

Uniform Placement of Alter-nodes on a Spherical Surface (U-PASS) for Ego-Centric Network and its Link to Minimum Energy Designs

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Abstract

An ego-centric network consists of a particular node (ego) that has relationships to all neighboring nodes (alters) in the network. Such network serves as an important tool to study the network structure of alters of the ego, and it is essential to present such network with good visualization. This work aims at introducing an efficient method, namely the Uniform Placement of Alters on Spherical Surface (U-PASS), to represent an ego-centric network so that all alters are scattered on the surface of the unit sphere uniformly. Unlike other simple uniformity that considers to maximize Euclidean distances among nodes, U-PASS is a three-stage method that spreads the alters with the consideration of existing edges among alters, no overlapping of node clusters, and node attribute information. Particle swarm optimization is employed to improve efficiency in node allocations. To guarantee the uniformity, we show the connection between our U-PASS to the minimum energy design on a two-dimensional flat plane with a specific gradient. Our simulation study shows good performance of U-PASS in terms of some distance statistics when compared to four state-of-the-art methods via self-organizing maps and force-driven approaches. We use a Facebook network to illustrate how this ego-centric network looks different after the alter nodes are allocated via our U-PASS.