Activity Report 2017

Project-Team DANTE

Dynamic Networks : Temporal and Structural Capture Approach

IN COLLABORATION WITH: Laboratoire de l'Informatique du Parallélisme (LIP)

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Creation of the Team: 2012 November 01, updated into Project-Team: 2015 January 01

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1. Personnel

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2. Overall Objectives

2.1. Overall Objectives

The goal of DANTE is to develop **novel models, algorithms and methods to analyse the dynamics of large-scale networks**, (*e.g. social networks, technological networks such as the Web and hyperlinks, Articles and co-citation, email exchanges, economic relations, bacteria/virus propagation in human networks...*). Large datasets describing such networks are nowadays more "accessible" due to the emergence of online activities

and new techniques of data collection. These advantages provide us an unprecedented avalanche of large data sets, recording the digital footprints of millions of entities (*e.g.* individuals, computers, documents, stocks, etc.) and their temporal interactions [1]. Such large amount of information allows for easier and more precise traceability of social activities, better observation of the structural and temporal evolution of social/technological/economical networks, the emergence of their localized and cascading failures, and provides information about the general roles of self-organization in an interdisciplinary sense. All these questions represent a major scientific, economic, and social challenge, which has the potential to revolutionize our understanding of the arising socio-technical world of our age.

Our main challenge is to propose **generic methodologies and concepts to develop relevant formal tools to model, analyse the dynamics and evolution of such networks, that is, to formalise the dynamic properties of both structural and temporal interactions of network entities/relations**:

- **Ask** application domains relevant questions, to learn something new about such domains instead of merely playing with powerful computers on huge data sets.

- **Access** and collect data with adapted and efficient tools. This includes a reflexive step on the biases of the data collected and their relations to real activities/application domain.

- **Model** the dynamics of networks by analyzing their structural and temporal properties jointly, inventing original approaches combining graph theory with signal processing. A key point is to capture temporal features in the data, which may reveal meaningful insights on the evolution of the networks.

- **Interpret** the results, make the knowledge robust and useful in order to be able to control, optimise and (re)-act on the network structure itself and on the protocols exchange/interactions in order to obtain a better performance of the global system.

The challenge is to solve a major scientific puzzle, common to several application domains (*e.g.*, sociology, information technology, epidemiology) and central in network science: how to understand the causality between the evolution of macro-structures and individuals, at local and global scales?

3. Research Program

3.1. Graph-based signal processing

Participants: Éric Fleury, Paulo Gonçalves, Márton Karsai, Sarah de Nigris, Sarra Ben Alaya.

> **Evolving networks can be regarded as "*out of equilibrium*" systems.** Indeed, their dynamics is typically characterized by non standard and intricate statistical properties, such as non-stationarity, long range memory effects, intricate space and time correlations.

Analyzing, modeling, and even defining adapted concepts for dynamic graphs is at the heart of DANTE. This is a largely open question that has to be answered by keeping a balance between specificity (solutions triggered by specific data sets) and generality (universal approaches disconnected from social realities). We will tackle this challenge from a graph-based signal processing perspective involving signal analysts and computer scientists, together with experts of the data domain application. One can distinguish two different issues in this challenge, one related to the graph-based organisation of the data and the other to the time dependency that naturally exits in the dynamic graph object. In both cases, a number of contributions can be found in the literature, albeit in different contexts. In our application domain, high-dimensional data "naturally reside" on the vertices of weighted graphs. The emerging field of signal processing on graphs merges algebraic and spectral graph theoretic concepts with computational harmonic analysis to process such signals on graphs [95].

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[1] YouTube claims to receive 48 hours of video every minute, Google and Facebook represent major world companies that generate millions of traces on our activities every second. Every day, hundreds of millions of posts are added to the blogosphere, from which information on citizen opinions and their evolutions can be collected.

As for the first point, adapting well-founded signal processing techniques to data represented as graphs is an emerging, yet quickly developing field which has already received key contributions. Some of them are very general and delineate ambitious programs aimed at defining universal, generally unsupervised methods for exploring high-dimensional data sets and processing them. This is the case for instance of the « diffusion wavelets » and « diffusion maps » pushed forward at Yale and Duke [79]. Others are more traditionally connected with standard signal processing concepts, in the spirit of elaborating new methodologies via some bridging between networks and time series, see, *e.g.*, ([90] and references therein). Other viewpoints can be found as well, including multi-resolution Markov models [98], Bayesian networks or distributed processing over sensor networks [89]. Such approaches can be particularly successful for handling static graphs and unveiling aspects of their organisation in terms of dependencies between nodes, grouping, etc. Incorporating possible time dependencies within the whole picture calls however for the addition of an extra dimension to the problem "as it would be the case when switching from one image to a video sequence", a situation for which one can imagine to take advantage of the whole body of knowledge attached to non-stationary signal processing [80].

3.2. Theory and Structure of dynamic Networks

Participants: Christophe Crespelle, Éric Fleury, Anthony Busson, Márton Karsai, Jean-Philippe Magué, Eric, Philippe Guichard, Jean Pierre Chevrot, Tommaso Venturini.

> **Characterization of the dynamics of complex networks.** We need to focus on intrinsic properties of evolving/dynamic complex networks. New notions (as opposed to classical static graph properties) have to be introduced: rate of vertices or links appearances or disappearances, the duration of link presences or absences. Moreover, more specific properties related to the dynamics have to be defined and are somehow related to the way to model a dynamic graph.

Through the systematic analysis and characterization of static network representations of many different systems, researchers of several disciplines have unveiled complex topologies and heterogeneous structures, with connectivity patterns statistically characterized by heavy-tails and large fluctuations, scale-free properties and non trivial correlations such as high clustering and hierarchical ordering [92]. A large amount of work has been devoted to the development of new tools for statistical characterisation and modelling of networks, in order to identify their most relevant properties, and to understand which growth mechanisms could lead to these properties. Most of those contributions have focused on static graphs or on dynamic process (*e.g.* diffusion) occurring on static graphs. This has called forth a major effort in developing the methodology to characterize the topology and temporal behaviour of complex networks [92], [83], [99], [88], to describe the observed structural and temporal heterogeneities [77], [83], [78], to detect and measure emerging community structures [81], [96], [97], to see how the functionality of networks determines their evolving structure [87], and to determine what kinds of correlations play a role in their dynamics [84], [86], [91].

The challenge is now to extend this kind of statistical characterization to dynamical graphs. In other words, links in dynamic networks are temporal events, called contacts, which can be either punctual or last for some period of time. Because of the complexity of this analysis, the temporal dimension of the network is often ignored or only roughly considered. Therefore, fully taking into account the dynamics of the links into a network is a crucial and highly challenging issue.

Another powerful approach to model time-varying graphs is via activity driven network models. In this case, the only assumption relates to the distribution of activity rates of interacting entities. The activity rate is realistically broadly distributed and refers to the probability that an entity becomes active and creates a connection with another entity within a unit time step [94]. Even the generic model is already capable to recover some realistic features of the emerging graph, its main advantage is to provide a general framework to study various types of correlations present in real temporal networks. By synthesising such correlations (*e.g.* memory effects, preferential attachment, triangular closing mechanisms, ...) from the real data, we are able to extend the general mechanism and build a temporal network model, which shows certain realistic feature in a controlled way. This can be used to study the effect of selected correlations on the evolution

of the emerging structure [85] and its co-evolution with ongoing processes like spreading phenomena, synchronisation, evolution of consensus, random walk etc. [85], [93]. This approach allows also to develop control and immunisation strategies by fully considering the temporal nature of the backgrounding network.

3.3. Distributed Algorithms for dynamic networks: regulation, adaptation and interaction

Participants: Thomas Begin, Anthony Busson, Isabelle Guerin Lassous, Philippe Nain.

> **Dedicated algorithms for dynamic networks.** First, the dynamic network object itself trigger original algorithmic questions. It mainly concerns distributed algorithms that should be designed and deployed to efficiently measure the object itself and get an accurate view of its dynamic behavior. Such distributed measure should be "transparent", that is, it should introduce no bias or at least a bias that is controllable and corrigible. Such problem is encountered in all distributed metrology measures / distributed probes: P2P, sensor network, wireless network, QoS routing... This question raises naturally the intrinsic notion of adaptation and control of the dynamic network itself since it appears that autonomous networks and traffic aware routing are becoming crucial.

Communication networks are dynamic networks that potentially undergo high dynamicity. The dynamicity exhibited by these networks results from several factors including, for instance, changes in the topology and varying workload conditions. Although most implemented protocols and existing solutions in the literature can cope with a dynamic behavior, the evolution of their behavior operates identically whatever the actual properties of the dynamicity. For instance, parameters of the routing protocols (*e.g.* hello packets transmission frequency) or routing methods (*e.g.* reactive / proactive) are commonly hold constant regardless of the nodes mobility. Similarly, the algorithms ruling CSMA/CA (*e.g.* size of the contention window) are tuned identically and they do not change according to the actual workload and observed topology.

Dynamicity in computer networks tends to affect a large number of performance parameters (if not all) coming from various layers (viz. physical, link, routing and transport). To find out which ones matter the most for our intended purpose, we expect to rely on the tools developed by the two former axes. These quantities should capture and characterize the actual network dynamicity. Our goal is to take advantage of this latter information in order to refine existing protocols, or even to propose new solutions. More precisely, we will attempt to associate "fundamental" changes occurring in the underlying graph of a network (reported through graph-based signal tools) to quantitative performance that are matter of interests for networking applications and the end-users. We expect to rely on available testbeds such as SensLab and FIT to experiment our solutions and ultimately validate our approach.

4. Application Domains

4.1. Life Science & Health

In parallel to the advances in modern medicine, health sciences and public health policy, epidemic models aided by computer simulations and information technologies offer an increasingly important tool for the understanding of transmission dynamics and of epidemic patterns. The increased computational power and use of Information and Communication Technologies make feasible sophisticated modelling approaches augmented by detailed in vivo data sets, and allow to study a variety of possible scenarios and control strategies, helping and supporting the decision process at the scientific, medical and public health level. The research conducted in the DANTE project finds direct applications in the domain of LSH since modelling approaches crucially depend on our ability to describe the interactions of individuals in the population. In the MOSAR/iBird project we are collaborating with the team of Pr. Didier Guillemot (Inserm/Institut. Pasteur/Université de Versailles). Within the TUBEXPO and ARIBO projects, we are collaborating with Pr. Jean-Christopge Lucet (Professeur des université Paris VII, Praticien hospitalier APHP).

