Nice Random Graphs Workshop, May 14-15

PROGRAM WEDNESDAY MAY 14

09h00-09h05 Opening Remarks
09h05-09h55 *Gábor Lugosi (ICREA, UPF Barcelona):* Connectivity and giant component in Bluetooth networks
09h55-10h25 *Sébastien Bubeck (Princeton Univ.):* On the influence of the seed graph in the preferential attachment model
10h25-10h55 COFFEE BREAK
10h55-11h45 *François Delarue (Univ. Nice):* Information Transmission under Random Emission Constraints
11h45-12h15 *Juanjo Rué (FU Berlin):* Applications of Tutte's tree decomposition in the enumeration of bipartite graph families

12h15-13h45 LUNCH BREAK

13h45-14h35 *Josep Díaz (UPC Barcelona):* Evolutionary graphs
14h35-15h05 *Stéphane Perennes (INRIA Sophia Antipolis):* Random graphs and design problems
15h05-15h35 *Julien Barré (Univ. Nice):* Rigidity percolation on random graphs
15h35-16h05 COFFEE BREAK
16h05-16h35 *Kunal Dutta (MPI Saarbrücken):* Induced paths, holes and trees in random graphs
16h35-17h25 *Mathew D. Penrose (Univ. Bath):* Connectivity and singletons in soft geometric graphs
17h25-17h55 *Tobias Müller (Univ. Utrecht):* Hyperbolic random geometric graphs

PROGRAM THURSDAY, MAY 15

09h00-09h50 *Tomasz Łuczak (Adam Mickewicz Univ. Poznań):* Random graphs and positional games
09h50-10h20 *Alain Barrat (CPT Marseille):* Modeling temporal networks using random itineraries
10h20-10h50 COFFEE BREAK
10h50-11h20 *Marc Barthelemy (CEA Saclay):* Time Evolution of Spatial Networks
11h20-12h10 *Luc Devroye (McGill Univ.):* Random Kademlia networks

12h10-13h30 LUNCH BREAK

13h30-14h20 *Jean-François Marckert (Labri, Univ. Bordeaux 1):* Stochastic coalescence revisited
14h20-14h50 *Nicolas Nisse (INRIA Sophia Antipolis):* how to beat the random walk when you have a clock?
14h50-15h20 COFFEE BREAK
15h20-15h50 *Hamed Amini (EPF Lausanne):* Shortest-weight Paths in Random Graphs
15h50-16h40 *Nicolas Broutin (INRIA Paris-Rocquencourt):* The scaling limit of the minimum spanning tree of a complete graph
16h40 End

Abstracts of the talks (in alphabetical order)

Hamed Amini (EPF Lausanne): Shortest-weight Paths in Random Graphs
Abstract: Consider a random regular graph with degree d and of size n. Assign to each edge an i.i.d. exponential random variable with mean one. In the first part, we establish a precise asymptotic expression for the maximum number of edges on the shortest-weight paths between a fixed vertex and all the other vertices, as well as between any pair of vertices. This is a joint work with Yuval Peres. We then analyze the impact of the edge weights on distances in sparse random graphs. Our main result consists of a precise asymptotic expression for the weighted diameter of sparse random graphs when the edge weights are i.i.d. exponential random variables. This is based on a joint work with Marc Lelarge.

Alain Barrat (CPT Marseille): Modeling temporal networks using random itineraries
Abstract: Thanks to advanced acquisition technologies and large scale production of time-resolved data, temporal information has become more accessible in numerous network datasets, stimulating the studies of temporal networks. Strong limitations perdure however. Indeed, data are often only accessible in restricted forms, such as single samples of limited sizes and statistical relevance. Moreover, comparison of connection patterns in the same system but at different times is not always possible. Some datasets only consist of aggregated information and do not provide access to the temporal course of events. In such circumstances, it is of interest to be able to generate synthetic time-extended structures whose aggregation would reproduce the data at hand. This would enable one to go beyond the approximation of static networks by incorporating dynamical components in network structures, and to study the effect of various dynamical properties of the network on dynamical processes taking place on it. In this context, we propose a procedure to generate plausible and realistic instances of temporal networks, with bursty, possibly repetitive and correlated temporal behaviors, corresponding to a given temporally aggregated structure. Regarding any weighted directed graph as being composed of the accumulation of paths between its nodes, our construction uses random walks of variable length to produce time-extended structures with adjustable features. The procedure is first described in a general framework. It is then illustrated in a case study inspired by a transportation system for which the resulting synthetic network is shown to accurately mimic the empirical phenomenology.

