ORDERING AND CONVERGENCE OF LARGE DEGREES IN RANDOM HYPERBOLIC GRAPHS

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Abstract. A natural way to construct a random graph is by sampling points in a Euclidean space and connecting pairs of points that are separated by a distance smaller than a given threshold. In the Random Hyperbolic Graph, one rather use a hyperbolic space, leading to different behaviours in terms of percolation, clustering, degree distribution, etc. In particular, when the parameter α is larger than $1/2$, the graph exhibits key properties of complex networks, including a scale-free degree distribution.

In this talk, we focus on nodes with large degrees, which can be seen as the hubs of the graphs and play a major role in its connectivity properties. We will prove convergence in distribution of the degree sequence to a Poisson point process for all values of α. This result is obtained by proving an ordering property for the highest degrees: specifically, we show that (with high probability) the k nodes closest to the centre of the underlying space have the k highest degrees. In the scale-free regime, this can be made more precise by showing that (with high probability) the ranking of the nodes by increasing distance to the centre coincides with the ranking by decreasing degree up to rank $n^{1/(1+8\alpha)}$, but the two rankings differ beyond that point.

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