4.2. Network Science / Complex networks

In the last ten years the science of complex networks has been assigned an increasingly relevant role in defining a conceptual framework for the analysis of complex systems. Network science is concerned with graphs that map entities and their interactions to nodes and links. For a long time, this mathematical abstraction has contributed to the understanding of real-world systems in physics, computer science, biology, chemistry, social sciences, and economics. Recently, however, enormous amounts of detailed data, electronically collected and meticulously catalogued, have finally become available for scientific analysis and study. This has led to the discovery that most networks describing real world systems show the presence of complex properties and heterogeneities, which cannot be neglected in their topological and dynamical description. This has called forth a major effort in developing the methodology to characterise the topology and temporal behaviour of complex networks, to describe the observed structural and temporal heterogeneities, to detect and measure emerging community structure, to see how the functionality of networks determines their evolving structure, and to determine what kinds of correlations play a role in their dynamics. All these efforts have brought us to a point where the science of complex networks has become advanced enough to help us to disclose the deeper roles of complexity and gain understanding about the behaviour of very complicated systems.

In this endeavour the DANTE project targets the study of dynamically evolving networks, concentrating on questions about the evolving structure and dynamical processes taking place on them. During the last year we developed developed several projects along these lines concerning three major datasets:

- Mobile telephony data: In projects with academic partners and Grandata we performed projects based on two large independent datasets collecting the telephone call and SMS event records for million of anonymised individuals. The datasets record the time and duration of mobile phone interactions and some coarse grained location and demographic data for some users. In addition one of the dataset is coupled with anonymised bank credit information allowing us to study directly the socioeconomic structure of a society and how it determines the communication dynamics and structure of individuals.

- Skype data: Together with Skype Labs/STACC and other academic groups we were leading projects in the subject of social spreading phenomena. These projects were based on observations taken from a temporally detailed description of the evolving social network of (anonymised) Skype users registered between 2003 and 2011. This data contains dates of registration and link creation together with gradual information about their location and service usage dynamics.

- Twitter data: In collaboration with ICAR-ENS Lyon we collected a large dataset about the microblogs and communications of millions of Twitter users in the French Twitter space. This data allows us to follow the spreading of fads/opinions/hashtags/ideas and more importantly linguistic features in online communities. The aim of this collaboration is to set the ground for a quantitative framework studying the evolution of linguistic features and dialects in an social-communication space mediated by online social interactions.

5. Highlights of the Year

5.1. Highlights of the Year

5.1.1. *Official launch of Dylnet:*

The aim of DyLNet [2] is to observe and characterise the relations between child socialisation and oral language learning during the preschool period by means of an innovative multidisciplinary approach that combines work in the fields of language acquisition, sociolinguistics and network science.

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[2]https://dylnet.univ-grenoble-alpes.fr/dylnet-project?language=en

It is implemented through the 3-year follow-up of all the children and teaching staff (≈ 220) at a socially mixed preschool. The social interactions between individuals are recorded using wireless sensor technology which will record inter-individual proximity data at 5 second intervals. These sensors will be worn for one week every month for a period of 3 years. The children's language development is monitored on the basis of their results in general language tests and the recording of their social use of language in natural interactions, through microphones implemented on the sensors. Finally, the children's social profiles is identified by means of questionnaires sent to their families.

Thanks to the analytical power of the network science, the social interaction data will be matched against the children's linguistic performances and sociolinguistic usage. The task, in particular, will be to examine the influence of the children's social relations on their language development (if individuals stay in the same peer community between two observation times, does the linguistic distance between them falls over the same period?) and, equally, the influence of language on these social relations (if two individuals belong to the same linguistic group at time T, does the probability that they will be in the same peer community increase at time $T + n$?). We shall also examine the interactions between the pupils and the teaching staff – teachers and classroom assistants – in order to observe whether their frequency has an impact on the children's language development. Finally, DyLNet will result in the provision to the scientific community of a database indicating the relations between the recorded interaction frequencies and the language descriptions of a broad school community of children and adults followed up over three years.

Because preschool is the first step in a child's school career, it is necessary to understand how children from different social backgrounds integrate and adapt to it. Oral language plays a key role in this process because it is the mean and result of socialisation at school. Social inequalities are a key factor in this chain since, as of age 2, children from different backgrounds do not exhibit the same level of language skills and do not all use, to the same extent, the linguistic codes that are encouraged at school. These early differences, which are transmitted within the family, have given rise to numerous studies that have revealed the influence of the nature and quantity of the speech addressed to children in different social environments. However, these works tell us little about the influence of peers, which may modulate the impact of the family given that peer groups give rise to a certain social mix. The DyLNet project will bring an important insight to this under-researched issue.

5.1.2. *Official launch of the Blaise Pascal Foundation*

The foundation Blaise Pascal (hereafter denoted by FBP) has been created on the 14th of November 2016. Its founders are the CNRS and the University of Lyon. The objectives of the foundation are to promote mathematics and computer science and to attract young people to scientific fields like computer science and mathematics. The FBP closely pays attention to gender issues in these scientific domains and to the difficulties for disadvantaged public to embrace scientific careers.

The actions of the FBP focus on: - a support to actors that promote mathematics and computer science via allocated funding based on call of proposals; - a structuring of actors to increase the impacts of their actions, to coordinate the efforts and to share experiences; - a development of innovative experiences via summer camps and clubs of mathematics and computer science.

The FBP has received an initial funding from the French government and its founders. To maintain its activities in the long term, external funding must be raised. Additional information on the FBP can be found here: http://fondationblaisepascal.strikingly.com.

Isabelle Guérin Lassous is the managing director of the foundation Blaise Pascal.

5.1.3. *Books on Dynamic Networks by Márton Karsai*

After a book chapter on *Control Strategies of Contagion Processes in Time-varying Networks* in Temporal Network Epidemiology in collaboration with Nicola Perra [57], a full book on *Bursty Human Dynamics* was just released at the end of the year in collaboration with Hang-Hyun Jo and Kimmo Kaski [56].

5.1.4. Public Data Lab and Fake News Field Guide

In February 2017, Tommaso Venturini has founded the Public Data Lab in collaboration with researchers from King's College London, the University of Amsterdam, the Politecnico di Milano, the University of Aalborg and other European research centres.

The PDL (http://publicdatalab.org) a network of young European researchers working on digital data and public interventions. The Public Data Lab seeks to facilitate research, engagement and debate around the future of the data society. We want to develop and disseminate innovative research, teaching, design and participation formats for the creation and use of public data. We work in collaboration with an interdisciplinary network of researchers, practitioners, journalists, civil society groups, designers, developers and public institutions across the world. Our approach is characterized by:

- Intervention around social, political, economic and ecological issues;
- Participation through involving different publics in the co-design of our work;
- Artisanship in advancing the craft of developing data projects and experiences;
- Openness in sharing our research, data and code for all to use.

In 2007, The Public Data Lab has published Field Guide on Fake News (http://fakenews.publicdatalab.org), which exemplifies our empirical approach to public debate inquiry and the way in which we mobilize digital methods in collaboration with stakeholders. The field guide has been selected as one of the project to be showcased during the celebration of the 50 years of the Inria.

More recently the PDL has received a small funding by the OrganiCities programme (http://organicity.eu/open-call/) to "develop a prototype service to support people in experimentation with urban data". In the Save Our Air project we will experiment combining air quality data and discursive inscriptions about urban environment.

5.1.5. Inria 50th anniversary

This year Inria has celebrated its 50th anniversary. In [19] the authors reflect on Inria's evolution through the decades and present its vision for the future.

6. New Software and Platforms

6.1. GraSP

Graph Signal Processing
KEYWORDS: Signal processing - Graph visualization - Graph - LaTeX - Matlab - GNU Octave
FUNCTIONAL DESCRIPTION: Matlab / GNU Octave toolbox to manipulate and visualize signals on graphs. LaTeX package to draw signals.

- Contact: Benjamin Girault

6.2. IoT-LAB aggregation-tools

KEYWORD: Internet of things
FUNCTIONAL DESCRIPTION: IoT-LAB aggregation-tools allow aggregating data results from many nodes at a time. It connects to several tcp connections and handle the received data.

- Participant: Gaetan Harter
- Contact: Eric Fleury
- URL: https://github.com/iot-lab/aggregation-tools

6.3. IoT-LAB cli-tools

KEYWORD: Internet of things

FUNCTIONAL DESCRIPTION: IoT-LAB cli-tools provide a basic set of operations for managing IoT-LAB experiments from the command-line.

- Participants: Frédéric Saint-Marcel and Gaetan Harter
- Contact: Eric Fleury
- URL: https://github.com/iot-lab/cli-tools

6.4. IoT-LAB gateway

KEYWORD: Internet of things

FUNCTIONAL DESCRIPTION: IoT-LAB software embedded on a IoT-LAB gateway node new generation provides the local management of the experiment on that node. It is a software bridge between the IoT-LAB server, the user open node and the control node.

- Contact: Frédéric Saint-Marcel
- URL: https://github.com/iot-lab/iot-lab-gateway

6.5. IoT-LAB robots

KEYWORDS: Internet of things - Robotics

FUNCTIONAL DESCRIPTION: IoT-LAB robots is an embedded robot controler on a Turtlebot2 providing the IoT-LAB node mobility functionnality

- Partner: Université de Strasbourg
- Contact: Julien Vandaële
- URL: https://github.com/iot-lab/

6.6. Queueing Systems

FUNCTIONAL DESCRIPTION: This tool aims at providing a simple web interface to promote the use of our proposed solutions to numerically solve classical queueing systems.

- Participants: Alexandre Brandwajn and Thomas Begin
- Contact: Thomas Begin
- URL: http://queueing-systems.ens-lyon.fr/

6.7. WSNet

KEYWORD: Network simulator

FUNCTIONAL DESCRIPTION: WSNet is a modular event-driven simulator targeted to Wireless Sensor Networks. Its main goals are to offer scalabiliy, extensibility and modularity for the integration of new protocols/hardware models and a precise radio medium simulation. We still hope to find the proper resource to make WSNet evolve into a wireless capillary network simulator suitable for conducting simulations at the urban scale.

- Participants: Rodrigue Domga Komguem and Fabrice Valois
- Partner: CEA-LETI
- Contact: Guillaume Chelius
- URL: https://gforge.inria.fr/projects/wsnet-3/

6.8. Platforms

6.8.1. FIT IoT-LAB

FUNCTIONAL DESCRIPTION

IoT-LAB provides full control of network IoT nodes and direct access to the gateways to which nodes are connected, allowing researchers to monitor nodes energy consumption and network-related metrics, e.g. end-to-end delay, throughput or overhead. The facility offers quick experiments deployment, along with easy evaluation, results collection and analysis. Defining complementary testbeds with different node types, topologies and environments allows for coverage of a wide range of real-life use-cases.

- Partner: FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research (Équipement d'Excellence (Equipex) research grant programme. The FIT consortium is composed of: Université Pierre et Marie Curie (UPMC), Inria, Université de Strasbourg, Institut Mines Télécom and CNRS
- Contact: Éric Fleury
- URL: https://www.iot-lab.info/

7. New Results

7.1. Graph & Signal Processing

Participants: Paulo Gonçalves, Éric Fleury, Sarra Ben Alaya, Esteban Bautista Ruiz, Gaëtan Frusque, Sarah de Nigris, Mikhail Tsitsvero.