Julien Barré (Univ. Nice): Rigidity percolation on random graphs
Abstract: Consider balls that are linked together by bars of fixed lengths; the balls act as pivots around which the bars can rotate. Is the structure obtained rigid or floppy? We will introduce this problem and explain its links with graph theory. We will then present old and new results and conjectures for rigidity percolation on random graphs, obtained by physicists and mathematicians.

Marc Barthelemy (CEA Saclay): Time Evolution of Spatial Networks

Nicolas Broutin (INRIA Paris-Rocquencourt): The scaling limit of the minimum spanning tree of a complete graph

Abstract: We consider a complete graph weighted with iid uniform weights and build the minimum spanning tree T_n. The tree T_n has attracted a lot of attention, but most informations known about its structure are local, even the famous result of Frieze saying that the total weight of converges to $\zeta(3)$. We are interested in the global structure of as $n \to \infty$, and consider it as a random metric space equipped with the graph distance d_{T_n}. We show that there exists a limit compact metric space M such that $(T_n, n^{-1/3} d_{T_n})$ converges in distribution to M. The metric space is a continuum random tree, that we prove different from Aldous' CRT using arguments relying on its fractal dimension.

This is a joint work with L. Addario-Berry, C. Goldschmidt and G. Miermont.

Sébastion Bubeck (Princeton Univ.): On the influence of the seed graph in the preferential attachment model

Abstract: We are interested in the following question: suppose we generate a large graph according to the linear preferential attachment model—can we say anything about the initial (seed) graph? A precise answer to this question could lead to new insights for the diverse applications of the preferential attachment model. In this work we focus on the case of trees grown according to the preferential attachment model. We first show that the seed has no effect from a weak local limit point of view. On the other hand, we conjecture that different seeds lead to different distributions of limiting trees from a total variation point of view. We prove this result for seeds with different degree sequences.

François Delarue (Univ. Nice): Information Transmission under Random Emission Constraints

Abstract: We model the transmission of a message on the complete graph with n vertices and limited resources. The vertices of the graph represent servers that may broadcast the message at random. Each server has a random emission capital that decreases at each emission. Quantities of interest are the number of servers that receive the information before the capital of all the informed servers is exhausted and the exhaustion time. We establish limit theorems (law of large numbers, central limit theorem and large deviation principle), as n tends to infinity, for the proportion of visited vertices before exhaustion and for the total duration. The analysis relies on a construction of the transmission procedure as a dynamical selection of successful nodes in a Galton-Watson tree with respect to the success epochs of the coupon collector problem.

Joint work with Francis Comets and Rene Schott.

Luc Devroye (McGill Univ.): Random Kademlia networks

Abstract: Kademlia is the de facto standard searching algorithms for P2P networks on the Internet, which is used by millions of users every day (especially those who like free downloads). We explain this graph model, and analyze its probabilistic performance.

Josep Díaz (UPC Barcelona): Evolutionary graphs
Abstract: I will present a survey of the fixation probability and the absorption times on different types of evolutionary graphs that arise in the simulation of the Moran process for mutation and infection.

Kunal Dutta (MPI Saarbrücken): Induced paths, holes, and trees in random graphs
Abstract: We study the concentration of the largest induced paths, trees and cycles (holes) in the random graph model $G(n, p)$ and prove a 2-point concentration for the size of the largest induced path and hole, for all $p = \Omega(n^{-1/2} \ln^2 n)$. As a corollary, we obtain an improvement over a result of Erdős and Palka concerning the size of the largest induced tree in a random graph. Further, we study the *path chromatic number* and *tree chromatic number*, i.e. the smallest number of parts into which the vertex set of a graph can be partitioned such that every part induces a (i) path or (ii) tree respectively, for $G(n, p)$. The arguments involve the application of a modified version of a probabilistic inequality of Krivelevich, Sudakov, Vu and Wormald. We also prove a lower bound showing the tightness of the application of the inequality up to logarithmic factors in the exponent.

Joint work with C. R. Subramanian.

1. P. Erdős and Z. Palka, Trees in Random Graphs. Discrete Mathematics 46 (1983),145-150.
2. M. Krivelevich, B. Sudakov, V. Vu and N. Wormald, On the probability of independent sets in random graphs, Rand. Struct. Alg. 22 (2003) 1-14.

Tomasz Łuczak (Adam Mickewicz Univ. Poznań): Random graphs and positional games
Abstract: It is well known that one can predict the result of some deterministic perfect information games between two players using the "random strategy heuristic", i.e. it is often the case that the player who has larger chances to win when both players are playing randomly is also the one who wins the game when both both players are playing their best strategies. This rather surprising phenomenon was first observed by Erdős and Selfridge and then studied and explored in a number of papers. In the talk we report on some recent results concerning so called Waiter-Client games on graphs, and follow the random strategy approach to analyze it.

