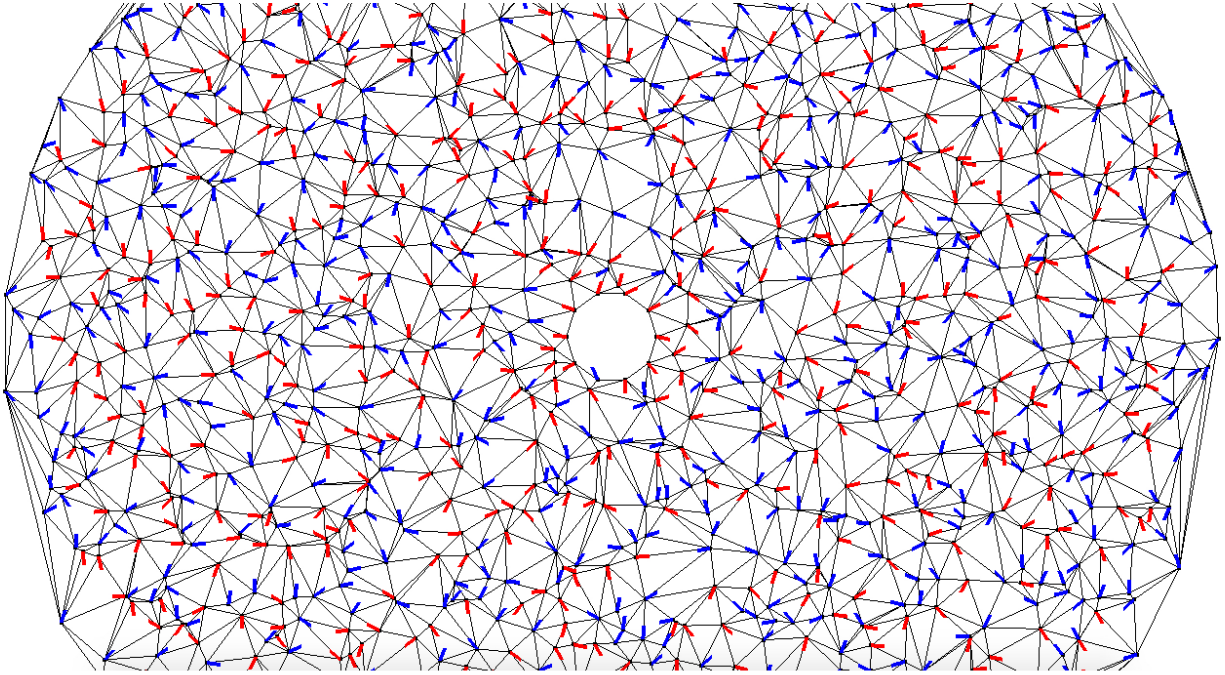
Figure 3: 2D pseudorandomly perturbed Delaunay triangulation of black hole exterior. Pointing outward: 0.446532, average dot product: -0.0664055.
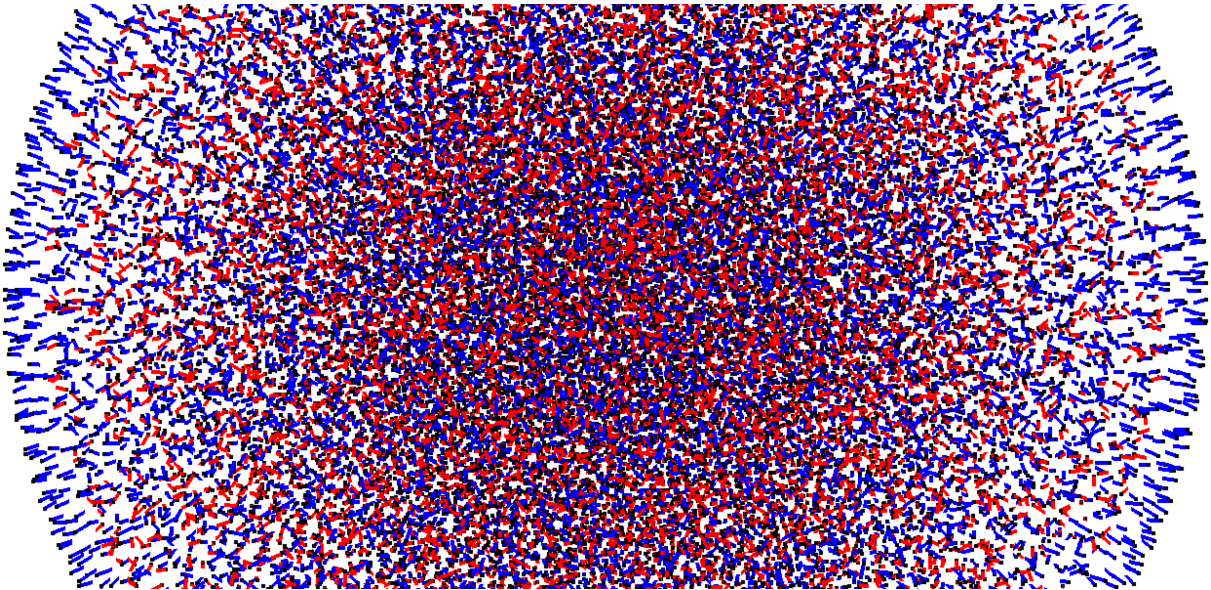

Figure 4: 3D Delaunay tetrahedralization of black hole exterior (tetrahedron edges not shown here). Pointing outward: 0.456549, average dot product: -0.0980582.

References

[1] Tomasz Konopka, Fotini Markopoulou, Simone Severini *Quantum Graphity: a model of emergent locality* (2008) arXiv:0801.0861 [hep-th]

[2] *dct* http://goanna.cs.rmit.edu.au/~gl/research/comp_geom/delaunay/delaunay.html

[3] *TetGen* http://wias-berlin.de/software/tetgen/

[4] *Voro++* http://math.lbl.gov/voro++/