7.1.1. Fractional Semi-Supervised Machine Learning

Graph-based semi-supervised learning for classification endorses a nice interpretation in terms of diffusive random walks, where the regularisation factor in the original optimisation formulation plays the role of a restarting probability. Recently, a new type of biased random walks for characterising certain dynamics on networks have been defined and rely on the γ-th power of the standard Laplacian matrix $\mathbf{L}^\gamma$, with $\gamma > 0$. In particular, these processes embed long range transitions, the Lévy flights, that are capable of one-step jumps between far-distant states (nodes) of the graph. In a series of two articles [28] and [29], we envisioned to build upon these volatile random walks to propose two new versions of graph based semi-supervised learning algorithms: one called fractional SSL corresponds to the case where $0 < \gamma < 1$ whose classification outcome could benefit from the dynamics induced by the fractional transition matrix, and the other less straightforwardly connected to random walks, derives from $\gamma > 1$.

7.1.2. Design of graph filters and filterbanks

Basic operations in graph signal processing consist in processing signals indexed on graphs either by filtering them or by changing their domain of representation, in order to better extract or analyze the important information they contain. The aim of our chapter [58] is to review general concepts underlying such filters and representations of graph signals. We first recall the different Graph Fourier Transforms that have been developed in the literature, and show how to introduce a notion of frequency analysis for graph signals by looking at their variations. Then, we move to the introduction of graph filters, that are defined like the classical equivalent for 1D signals or 2D images, as linear systems which operate on each frequency of a signal. Some examples of filters and of their implementations are given. Finally, as alternate representations of graph signals, we focus on multiscale transforms that are defined from filters. Continuous multiscale transforms such as spectral wavelets on graphs are reviewed, as well as the versatile approaches of filterbanks on graphs. Several variants of graph filterbanks are discussed, for structured as well as arbitrary graphs, with a focus on the central point of the choice of the decimation or aggregation operators.

7.1.3. GraSP: A Matlab Toolbox for Graph Signal Processing

In [30], we publicised the recent developments and new functionalities of our Graph Signal Processing Toolbox (GraSP).

7.2. Performance analysis and networks protocols

Participants: Mohammed Amer, Thomas Begin, Anthony Busson, Éric Fleury, Yannick Leo, Isabelle Guerin Lassous, Philippe Nain, Huu Nghi Nguyen, Laurent Reynaud.

7.2.1. Network Softwarization

We have developed a modelling framework to analytically evaluate the performance of DPDK-based virtual switches in the context of NFV (Network Function Virtualisation) networks. In [34], we extended our previous work [82] to enable non-null switch-over times that account for a delay overhead whenever a CPU starts polling a different queue. More recently, in [35], we refined our framework to let it deal with batches of packets (i.e. several packets on the same queue are processed together) that tends to speed up the performance of the virtual switches. These works were partly funded by the French ANR REFLEXION under the "ANR-14-CE28-0019" project.

7.2.2. Wi-Fi optimization

Densification of Wi-Fi networks has led to the possibility for a station to choose between several access points (APs). On the other hand, the densification of APs generates interference, contention and decreases the global throughput as APs have to share a limited number of channels. Optimizing the association step between APs and stations can alleviate this problem and increase the overall throughput and fairness between stations. We have proposed an original solution to this optimization problem based on a mathematical model and introduce a local search algorithm to solve this problem through a suitable neighborhood structure. Our evaluation, based on simulations, shows that the proposed solution improves the overall throughput and the fairness of the network. We are currently working on variant of this problem where the traffic to the stations is taken into account in the model and the optimization formulation.

7.2.3. Caching

In [72] we focus on the LRU cache where requests for distinct contents are described by independent stationary and ergodic processes. We extend a TTL-based approximation of the cache hit probability first proposed by R. Fagin in 1977 for the independence reference model to this more general workload model. We show that under very general conditions this approximation is exact as the cache size and the number of contents go to infinity. Moreover, we establish this not only for the aggregate cache hit probability but also for every individual content. Last, we obtain a rate of convergence.

In [70] we consider the problem of allocating cache resources among multiple content providers. The cache can be partitioned into slices and each partition can be dedicated to a particular content provider, or shared among a number of them. It is assumed that each partition employs the LRU policy for managing content. We propose utility-driven partitioning, where we associate with each content provider a utility that is a function of the hit rate observed by the content provider. We consider two scenarios: i) content providers serve disjoint sets of files, ii) there is some overlap in the content served by multiple content providers. In the first case, we prove that cache partitioning outperforms cache sharing as cache size and numbers of contents served by providers go to infinity. In the second case, It can be beneficial to have separate partitions for overlapped content. In the case of two providers it is usually always beneficial to allocate a cache partition to serve all overlapped content and separate partitions to serve the non-overlapped contents of both providers. We establish conditions when this is true asymptotically but also present an example where it is not true asymptotically. We develop online algorithms that dynamically adjust partition sizes in order to maximize the overall utility and prove that they converge to optimal solutions, and through numerical evaluations we show they are effective.

7.2.4. Mobile networks

The development of analytical models to analyze the behavior of vehicular ad hoc networks (VANETs) is a challenging aim. Adaptive methods are suitable for many algorithms (*e.g.* choice of forwarding paths, dynamic resource allocation, channel control congestion) and services (*e.g.* provision of multimedia services, message dissemination). These adaptive algorithms help the network to maintain a desired performance level. However, this is a difficult goal to achieve, especially in VANETs due to fast position changes of the VANET nodes.

Adaptive decisions should be taken according to the current conditions of the VANET. Therefore, evaluation of transient measures is required for the characterization of VANETs. In the literature, different works address the characterization and measurement of the idle (or busy) time to be used in different proposals to attain a more efficient usage of wireless network. We have developed an analytical model based on a straightforward Markov reward chain (MRC) to obtain transient measurements of the idle time of the link between two VANET nodes. We have shown that numerical results from the analytical model fit well with simulation results [20].

In another study, we have investigated the application of an adapted controlled mobility strategy on self-propelling nodes, which could efficiently provide network resource to users scattered on a designated area. We have designed a virtual force-based controlled mobility scheme (called VFPc) and evaluated its ability to be jointly used with a dual packet-forwarding and epidemic routing protocol. In particular, we have studied the possibility for end-users to achieve synchronous communications at given times of the considered scenarios. On this basis, we have studied the delay distribution for such user traffic and show the advantages of our solution compared to other packet-forwarding and packet-replication schemes, and highlighted that VFPc-enabled applications could take benefit of both schemes to yield a better user experience, despite challenging network conditions [21].

7.3. Modeling of Dynamics of Complex Networks

Participants: Jean Pierre Chevrot, Christophe Crespelle, Sicheng Dai, Éric Fleury, Eric, Philippe Guichard, Márton Karsai, Yannick Leo, Sebastien Lerique, Jacob Levy Abitbol, Jean-Philippe Magué, Matteo Morini, Samuel Unicomb, Samuel Unicomb.

7.3.1. *Multilayer networks*

In [67] we introduce a new class of stochastic multilayer networks. A stochastic multilayer network is the aggregation of M networks (one per layer) where each is a subgraph of a foundational network G. Each layer network is the result of probabilistically removing links and nodes from G. The resulting network includes any link that appears in at least K layers. This model is an instance of a non-standard site-bond percolation model. Two sets of results are obtained: first, we derive the probability distribution that the M-layer network is in a given configuration for some particular graph structures (explicit results are provided for a line, an algorithm is provided for a tree), where a configuration is the collective state of all links (each either active or inactive). Next, we show that for appropriate scalings of the node and link selection processes in a layer, links are asymptotically independent as the number of layers goes to infinity, and follow a Poisson distribution. Numerical results are provided to highlight the impact of having several layers on some metrics of interest (including expected size of the cluster a node belongs to in the case of the line). This model finds applications in wireless communication networks with multichannel radios, multiple social networks with overlapping memberships, transportation networks, and, more generally, in any scenario where a common set of nodes can be linked via co-existing means of connectivity.

7.3.2. *Models of time varying networks*

In terms of modelling temporal networks we had the following main contributions in 2017.

A book on Bursty Human Dynamics, written by M. Karsai as a the leading author. Bursty dynamics is a common temporal property of various complex systems in Nature but it also characterises the dynamics of human actions and interactions. At the phenomenological level it is a feature of all systems that evolve heterogeneously over time by alternating between periods of low and high event frequencies. In such systems, bursts are identified as periods in which the events occur with a rapid pace within a short time-interval while these periods are separated by long periods of time with low frequency of events. As such dynamical patterns occur in a wide range of natural phenomena, their observation, characterisation, and modelling have been a long standing challenge in several fields of research. However, due to some recent developments in communication and data collection techniques it has become possible to follow digital traces of actions and interactions of humans from the individual up to the societal level. This led to several new observations of bursty phenomena in the new but largely unexplored area of human dynamics, which called for the renaissance

to study these systems using research concepts and methodologies, including data analytics and modelling. As a result, large amount of new insight and knowledge as well as innovations have been accumulated in the field, which provided the timely opportunity to write a monograph book [56] to make an up-to-date review and summary of the observations, appropriate measures, modelling, and applications of heterogeneous bursty patterns occurring in the dynamics of human behaviour.

In another contribution M. Karsai and collaborators introduced a new representation of temporal networks [73]. The dynamics of diffusion-like processes on temporal networks are influenced by correlations in the times of contacts. This influence is particularly strong for processes where the spreading agent has a limited lifetime at nodes: disease spreading (recovery time), diffusion of rumors (lifetime of information), and passenger routing (maximum acceptable time between transfers). We introduce weighted event graphs as a powerful and fast framework for studying connectivity determined by time-respecting paths where the allowed waiting times between contacts have an upper limit. We study percolation on the weighted event graphs and in the underlying temporal networks, with simulated and real-world networks. We show that this type of temporal-network percolation is analogous to directed percolation, and that it can be characterized by multiple order parameters.

M. Karsai also contributed to a new definition to better quantify attention distributed in dynamical egocentric social networks [64]. Granovetter's weak tie theory of social networks is built around two central hypotheses. The first states that strong social ties carry the large majority of interaction events; the second maintains that weak social ties, although less active, are often relevant for the exchange of especially important information (e.g., about potential new jobs in Granovetter's work). While several empirical studies have provided support for the first hypothesis, the second has been the object of far less scrutiny. A possible reason is that it involves notions relative to the nature and importance of the information that are hard to quantify and measure, especially in large scale studies. Here, we search for empirical validation of both Granovetter's hypotheses. We find clear empirical support for the first. We also provide empirical evidence and a quantitative interpretation for the second. We show that attention, measured as the fraction of interactions devoted to a particular social connection, is high on weak ties — possibly reflecting the postulated informational purposes of such ties — but also on very strong ties. Data from online social media and mobile communication reveal network-dependent mixtures of these two effects on the basis of a platform's typical usage. Our results establish a clear relationships between attention, importance, and strength of social links, and could lead to improved algorithms to prioritize social media content.

7.3.3. Dynamical processes on networks

Another field which has been intensively studied during the last year addresses dynamical processes on temporal and static networks.

