World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:9, No:01, 2015

# Optimization of Reliability and Communicability of a Random Two-Dimensional Point Patterns Using Delaunay Triangulation

**Authors :** Sopheak Sorn, Kwok Yip Szeto

**Abstract :** Reliability is one of the important measures of how well the system meets its design objective, and mathematically is the probability that a complex system will perform satisfactorily. When the system is described by a network of N components (nodes) and their L connection (links), the reliability of the system becomes a network design problem that is an NP-hard combinatorial optimization problem. In this paper, we address the network design problem for a random point set's pattern in two dimensions. We make use of a Voronoi construction with each cell containing exactly one point in the point pattern and compute the reliability of the Voronoi's dual, i.e. the Delaunay graph. We further investigate the communicability of the Delaunay network. We find that there is a positive correlation and a negative correlation between the homogeneity of a Delaunay's degree distribution with its reliability and its communicability respectively. Based on the correlations, we alter the communicability and the reliability by performing random edge flips, which preserve the number of links and nodes in the network but can increase the communicability in a Delaunay network at the cost of its reliability. This transformation is later used to optimize a Delaunay network with the optimum geometric mean between communicability and reliability. We also discuss the importance of the edge flips in the evolution of real soap froth in two dimensions.

**Keywords :** Communicability, Delaunay triangulation, Edge Flip, Reliability, Two dimensional network, Voronio
**Conference Title :** ICCGCV 2015 : International Conference on Computational Geometry and Computer Vision
**Conference Location :** Istanbul, Türkiye
**Conference Dates :** January 26-27, 2015