This is a joint work with Małgorzata Bednarska-Bzdęga, Danny Hefetz, and Michael Krivelevich.

Gábor Lugosi (ICREA, UPF Barcelona): Connectivity and giant component in Bluetooth networks
Abstract: Consider a graph whose vertices represent n uniform random points in the unit square. One may form a random geometric graph by connecting two points by an edge if the distance of the points is at most r. Let c be a positive integer. We form a subgraph of the random geometric graph by selecting, at random, c vertices among the neighbors of any given vertex, and keeping only the edges joining the vertex to the selected neighbors. We present various results about connectivity properties of such graphs.

Joint work with Nicolas Broutin and Luc Devroye.

Jean-François Marckert (Labri, Univ. Bordeaux 1): Stochastic coalescence revisited
Abstract: Consider N particles merging into clusters with the following random rule: a cluster of size x and a cluster of size y merge at rate $K(x, y)$. The function K is called the rate kernel. Such a process is called stochastic coalescent. For special rate functions, $K(x, y) = xy$ and $K(x, y) = x + y$, discussed in the talk, the random processes giving the size of the clusters according to the time correspond

- to the size of the connected components in the Erds-Rnyi graph for $K(x, y) = xy$ (Aldous)
- to the size of the blocks of consecutive occupied places in a circular parking (Chassaing-Louchard).

The asymptotic of a picture of a large coalescence system taken at some special time t has some description in terms of some Brownian processes. The size of the components correspond to the sizes of the excursions of this process.

In the above paragraph we used the word 'picture' figures the fact that the process indexed by the time, "the video of the coalescence process" is not known to converge to some continuous coalescent built with the Brownian processes evoked above, even if such continuous processes are well defined and exist (Aldous, Pitman, Bertoin, Chassaing-Louchard). The talk is devoted to this question. We provide a new description of the coalesence processes which makes it possible to prove this convergence.

Joint work with Nicolas Broutin.

Tobias Müller (Univ. Utrecht): Hyperbolic random geometric graphs
Abstract: Random geometric graphs are constructed by sampling n points at random from some probability distribution on the plane and connecting two points when the distance is less than some parameter r. I this talk I will discuss some preliminary results on what happens when the points of the random geometric graph live in the hyperbolic plane rather than the ordinary, euclidean plane. Perhaps rather surprising, this variation on the model leads to very different behaviour from the standard, euclidean version.

(Based on ongoing joint works with Bode, Broman, Fountoulakis and Tykesson)

Nicolas Nisse (INRIA Sophia Antipolis): how to beat the random walk when you have a clock?
Abstract: We study the problem of finding a destination node t by a mobile agent in an unreliable network. Each node is able to give advice concerning the next node to visit so as to go closer to the target t. Unfortunately, exactly k of the nodes, called liars, give advice which is incorrect. We focus on strategies which efficiently solve the search problem in scenarios in which, at each node, the agent may only choose between following the local advice, or randomly selecting an incident edge. The performance of such strategies is studied for two classes of regular graphs with extremal values of expansion, namely, for rings and for random regular graphs.

This is a joint work with N. Hanusse, D. Ilcinkas and A. Kosowski.

Mathew D. Penrose (Univ. Bath): Connectivity and singletons in soft geometric graphs
Abstract: Consider a random graph on n vertices scattered uniformly at random in the unit d-cube ($d > 1$ fixed), in which any two vertices distant at most r apart are connected with probability p. This generalizes some well-known random graph models. We describe how for n large under *any* choice of the parameter sequence $((r(n), p(n)), n \geq 1)$, the probability that the resulting graph is connected is governed by the probability that it is free of isolated vertices, and the number of isolated vertices is approximately Poisson. We describe some aspects of the proof.

Stéphane Perennes (INRIA Sophia Antipolis): Random graphs and design problems
Abstract: In this talk I will review some classical design problems for which random graphs provide solutions that are till now far better than deterministic constructions. Namely I will focus on issues such as (Δ, D) problem(s), minimum broadcast graph, expanders, and robust graphs. In the course of the presentation I will mention some open questions.

Juanjo Rué (FU Berlin): Applications of Tutte's tree decomposition in the enumeration of bipartite graph families
Abstract: We adapt the grammar introduced by Chapuy, Fusy, Kang and Shoilekova to study bipartite graph families which are defined by their 3-connected components. More precisely, in this talk I will explain how to get the counting formulas for bipartite series-parallel graphs (and more generally of the Ising model over this family of graphs), as well as asymptotic estimates for the number of such graphs with a fixed size.

This talk is based in a work in progress joint with Kerstin Weller.