In a book chapter M. Karsai summarised his recent findings on temporal network immunisation [57]. The vast majority of strategies aimed at controlling contagion processes on networks consider a timescale separation between the evolution of the system and the unfolding of the process. However, in the real world, many networks are highly dynamical and evolve, in time, concurrently to the contagion phenomena. Here, we review the most commonly used immunization strategies on networks. In the first part of the chapter, we focus on controlling strategies in the limit of timescale separation. In the second part instead, we introduce results and methods that relax this approximation. In doing so, we summarize the main findings considering both numerical and analytically approaches in real as well as synthetic time-varying networks.

With the PhD student S. Unicomb, M. Karsai and a collaborator developed a new formalism, which is capable to precisely capture and predict the non-monotonous dependence of threshold driven dynamics on weight heterogeneities in networks [76]. Weighted networks capture the structure of complex systems where interaction strength is meaningful. This information is essential to a large number of processes, such as threshold dynamics, where link weights reflect the amount of influence that neighbours have in determining a node's behaviour. Despite describing numerous cascading phenomena, such as neural firing or social contagion, the modelling of threshold dynamics on weighted networks has been largely overlooked. We fill this gap by studying a dynamical threshold model over synthetic and real weighted networks with numerical

and analytical tools. We show that the time of cascade emergence depends non-monotonously on weight heterogeneities, which accelerate or decelerate the dynamics, and lead to non-trivial parameter spaces for various networks and weight distributions. Our methodology applies to arbitrary binary state processes and link properties, and may prove instrumental in understanding the role of edge heterogeneities in various natural and social phenomena.

With other co-authors, M. Karsai published another book chapter about his recent findings on the modelling threshold driven dynamics on networks [55]. The collective behaviour of people adopting an innovation, product or online service is commonly interpreted as a spreading phenomenon throughout the fabric of society. This process is arguably driven by social influence, social learning and by external effects like media. Observations of such processes date back to the seminal studies by Rogers and Bass, and their mathematical modelling has taken two directions: One paradigm, called simple contagion, identifies adoption spreading with an epidemic process. The other one, named complex contagion, is concerned with behavioural thresholds and successfully explains the emergence of large cascades of adoption resulting in a rapid spreading often seen in empirical data. The observation of real world adoption processes has become easier lately due to the availability of large digital social network and behavioural datasets. This has allowed simultaneous study of network structures and dynamics of online service adoption, shedding light on the mechanisms and external effects that influence the temporal evolution of behavioural or innovation adoption. These advancements have induced the development of more realistic models of social spreading phenomena, which in turn have provided remarkably good predictions of various empirical adoption processes. In this chapter we review recent data-driven studies addressing real-world service adoption processes. Our studies provide the first detailed empirical evidence of a heterogeneous threshold distribution in adoption. We also describe the modelling of such phenomena with formal methods and data-driven simulations. Our objective is to understand the effects of identified social mechanisms on service adoption spreading, and to provide potential new directions and open questions for future research.

Y. Leo, E. Fleury and M. Karsai is in the final stage to publish a study on a unique mobile call/banking dataset on the dynamics of purchasing patterns. We analyse a coupled dataset collecting the mobile phone communications and bank transactions history of a large number of individuals living in a Latin American country. After mapping the social structure and introducing indicators of socioeconomic status, demographic features, and purchasing habits of individuals we show that typical consumption patterns are strongly correlated with identified socioeconomic classes leading to patterns of stratification in the social structure. In addition we measure correlations between merchant categories and introduce a correlation network, which emerges with a meaningful community structure. We detect multivariate relations between merchant categories and show correlations in purchasing habits of individuals. Finally, by analysing individual consumption histories, we detect dynamical patterns in purchase behaviour and their correlations with the socioeconomic status, demographic characters and the egocentric social network of individuals. Our work provides novel and detailed insight into the relations between social and consuming behaviour with potential applications in resource allocation, marketing, and recommendation system design.

7.3.4. SoSweet

The SoSweet project focuses on the synchronic variation and the diachronic evolution of the variety of French language used on Twitter.

In one paper accepted to WWW'18 we addressed some of the main questions of the project using a unique dataset combining the largest French Twitter dataset and demographic data coming from INSEE [31]. Our usage of language is not solely reliant on cognition but is arguably determined by myriad external factors leading to a global variability of linguistic patterns. This issue, which lies at the core of sociolinguistics and is backed by many small-scale studies on face-to-face communication, is addressed here by constructing a dataset combining the largest French Twitter corpus to date with detailed socioeconomic maps obtained from national census in France. We show how key linguistic variables measured in individual Twitter streams depend on factors like socioeconomic status, location, time, and the social network of individuals. We found that *(i)* people of higher socioeconomic status, active to a greater degree during the daytime, use a more standard language; *(ii)* the southern part of the country is more prone to use more standard language than the northern

one, while locally the used variety or dialect is determined by the spatial distribution of socioeconomic status; and *(iii)* individuals connected in the social network are closer linguistically than disconnected ones, even after the effects of status homophily have been removed. Our results inform sociolinguistic theory and may inspire novel learning methods enabling the inference of socioeconomic status of people from the way they tweet.

7.3.5. *Relational methods for media studies*

A very relevant application of the research that DANTE carries out on networks structures and networks dynamics concerns the field of journalism and media study. Relational analysis may be helpful in these fields in two different way.

On the one hand, the advent of digital media has challenged the established vertical structure of information distribution typical of broadcasting media with a decentralised organisation that facilitates the spreading of contents through all sort of horizontal channels (in the Web and in Social Media). This new type of circulation is still insufficiently studied and require both quantitative and qualitative investigation. We tried to provide the first in our Field Guide to Fake News already introduced in the highlights of this document [68] and in a forthcoming chapter on the heterogeneous clustering of French Media system for the The Routledge Handbook to Developments in Digital Journalism Studies [60]. As for the qualitative study of the structure of the media system, we published and analysis of the strategies employed by Facebook to steer the evolution of the technology of Live Video Streaming [23].

On the other hand, network analysis can be a powerful tool to investigate and narrate journalistic stories, but its techniques need adapted to the language used by journalists and understood by their audiences. We tried to provide such a translation in a paper for the journal Digital Journalism [13] and in a chapter for the Datafied Society book [59].

The use of network analysis to study vast societal phenomena has also profound implications for the theory of social sciences, which we tried to explore in a paper for the journal Big Data & Society [25] and in a chapter of a book on the Frontiers of Social Science [63], and for their practice [62].

7.3.6. *Philosophy of technologies revisited by Internet*

The Internet, as a technology of writing, helps us to understand that a technology is not always a mean to reach a goal, nor an application of science. In fact, the Internet does not appear as a revolution, but as a revealer. We understand that a technology can be reflexive (it invites us to think it) and that it cannot be clearly separated from human activities (writing, etc.). For instance, 50 years ago, we imagined we could think with our own mind (and perhaps with a paper and pencil). Now, we know that we cannot think without material stuff (a computer, the internet, etc.). A very few philosophers knew this fact (Leibniz, Boole, etc.). But this evidence transforms completely the philosophy of technologies. Another important point is the effect of technology on epistemology. We realise that we can not ask or imagine some questions if the technology is not there (eg: social cartography or statistics). This fact invites us to insert technologies and methods in the traditional diptych of theory and experience. In synthesis, we also discover strong links between technology and culture; hence the role of engineers in the construction of culture [53], [18], [52], [54], [71].

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *GranDATA*

Participants: Márton Karsai [correspondant], Éric Fleury.

Founded in 2012, Grandata is a Palo Alto-based company that leverages advanced research in Human Dynamics (the application of âbig dataâ to social relationships and human behaviour) to identify market trends and predict customer actions. Leading telecom and financial services firms are using Grandataâs Social Universe product to transform âbig dataâ into impressive business results.

The DANTE team and Grandata started to collaborate in 2014 on the analysis of large datasets provided by the company. The aim of the collaboration is to gain better understanding about the dynamical patterns of human interactions, mobility, and the socio-economic structure of the society.

8.2. Bilateral Grants with Industry

8.2.1. *Orange R&D*
Participant: Isabelle Guerin Lassous.

A contract has been signed between Inria and France Télécom for the PhD supervision of Laurent Reynaud. The PhD thesis subject concerns mobility strategies for fault resilience and energy conservation in wireless networks.

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. *IXXI*

9.1.1.1. *ISI Torino / Dante*
Participant: Márton Karsai [correspondant].

This project involves M. Karsai and L. Gauvin (ISI Torino) and funded by the IXXI Complex System Institute. The purpose of this project is to investigate the presence and the importance of higher-order correlations in dynamical networks. As the first attempt to address this problem we applied autoencoder, a recent representation using deep neural networks, on modelled and small-scale real temporal networks. However, since the results were trivial on the modelled network and not convincing on the real one we decided to take a different approach during the second phase of the project. We involved an IXXI PhD student, Jacobo Levy Abitbol, to work out a method for temporal network embedding. Our idea is to extend the node2vec representation of static networks for time-varying structures, by using a local random walk to explore the structural-temporal neighbourhood of a node. Based on such local information we can effectively propose an embedding, which captures the temporal and structural properties of nodes in a temporal network.

9.2. National Initiatives

9.2.1. *ANR*

9.2.1.1. *Equipex FIT (Futur Internet of Things)*
Participant: Éric Fleury [correspondant].

FIT is one of 52 winning projects in the Equipex research grant program. It will set up a competitive and innovative experimental facility that brings France to the forefront of Future Internet research. FIT benefits from 5.8 million euro grant from the French government Running from 22.02.11 – 31.12.2019. The main ambition is to create a first-class facility to promote experimentally driven research and to facilitate the emergence of the Internet of the future.

9.2.1.2. *ANR GRAPHSIP (Graph Signal Processing)*
Participants: Paulo Gonçalves [correspondant], Éric Fleury, Thomas Begin, Sarra Ben Alaya.

An increasing number of application areas require the processing of massive datasets. These data can often be represented by graphs in order to encode complex interactions. When data vectors are associated with graph vertices, a so-called graph signal is obtained. The processing of such graph signals includes several open challenges because of the nature of the involved information. Indeed graph theory and signal and image processing methodologies do not combine readily. In particular, such a combination requires new developments, allowing classical signal processing methods to work on irregular grids and non Euclidean spaces. Considering the significant success of classical signal processing tools, it appears essential to generalise their use to graph signals. The GRAPHSIP project aims at developing a set of advanced methods and algorithms for the processing of graph signals: multi-scale transforms and solutions of variational problems on graphs. The major outcomes of this project are expected to lead to significant breakthroughs for graph data processing. The project will also focus on two novel applications on instances of graph signals: brain networks and 3D colour point clouds. They will exemplify and illustrate the proposed methodological advances on emerging applications.

9.2.1.3. ANR INFRA DISCO (DIstributed SDN COntrollers for rich and elastic network services)

Participants: Thomas Begin [correspondant], Anthony Busson, Isabelle Guerin Lassous, Huu Nghi Nguyen.

The DANTE team will explore the way SDN (Software Designed Network) can change network monitoring, control, urbanisation and abstract description of network resources for the optimisation of services. More specifically, the team will address the issues regarding the positioning of SDN controllers within the network, and the implementation of an admission control that can manage IP traffic prioritisation.

9.2.1.4. ANR REFLEXION (REsilient and FLEXible Infrastructure for Open Networking)

Participants: Thomas Begin [correspondant], Anthony Busson, Isabelle Guerin Lassous, Zidong Su.

The DANTE team will work on the monitoring of NFV proposing passive and light-weight metrology tools. They will then investigate the modelling of low-level resources consumptions and finally propose methods to dynamically allocate these resources taking into account performance constraints.

9.2.1.5. ANR CONTINT CODDDE

Participants: Éric Fleury [correspondant], Christophe Crespelle, Márton Karsai.

It is a collaborative project between the ComplexNetwork team at LIP6/UPMC; Linkfluence and Inria Dante. The CODDDE project aims at studying critical research issues in the field of real-world complex networks study:

- How do these networks evolve over time?
- How does information spread on these networks?
- How can we detect and predict anomalies in these networks?

In order to answer these questions, an essential feature of complex networks will be exploited: the existence of a community structure among nodes of these networks. Complex networks are indeed composed of densely connected groups of that are loosely connected between themselves.

The CODDDE project will therefore propose new community detection algorithms to reflect complex networks evolution, in particular with regards to diffusion phenomena and anomaly detection.

These algorithms and methodology will be applied and validated on a real-world online social network consisting of more than 10 000 blogs and French media collected since 2009 on a daily basis (the dataset comprises all published articles and the links between these articles).

9.2.1.6. ANR SoSweet

Participants: Jean Pierre Chevrot, Éric Fleury, Márton Karsai [correspondant], Jean-Philippe Magué [PI].

The SoSweet project focuses on the synchronic variation and the diachronic evolution of the variety of French used on Twitter. The recent rise of novel digital services opens up new areas of expression which support new linguistic behaviours. In particular, social medias such as Twitter provide channels of communication through which speakers/writers use their language in ways that differ from standard written and oral forms. The result is the emergence of new varieties of languages. The main goal of SoSweet is to provide a detailed account of the links between linguistic variation and social structure in Twitter, both synchronically and diachronically. Through this specific example, and aware of its bias, we aim at providing a more detailed understanding of the dynamic links between individuals, social structure and language variation and change.

9.2.1.7. ANR DylNet
Participants: Jean Pierre Chevrot, Jean-Philippe Magué, Éric Fleury [correspondant], Márton Karsai.

The DylNet project aims to observe and to characterise the relationships between childhood sociability and oral-language learning at kindergarten. With a view to this, it takes an multidisciplinary approach combining work on language acquisition, sociolinguistics, and network science. It will be implemented by following all the children (≈ 220) and teaching staff in one kindergarten over a 3-year period. The use of wireless proximity sensors will enable collection of social contacts throughout the study. The data on sociability will be linked to the results of language tests and recordings of verbal interactions used to follow the childrenâs progress on both a psycholinguistic level (lexicon, syntax, pragmatics) and a sociolinguistic level (features showing belonging to a social group). The aim is to better understand the mechanisms of adaptation and integration at work when young children first come into contact with the school context.

9.2.2. CNRS

9.2.2.1. CNRS CO3I
Participants: Jean Pierre Chevrot [correspondant], Éric Fleury, Jean-Philippe Magué, Márton Karsai.

The CO3i project (Cognition individuelle et connaissance collective) is funded by the Mission pour l'Interdisciplinarité du CNRS. CO3i is an interdisciplinary theoretical project that aims at reanalyse and better articulate two distinctions: collective vs. individual and social vs. cognitive. Generally, the study of cognition is associated to the individual, whereas the social phenomena are seen as collective. In fact, there is an individual social cognition and there is a collective social knowledge. We have organised three days of interdisciplinary workshop confronting the views of sociologists, cognitive scientists, network scientists, linguists, and philosophers of science. Nourished by projects using various methodologies (massive data, experimentation, observation, corpus), the reflection will be finalised towards the publication of an international book. See: https://co3i.hypotheses.org/

9.2.3. Inria

9.2.3.1. Inria PRE LIAISON
Participants: Márton Karsai [correspondant], Éric Fleury.

This project implements unsupervised deep learning approaches to infer correlations/patterns that exist between dynamic linguistic variables, the mesoscopic and dynamic structure of the social network, and their socio-economic attributes. This interdisciplinary project is positioned at the crossroads of Natural Language Processing (NLP), Network Science, Data Science and Machine Learning.

9.2.4. HCERES

9.2.4.1. HCERES/Inria
Participants: Éric Fleury, Eric, Philippe Guichard [correspondant].

Bilateral project on the evolution of the Multi/inter-disciplinary of SHS. An increasing number of researchers in SHS has the desire to develop new researches with computer scientists or mathematicians because they want to apply new methodologies (according to various or numerous data) or to develop older ones, which can now be easily implemented online. Some also develop a reflexion on their discipline, with the idea that epistemological questions are revitalised by the internet. This reality invite them to discuss with philosophers or with other SHS scientists who have the same intuition (eg: cartography, visualisation).

The project is hence to measure these new forms or inter-multi-disciplinarity. The main source will be the publications of all academics of French SHS laboratories, to find out who writes a paper with somebody of a different discipline and/or laboratories. All data are anonimized,

9.2.5. Inria

9.2.5.1. IPL BetterNet
Participant: Eric, Philippe Guichard.

BETTERNET: An Observatory to Measure and Improve Internet Service Access from User Experience [3]. BetterNet aims at building and delivering a scientific and technical collaborative observatory to measure and improve the Internet service access as perceived by users. In this Inria Project Lab, we will propose new original user-centered measurement methods, which will associate social sciences to better understand Internet usage and the quality of services and networks with a particular focus on geography and cartography.

9.3. European Initiatives

9.3.1. FP7 & H2020 Projects

9.3.1.1. EMBERS

Title: Enabling a Mobility Back-End as a Robust Service

Programm: H2020

Duration: December 2015 - November 2018

Coordinator: UPMC

Partners:

Fraunhofer Gesellschaft Zur Forderung Der Angewandten Forschung Ev (Germany)

Technische Universitat Berlin (Germany)

Universite Pierre et Marie Curie - Paris 6 (France)

Ubiwhere Lda (Portugal)

Inria contact: Eric Fleury

EMBERS will bring to market a back-end for smart city mobility that is developed by a European small enterprise based upon its smart parking and smart traffic management products that two municipalities in Portugal currently deploy. The Mobility Back-end as a Service (MBaaS) replaces such all-in-one systems, in which a municipality purchases the full set of components from a single vendor. Instead, the city manager can purchase best-of-breed devices and apps developed by third parties, with the only constraint being that they interoperate with the back-end via a free, open, smart city mobility API. This domain-specific API lowers barriers to entry for app and device developers, making it easier for innovative SMEs to enter the market. Furthermore, the API is offered via a variety of generic interfaces, including oneM2M, ETSI M2M, OMA LWM2M, and FIWARE NGSI. EMBERS thus clears the way for developers and to municipalities that have adopted any one of these potential emerging machine-to-machine (M2M) communication standards. Beyond its primary goal of bringing the MBaaS to market, EMBERS will stimulate development of an entire ecosystem around the MBaaS smart city mobility API. Separating out the back-end from the other components will, however, require rigorous testing. EMBERS will experiment with the system on two testbeds that are part of the FIRE OneLab facility: the FUSECO Playground, for M2M communications, and FIT IoT-LAB, for wireless sensor devices. EMBERS will host a hackathon and an app challenge to bring in third party developers. The project will also include three demonstrators by third parties via an open call. These activities will contribute back to FIRE by demonstrating successful experimentation by SMEs developing close-to-market products. The project will also conduct real world pilots in two or more cities as a final step in bringing the MBaaS to market.

9.3.1.2. ARMOUR

Title: Large-Scale Experiments of IoT Security & Trust (Project nÂ°688237)

Programm: H2020

Duration: 2015 Dec to 2018

Coordinator: UPMC

Partners:

Synelixis Lyseis Pliroforikis Automatismou & Tilepikoinonion Monoprosopi EPE (Greece)

Smartesting Solutions & Services (France)

Unparallel Innovation, Lda (Portugal)

Easy Global Market (France)

ODIN Solutions (Spain)

Universite Pierre et Marie Curie - Paris 6 (France)

Inria contact: Eric Fleury

ARMOUR will provide duly tested, benchmarked and certified Security & Trust solutions for large-scale IoT using upgraded FIRE large-scale IoT/Cloud testbeds properly-equipped for Security & Trust experimentations. ARMOUR takes the top large-scale FIT IoT-LAB testbed â a FIRE OpenLAB / FIT IoT LAB facility â and enhances it as to enable experimentally-driven research on a key research dimension: large-scale IoT Security & Trust. Presently, no proper installations exist to experiment IoT Security & Trust on large-scale conditions; ARMOUR will develop and install such capability.

9.3.1.3. CLARIN-PLUS

Title: European Research Infrastructure for Language Resources and Technology

Programm: H2020 and part of CLARIN ERIC

Duration: 28 months, from September 2015 to December 2017

Coordinator: Franciska de Jong, CLARIN ERIC

Partners:

CLARIN ERIC,

EKUT,

UCPH,

CUNI

Inria contact: Jean-Philippe Magué

CLARIN-PLUS is dedicated to enhancing CLARIN. Following the recommendations of the 2013 ESFRI Assessment Expert Group, CLARIN-PLUS proposes to accelerate the implementation and to strengthen and consolidate CLARIN in the following areas: 1. The central (technical) hub; 2. The central office; 3. Partnerships with other infrastructures; 4. Outreach; 5. Governance.

9.4. International Initiatives

9.4.1. Inria International Partners

9.4.1.1. Declared Inria International Partners

Taiwan, ACADEMIA SINICA & IIIS. Signature of a MoU in the framework of IoT-LAB.

Algorithms research group of the University of Bergen, Norway. PICS project of CNRS on graph editing problems for analysis and modeling of complex networks.

University of Massachusetts, Amherst, USA.

9.4.1.2. Informal International Partners

University of Namur: Department of Mathematics/Naxys (Belgium). Collaboration with Renaud Lambiotte on dynamical processes on dynamical networks and communities detections.

Aalto University: Department of Biomedical Engineering and Computational Science (Finland). Collaboration with Jari Saramaki on modeling temporal networks and community like modular structure

Central European University (Hungary). Collaboration with János Kertész on modeling complex contagion phenomena.

ISI Foundation (Italy). Collaboration with Laetitia Gauvin on multiplex networks and transportation systems

University of South California (USA). Collaboration with Antonio Ortega on Graph Signal Processing

University of Pennsylvania (USA). Collaboration with Alejandro Ribeiro on Graph Signal Processing

LNCC, Petropolis (Brazil). Collaboration with Arthur Ziviani on Temporal Graph modeling ans algorithms.

College of Information and Computer Sciences at the University of Massachusetts Amherst.

University of California, Santa Cruz (USA). Collaboration with Alexandre Brandwajn on the solutions to multi-server queues.

9.4.2. Participation in Other International Programs

STIC AMSUD MOTIf with Grand Data from Argentina and LNCC from Brazil. ,

The general goal of the MOTIf project is to understand, model, and predict individual behavior embedded in social and technological environments. We propose to work in two directions in order to tackle this challenge: (1) aim to understand spatiotemporal patterns of service usage of individuals to learn when, where, and what people are doing. (2) aim to understand the fine-grained sociodemographic structure of society and see how the demographic characteristics of individuals in a social network correlate with the dynamics of their egocentric and global network evolution.

9.4.2.1. PHC Peridot
Participants: Mohammed Amer, Thomas Begin, Anthony Busson, Isabelle Guerin Lassous.

Framework for Control and Monitoring of Wireless Mesh Networks (WMN) using Software-Defined Networking (SDN). The main objective of this project is propose mechanisms and modifications in the SDN architecture, specifically in the OpenFlow, which allow SDN mechanisms to operate over WMN considering the dynamic network topology that WMN may experience and some other relevant characteristics. The project will involve devising mechanisms for controlling mesh switches through controllers in a wireless environment, which will require developing novel and WMN-specific rules, actions and commands. The project will involve proposing mechanism that consider dynamic environment of WMN along with providing redundancy in the network. Besides, there is a requirement to have an adaptive measurement API for WMN. This is the second objective of our research project. The proposed measurement API will enable the network operators to monitor network traffic over WMN which may be content-specific or host-specific. This is a joint project between DANTE and M. A. Jinnah University, Islamabad. It started in June 2015 and will end in June 2018.

9.5. International Research Visitors

- Maximiliano Bueno Lopez from NTNU visited the Dante team for one week. His visit was part of an ERCIM program on Empirical Mode Decomposition.
- Alexandre Brandwajn, Professor Emeritus, Computer Engineering from UCSC (University of California, Santa Cruz) visited the Dante team for two months during Spring 2017. His visit was funded by ENS Lyon and Milyon labex.
- Cristhian Iza Paredes from UPC (Polytechnic University of Catalonia) visited the Dante team for three months. His visit was part of a Fonds Recherche project of ENS Lyon.
- Isabel Martin Faus from UPC (Polytechnic University of Catalonia) visited the Dante team for one month. Her visit was part of a Fonds Recherche project of ENS Lyon.
- Mukhtiar Bano and Sherjeel Gilani visited the Dante team for two weeks. Their visit was part of a Peridot project (PHC with Pakistan).

- Amir Qayyum visited the Dante team for one week. His visit was part of a Peridot project (PHC with Pakistan).

- Amer Mouawad (University of Bergen) visited the Dante team for one week in November 2017. His visit was part of a PICS project of CNRS with the Algorithms group of the University of Bergen, Norway.

- G. Iniguez from Aalto University visited M. Karsai two times for one week. One of these visits was financed from the CODDDE project, while the other was financed by the Finnish partner.

9.5.1. Visits of International Scientists

9.5.1.1. Internships

- Giuseppe Torrisi from Sapienza University, Erasmus Learning Agreement Student Mobility for Traineeships

9.5.2. Visits to International Teams

9.5.2.1. Research Stays Abroad

- Philippe Nain stayed at UMass from September 2016 to January 2017.

10. Dissemination

10.1. Promoting Scientific Activities

10.1.1. Scientific Events Organisation

10.1.1.1. General Chair, Scientific Chair

- Márton Karsai was co-chair of 6th International Conference on Complex Networks and Their Applications (Complex Networks 20117)

- Márton Karsai was co-chair of the Computational Social Science: from social contagion to collective behaviour Satellite meeting of the CCS'17 conference.

- Márton Karsai was the co-chair of the Machine Learning in Networks Science Satellite meeting of the NetSci'17 conference

- Éric Fleury, was sponsor-chair of 6th International Conferenvce on Complex Networks and Their Applications (Complex Networks 2017)

- Isabelle Guérin Lassous was general chair of the 14th ACM International Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Networks (PE-WASUN 2017).

10.1.1.2. Member of the Organizing Committees

- Éric Guichard was the chair and organiser of he summer school "Cartography and visualisation" [4].

- Éric Guichard was the scientific organiser of the *LaTeX days: "Édition et typographie numériques, épistémologie"* [5] supported by Enssib and the GUTenberg association [6].

- Jean-Pierre Chevrot was member of the Organizing Committee of Congress of the International Assiociation for the Study of Child Language (IASCL 2017)

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[4] http://barthes.enssib.fr/ECV-2017
[5] http://barthes.enssib.fr/LaTeX-2017
[6] https://www.pointypo.com/journees-latex-edition-typographie-numeriques-epistemologie/

10.1.2. Scientific Events Selection

10.1.2.1. Chair of Conference Program Committees

- Márton Karsai is the Chair of Complex Networks 2017

10.1.2.2. Member of the Conference Program Committees

- Éric Fleury was on the PC of the conference ComplexNet, of the Conference on Complex Networks: From Theory to Interdisciplinary Applications, SensorNet 2017 and CoRes 2016.

- Thomas Begin was on the PC of the 43nd IEEE Conference on Local Computer Networks (LCN).

- Isabelle Guérin Lassous was, in 2017, a member of the program committee of the conferences ACM MSWiM, IEEE ICC and Globecom, and ICNC.

- Márton Karsai was, in 2017, a member of the program committee of the conferences COM-PLENET, NetSciCom - IEEE INFOCOM, DAMN! 2017 - IEEE PerCom, MLNS satellite NetSci'17, NetSci'17, CCS'17, Complex Networks 2017

- Jean-Pierre Chevrot was on the PC of the conference Variation in Language Acquisition 3 (ViLA3), Salzburg, Austria.

- Christophe Crespelle was on the PC of DyNo 2017, 3rd International Workshop on Dynamics in and of Networks, Skopje, Macedonia.

10.1.3. Journal

10.1.3.1. Member of the Editorial Boards

- Isabelle Guérin Lassous is member of the editorial boards of Computer Communications (Elsevier), Ad Hoc Networks (Elsevier) and Discrete Mathematics & Computer Science.

- Anthony Busson is member of the editorial boards of Computer Communications (Elsevier).

- Márton Karsai is member of the editorial boards of Advances in Complex Systems (World Scientific).

- Philippe Nain is Editor-in-Chief of Performance Evaluation (Elsevier)

- Márton Karsai was acting as a reviewer for the journals of Nature Communications, PNAS, PRL, PRX, PRE, Scientific Reports, EPJ Data Science, SNAM, EPL, EPJ B, PLoS One, Journal of Statistical Mechanics, Physics Letter A, Advanced in Complex Systems, Journal of Physics: Condensed Matter, Complex Networks, New Journal of Physics, Physica Scripta, Network Science; and for project agencies as ANR, FET-H2020 RIA.

10.1.4. Invited Talks

- Éric Fleury gave a talk at the workshop "Trajectoires et dynamiques des réseaux : approches quantitatives" granted by the CNRS GDR Analyse de réseaux en SHS. The report made by Marianne Humblet et Pierre Mercklé is available online: https://arshs.hypotheses.org/529.

- Éric Fleury gave a talk at the summer school "Cartography and visualisation".

- Éric Fleury gave a talk at MARAMI 2017.

- Éric Guichard gave a talk at the LaTeX days on "Enjeux épistémologiques de l'écriture numérique".

- Éric Guichard gave a talk at the annual Lidilem seminar on "La culture numérique, une autre culture de l'écrit.".

- Éric Guichard gave a talk for the IPL Better-Net on "Expériences géographiques".

- Paulo Gonçalves gave a talk at the Thematic Week on "Graphs, Machine Learning and Signal Processing" (McGill's Bellairs Research Institute).

- Paulo Gonçalves gave a talk at the open days of the *Fédération Rhône-Alpes-Auvergne* on "Statistics and neurosciences".

- Isabelle Guérin Lassous gave a talk at CUST and NUST in Pakistan and a seminar at the LIG laboratory on Wi-Fi association.

- Thomas Begin gave a talk at CUST and NUST in Pakistan on the modeling of DPDK-based virtual switches.

- Jean-Pierre Chevrot gave a talk at the University of Indiana at Bloomington "Interfaces of sociolinguistics: Cognition and massive data".

- Jean-Pierre Chevrot gave a keynote talk at the Language and Perception conference, Bern, Switzerland "Sociolinguistic perception: Linguistic knowledge and social categories".

- Jean-Pierre Chevrot gave a talk at the Laboratoire d'Informatique de Grenoble "Acquisition du langage et usages sociolinguistiques : le social, le cognitif et le réseau"

- Márton Karsai was an invited lecturer at RIO 2017 Summer School on Computer Science, University of Rio Cuarto (13-18 February 2017, Rio Cuarto, Argentina)

- Márton Karsai was an invited lecturer at PhD Course on Network Analysis and Applications, IMe´Ra – Aix-Marseille University (9 April 2017, Marseille, France)

- Márton Karsai gave an invited talk on Socioeconomic dependencies of linguistic patterns in Twitter, Inria Almanach seminar (13 November 2017, Paris, France)

- Márton Karsai gave an invited talk on Spatial networks and human mobility, GoPro 2017, ENS Lyon (13 December 2017, Lyon, France)

10.1.5. Leadership within the Scientific Community

- Éric Fleury is Co-chair of the Networking group ResCom of the CNRS GDR ASR. He is also a member of the scientific committee of the GDR ASR.

- Philippe Nain is the coordinator of the "Strategic Technology Monitoring & Prospective Studies Inria Unit".

- In the context of Inria 50th anniversary, Pascal Guitton, Philippe Nain and François Sillion reflect on Inria's evolution through the decades and present its vision for the future in [19] .

10.1.6. Scientific Expertise

- Isabelle Guérin Lassous is a member of the research committee of the Milyon labex.

- Éric Fleury is member of the Inria Advanced and starting research position jury and junior research position (CR2/CR1)

- Éric Fleury has been an expert for the Fund for Scientific Research - FNRS.

- Éric Fleury has been a member of evaluation panels as part of the French National Research Agencys (ANR) and member of the program committee of the ANR ROSE Challenge (RObotique et Capteurs au Service d'Ecophyto)

- Éric Fleury is member of the Inria Evaluation Committee.

- Éric Guichard is a member of the scientific committee of the 8th Major Societal Challenges: "Innovative, inclusive and adaptive societies" of teh the French National Research Agency [7]

- Éric Guichard is a member of the scientific committee of LASCO Idea Lab of the IMT (LAboratoire Sens et COmpréhension du monde contemporain de l'Institut Mines-Télécom).

- Éric Guichard is a member of the international evaluation board of the doctoral program *Filosofia da Ciencia, Tecnologia, Arte e Sociedade* of the University of Lisbon.

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[7]http://www.agence-nationale-recherche.fr/en/funding-opportunities/work-programme-2017/major-societal-challenges-at-the-frontiers-of-research-components/

- Éric Guichard is the manager of the RAIL (Réseau de l'Atelier Internet Lyonnais), founded in 2017 and supported by IXXI and Enssib. RAIL [8] is a federative open group of research founded in March, 2017. Its main projects are both theoretical and practical, each part feeding the other : establishing critical thought of the Internet, rethinking epistemology ; and, on the other hand, the measurements and the graphic productions in connection with the Internet. These interactions allow the participants of the RAIL to specify the concepts and practices which help to get a good un- derstanding of the Internet, which is defined as a contemporary form of writing. RAIL's key words are : digital territories, representations and spatial productions, imaginary, scientific and digital culture, literate worlds, links between technique and politics.

10.1.7. Research Administration

- Paulo Gonçalves is scientific liaison officer for international relations in Inria Research Centre of Rhône-Alpes.
- Paulo Gonçalves is a member of the executive committee of the Milyon labex and referent for its valorisation committee.
- Isabelle Guérin Lassous is member of the department council of the Computer Science department of Université Lyon 1.
- Isabelle Guérin Lassous is the managing director of the Foundation Blaise Pascal.
- Anthony Busson is member of the Thesis Commission at LIP.
- Anthony Busson is head of the CS department at the IUT.
- Anthony Busson was a HCERES expert member (laboratory LMIA-MIPS - Université de Haute Alsace).
- Éric Fleury is Deputy Scientific Delegate for Inria Grenoble Rhône Alpes
- Éric Fleury is in the in the Executive Committee of the IXXI â Rhône-Alpes Complex Systems Institute.
- Éric Fleury is member of the Council of the LIP laboratory.
- Éric Fleury is a member of the executive committee of the Milyon labex.
- Thomas Begin is an elected member of the Council of the LIP laboratory.
- Jean Pierre Chevrot is member of the steering committee of the IXXI - Rhône-Alpes Complex Systems Institute.
- Márton Karsai is the co-responsible for the M2 master program in Modelling of Complex Systems at ENS Lyon
- Márton Karsai is the elected council member of the Complex System Society (2015-)
- Márton Karsai is the elected member of the steering committee of the IXXI Complex System Institute (2017-)
- Éric Guichartd is a member of the steering committee of the IXXI Complex System Institute
- Jean-Philippe Magué is a member of the executive committee of the IXXI Complex System Institute
- Jean-Philippe Magué is a member of the executive committee of the Aslan Labex, in charge of the language complexity work package.

10.2. Teaching - Supervision - Juries

10.2.1. Teaching

10.2.1.1. Teaching by Éric Fleury

Éric Fleury is Professor at the Computer Science department of ENS de Lyon and holds a Inria chair.

Master: CR15 - Complex Networks, 18H, M2, ENS de Lyon, France

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[8]http://barthes.ens.fr/RAIL or http://barthes.enssib.fr/RAIL/

10.2.1.2. Teaching by Márton Karsai

Márton Karsai is Associate Professor at the Computer Science department of ENS de Lyon and holds a Inria chair.

> Master: CR15 - Complex Networks, 21H, M2, ENS de Lyon, France
>
> Master: Dynamical Processes on Networks, 6H, M2, ENS de Lyon, France
>
> Master: Modeling Social Systems, 9H, M2, ENS de Lyon, France
>
> Bachelor: Interdisciplinary Applications of Complex Networks - Non-specialist course, 6H, L3, ENS de Lyon, France
>
> Master: Complex Networks 16H, Collegio Carlo Alberto, Torino Italy (guest lecturer)

10.2.1.3. Teaching by Paulo Gonçalves

> Engineering school CPE-Lyon (years 3-5): Signal Processing (80 hours/yr)

10.2.1.4. Teaching by Isabelle Guérin Lassous

Professor at Université Claude Bernard Lyon 1 in the Computer Science department since 2006. She lectures at the University.

> Master: "Distributed algorithms", 30h, Master (M1), University Lyon 1, France
>
> Master: "QoS and Multimedia Networks", 20h, Master (M2), University Lyon 1, France
>
> Master: "Wireless Networks", 10h, Master (M2), University Lyon 1, France

10.2.1.5. Teaching by Anthony Busson

Professor at the IUT (Institut Universitaire de Technologie) of Université Claude Bernard Lyon 1 in the computer science department since 2012.

> Master: "MPLS", 6h, Master (M2), University Lyon 1, France
>
> DUT: full service (192h) in networking, operating-systems, and programming.

10.2.1.6. Teaching by Thomas Begin

Assistant Professor at Université Claude Bernard Lyon 1 in the Computer Science department since 2009.

> Master: "Networking", 20h, Master (M1), University Lyon 1, France
>
> Master: "Advanced networks", 20h, Master (M2 SRIV), University Lyon 1, France
>
> Master: "Computer networks", 20h, Bachelor (L3), University Lyon 1, France
>
> Master: "Introduction to Networking", 30h, Master (M2 CCI), University Lyon 1, France
>
> Master: "Distributed systems", 10h, Master (M1), University Lyon 1, France

10.2.1.7. Teaching by Christophe Crespelle

Associate Professor at Université Claude Bernard Lyon 1 in the Computer Science department since 2010.

> Master: "Introduction to Computer Science", 30h, Master (M2), ENS de Lyon, France

10.2.1.8. Teaching by Philippe Nain

> Master: "Network Performance Evaluation", 24h, Master (M2), ENS de Lyon, France

10.2.2. Supervision

> HDR defense: Christophe Crespelle, Structures of Complex Networks and of their Dynamics. September 2017.
>
> PhD defense: Laurent Reynaud, Designing optimized and disruption-tolerant mobility strategies for wireless networks. March 20117, I. Guérin Lassous
>
> PhD defense: Matteo Morini, New tools for understanding the dynamics of social networks, Oct 20117, E. Fleury, P. Jensen and M. Karsai

PhD defense: Huu-Nghi Nguyen, Passive measurement in Software Defined Networks. March 2017, T. Begin and A. Busson and I. Guérin Lassous

Philosophy Master defence: Coline Ferrarato (ENS / EHESS), *Philosophie du logiciel. Dialogue entre Simondon et un objet technique numérique* [9], Eric Guichard and Mathias Girel.

Master defense: Arthur Perret (ENSIB): *Écrire la carte. Les apports intellectuels de la cartographie numérique* [10], Eric Guichard.

Master defense: Raimon Fabregat (ENS de Lyon), *Decomposition of dynamic networks via non-negative matrix factorization for the study of neural assemblies in the brains of rats*, Paulo Gonçalves.

Master defense: Louis Duvivier (ENS de Lyon), *Causal correlations in temporal graphs*, Christophe Crespelle and Marton Karsai.

PhD in progress: Sarra Ben Alaya, Multi-scale classification and analysis of data on networks. Nov. 2015, P. Gonçalves (P. Borgnat, co-advisor). Sarra ended prematurely her PhD in Novembre 2017.

PhD in progress: Esteban Bautista Ruiz, Statistical Graph Signal Processing. P. Gonçalves (P. Abry, co-advisor). Started Sept. 1st, 2016.

PhD in progress: Mohammed Amer, WiFi network management: a SDN approach. January 2015, A. Busson and I. Guérin Lassous

PhD in progress: Lafdal Mohamed Adbelwedoud, Inference of conflict graph in IEEE 802.11 networks. September 2017, A. Busson and I. Guérin Lassous

PhD in progress: Samuel Unicomb, Spreading processes on temporal networks, Oct 2016, E. Fleury and M. Karsai

PhD in progress: Jacobo Levy Abitbol, Information diffusion and language evolution on dynamical social networks, Oct 2016, E. Fleury and M. Karsai

PhD in progress: Marija Stojanova, Performance Modelling of IEEE 802.11 networks , Oct 2016, T. Begin

PhD in progress: Sicheng Dai, Dynamic Multilayer Network Modelling

PhD in progress: Gaetan Frusque, *Modal Decompositions of Dynamic Graphs : Application in Neurosciences*, P. Gonçalves (P. Borgnat, co-advisor). Started October 1st, 2017.

PhD in progress: Rémy Grünblatt, Controlled mobility for UAV networks, October 2017, I. Guérin Lassous and O. Simonin.

10.2.3. Juries

- Isabelle Guérin Lassous was a reviewer of the HDR examination boards of Enrico Natalizio (UTC), Sara Alouf (Inria) and Gentian Jakllari (University Toulouse).

- Isabelle Guérin Lassous was a member of the HDR examination boards of Claire Goursaud (Insa Lyon), Christophe Crespelle (University Lyon 1) and Laure Gonnord (University Lyon 1).

- Isabelle Guérin Lassous was a reviewer of the Ph.D thesis examination board of Quentin Vey (University Toulouse), Diego Neves da Hora (UPMC) and Tran Anh Quang Pham (University Rennes 1).

- Isabelle Guérin Lassous was a member of the Ph.D thesis examination board of Su Qiankun (University Toulouse).

- Anthony Busson was member and reviewer of the Ph.D of Mohamed Labraoui entitled "Les réseaux maillés sans fils assistés par le SDN" (LIP-6 December 2017).

- Anthony Busson was member and reviewer of the Ph.D of Luis David Alvarez Corrales "Communications coopératives pour des très grands réseaux cellulaires" (Telecom Paris Tech November 2017).

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[9]http://barthes.enssib.fr/travaux/Coline-Ferrarato-masterphilologiciel.pdf
[10]http://barthes.enssib.fr/travaux/Epistemo-carto-num-Perret.pdf

- Anthony Busson was member and reviewer of the Ph.D of Mandimby Nirina Ranaivo Rakoton-dravelona "Utilisation d'une autostructuration pour un routage hiérarchique géographique dans les réseaux sans fil ad hoc" (Université de la Réunion - Juillet 2017).

- Éric Fleury was member and reviewer of the HdR of Jean-Philippe Cointet titled "La cartographie des traces textuelles comme méthodologie d'enquête en science sociales"

- Éric Fleury was member of the PhD examination board of Mattéo Morini.

- Paulo Gonçalves was reviewer of the PhD dissertation of Lionnel Martin (EPFL) on "Robust and Efficient Data Clustering with Signal Processing on Graphs".

- Christophe Crespelle was member and reviewer of the Ph.D of Kaoutar Ghazi titled "Heuristics and Conjectures about the 2-dimension of partial orders", University Clermont Auvergne, September 2017.

- Márton Karsai was member of the Ph.D of Sebastien Lerique on "Epidemiology of Representations: An Empirical Approach" (École des Hautes Études en Sciences Sociales, Paris, October 2017).

- Márton Karsai was opponent of the Ph.D of Pietro della Briotta Parolo on "Analysis of Cumulative and Temporal Patterns in Science" (Aalto University, School of Science, Espoo Finland, December 2017).

10.3. Popularization

Isabelle Guérin Lassous is the managing director of the Foundation Blaise Pascal. The objectives of the foundation are to promote mathematics and computer science and to attract young people to scientific fields like computer science and mathematics. The actions of the FBP focus on:

- a support to actors that promote mathematics and computer science via allocated funding based on call of proposals;

- a structuring of actors to increase the impacts of their actions, to coordinate the efforts and to share experiences;

- a development of innovative experiences via summer camps and clubs of mathematics and computer science.

11. Bibliography

Major publications by the team in recent years

[1] T. BEGIN, B. BAYNAT, I. GUÉRIN LASSOUS, T. ABREU. *Performance analysis of multi-hop flows in IEEE 802.11 networks: A flexible and accurate modeling framework*, in "Performance Evaluation", February 2016, vol. 96, pp. 12–32 [*DOI :* 10.1016/J.PEVA.2015.12.003], https://hal.archives-ouvertes.fr/hal-01246822

[2] A. BRANDWAJN, T. BEGIN. *Multi-server preemptive priority queue with general arrivals and service times*, in "Performance Evaluation", 2017 [*DOI :* 10.1016/J.PEVA.2017.08.003], https://hal.inria.fr/hal-01581118

[3] A. T. GIANG, A. BUSSON, A. LAMBERT, D. GRUYER. *Spatial capacity of IEEE 802.11p based VANET: models, simulations and experimentations*, in "IEEE Transactions on Vehicular Technology", January 2015, 15 p. [*DOI :* 10.1109/TVT.2015.2474156], https://hal.archives-ouvertes.fr/hal-01217564

[4] B. GIRAULT, P. GONÇALVES, E. FLEURY. *Translation on Graphs: An Isometric Shift Operator*, in "IEEE Signal Processing Letters", December 2015, vol. 22, n° 12, pp. 2416 - 2420 [*DOI :* 10.1109/LSP.2015.2488279], https://hal.inria.fr/hal-01221562

[5] M. Karsai, G. Iñiguez, K. Kaski, J. Kertész. *Complex contagion process in spreading of online innovation*, in "Journal of the Royal Society Interface", October 2014, vol. 11, 20140694 p. [*DOI :* 10.1098/rsif.2014.0694], https://hal.inria.fr/hal-01100359

[6] T. Obadia, R. Silhol, L. Opatowski, L. Temime, J. Legrand, A. C. Thiébaut, J.-L. Herrmann, E. Fleury, D. Guillemot, P.-Y. Boelle. *Detailed Contact Data and the Dissemination of Staphylococcus aureus in Hospitals*, in "PLoS Computational Biology", 2015, vol. 11, n° 3, e1004170 p. , on behalf of the I-Bird study Group [*DOI :* 10.1371/journal.pcbi.1004170], http://hal.upmc.fr/hal-01134050

[7] M. Tizzoni, K. Sun, D. Benusiglio, M. Karsai, N. Perra. *The Scaling of Human Contacts in Reaction-Diffusion Processes on Heterogeneous Metapopulation Networks*, in "Scientific Reports", October 2015, vol. 5, n° 15111, https://hal.inria.fr/hal-01100351

Publications of the year

Doctoral Dissertations and Habilitation Theses

[8] C. Crespelle. *Structures of Complex Networks and of their Dynamics*, Université Claude Bernard Lyon 1, September 2017, Habilitation à diriger des recherches, https://hal.archives-ouvertes.fr/tel-01672082

[9] M. Morini. *Tools for Understanding the Dynamics of Social Networks*, Université de Lyon, September 2017, https://tel.archives-ouvertes.fr/tel-01622941

[10] H.-N. Nguyen. *Passive measurement in Software Defined Networks*, Université de Lyon, March 2017, https://tel.archives-ouvertes.fr/tel-01538435

[11] L. Reynaud. *Designing optimized and disruption-tolerant mobility strategies for wireless networks*, Université de Lyon, March 2017, https://tel.archives-ouvertes.fr/tel-01540925

Articles in International Peer-Reviewed Journals

[12] C. Bellanger, J.-P. Chevrot, E. Spinelli. *Gender context effects in noun recognition: grammatical cues or co-occurrence effects?*, in "Language, Cognition and Neuroscience", June 2017, vol. 32, n° 9, pp. 1204 - 1209 [*DOI :* 10.1080/23273798.2017.1335876], https://hal.inria.fr/hal-01674552

[13] L. Bounegru, T. Venturini, J. Gray, M. Jacomy. *Narrating Networks: Exploring the Affordances of Networks as Storytelling Devices in Journalism*, in "Digital Journalism ", 2017, vol. 5, n° 6, pp. 699-730, https://arxiv.org/abs/1801.01322 [*DOI :* 10.1080/21670811.2016.1186497], https://hal.archives-ouvertes.fr/hal-01672285

[14] A. Brandwajn, T. Begin. *Multi-server preemptive priority queue with general arrivals and service times*, in "Performance Evaluation", 2017 [*DOI :* 10.1016/j.peva.2017.08.003], https://hal.inria.fr/hal-01581118

[15] A. Brandwajn, T. Begin, H. Castel-Taleb, T. Atmaca. *A study of systems with multiple operating levels, probabilistic thresholds and hysteresis*, in "IEEE Transactions on Parallel and Distributed Systems", 2017, forthcoming [*DOI :* 10.1109/TPDS.2017.2773496], https://hal.inria.fr/hal-01670974

[16] L. Buson, A. Nardy, D. Muller, J.-P. Chevrot. *The sociolinguistic repetition task: A new paradigm for exploring the cognitive coherence of language varieties*, in "Topics in cognitive science", 2018, forthcoming, https://hal.inria.fr/hal-01674578

[17] C. DUGUA, A. NARDY, L. LIÉGEOIS, J.-P. CHEVROT, D. CHABANAL. *L'acquisition des liaisons après les clitiques préverbaux est-elle spécifique ? Apport d'une expérimentation à grande échelle*, in "Journal of French Language Studies", March 2017, vol. 27, n⁰ 01, pp. 73 - 86 [*DOI :* 10.1017/S0959269516000387], https://hal.inria.fr/hal-01674595

[18] É. GUICHARD. *What the internet does to writing*, in "Revue Belge de psychanalyse", October 2017, vol. 71, pp. 1-7, Cf. http://www.psychanalyse.be/revue/page.php?article=71r1, https://hal.archives-ouvertes.fr/hal-01672730

[19] P. GUITTON, P. NAIN, F. X. SILLION. *Inria: From Cold War Computing to Digital Sciences*, in "IEEE Computer Society", August 2017, vol. 50, n⁰ 8, pp. 8-12 [*DOI :* 10.1109/MC.2017.3001238], https://hal.inria.fr/hal-01614162

[20] I. GUÉRIN LASSOUS, I. FAUS MARTIN, L. URQUIZA AGUIAR, M. AGUILAR IGARTUA. *Transient analysis of idle time in VANETs using Markov-reward models*, in "IEEE Transactions on Vehicular Technology", 2017, forthcoming, https://hal.inria.fr/hal-01671587

[21] I. GUÉRIN LASSOUS, L. REYNAUD. *Improving the Performance of Challenged Networks with Controlled Mobility*, in "Journal on Mobile Networks and Applications (MONET)", January 2017, https://hal.inria.fr/hal-01671596

[22] M. LATAPY, E. ROTENBERG, C. CRESPELLE, F. TARISSAN. *Rigorous Measurement of the Internet Degree Distribution*, in "Complex Systems", 2017, vol. 26, n⁰ 1, https://hal.archives-ouvertes.fr/hal-01500371

[23] K. REIN, T. VENTURINI. *Ploughing digital landscapes: How Facebook influences the evolution of live video streaming*, in "New Media and Society", 2018, forthcoming [*DOI :* 10.1177/1461444817748954], https://hal.archives-ouvertes.fr/hal-01672284

[24] H. SOLEIMANI, T. BEGIN, A. BOUKERCHE. *Safety Message Generation Rate Adaptation in LTE-based Vehicular Networks*, in "Computer Networks", April 2017, 11 p. [*DOI :* 10.1016/J.COMNET.2017.04.054], https://hal.inria.fr/hal-01549606

[25] T. VENTURINI, M. JACOMY, A. MEUNIER, B. LATOUR. *An unexpected journey: A few lessons from sciences Po médialab's experience*, in "Big Data & Society", 2017, vol. 4, n⁰ 2 [*DOI :* 10.1177/2053951717720949], https://hal.archives-ouvertes.fr/hal-01670177

Invited Conferences

[26] J.-P. CHEVROT. *Interfaces of sociolinguistics: Cognition and massive data*, in "Indiana University's Horizons of Knowledge lecture", Bloomington, United States, October 2017, https://hal.inria.fr/hal-01676775

[27] J.-P. CHEVROT. *Sociolinguistic perception: Linguistic knowledge and social categories*, in "Language and perception", Berne, Switzerland, September 2017, https://hal.inria.fr/hal-01676776

International Conferences with Proceedings

[28] E. BAUTISTA, S. DE NIGRIS, P. ABRY, K. AVRACHENKOV, P. GONÇALVES. *Lévy Flights for Graph Based Semi-Supervised Classification.* , in "26th colloquium GRETSI", Juan-Les-Pins, France, GRETSI, 2017 - Proceeding of the 26th colloquium, September 2017, https://hal.inria.fr/hal-01586760

[29] S. DE NIGRIS, E. BAUTISTA, P. ABRY, K. AVRACHENKOV, P. GONÇALVES. *Fractional Graph-based Semi-Supervised Learning*, in "EUSIPCO 2017 - 25th European Signal Processing Conference", Kos Island, Greece, August 2017, https://hal.inria.fr/hal-01586767

[30] B. GIRAULT, S. S. NARAYANAN, A. ORTEGA, P. GONÇALVES, E. FLEURY. *GRASP: A Matlab Toolbox for Graph Signal Processing*, in "2017 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)", New Orleans, United States, March 2017, demo [*DOI :* 10.1109/ICASSP.2017.8005300], https://hal.inria.fr/hal-01424804

[31] J. LEVY ABITBOL, M. KARSAI, J.-P. MAGUÉ, J.-P. CHEVROT, E. FLEURY. *Socioeconomic dependencies of linguistic patterns in Twitter: a multivariate analysis*, in "The Web Conference 2018", Lyon, France, April 2018, https://hal.inria.fr/hal-01674620

[32] P. MANGOLD, Y. LÉO, J.-P. CHEVROT, E. FLEURY, M. KARSAI, J.-P. MAGUÉ, A. NARDY, J. PEUVERGNE. *Optional realization of the French negative particule (ne) on Twitter: Can big data reveal new sociolinguistic patterns?* , in "ICLAVE 9 2017 - International Conference on Language Variation in Europe", Malaga, Spain, June 2017, https://hal.inria.fr/hal-01456302

[33] M. STOJANOVA, T. BEGIN, A. BUSSON. *Conflict graph-based Markovian model to estimate throughput in unsaturated IEEE 802.11 networks*, in "IEEE International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks, WiOpt 17", Paris, France, May 2017, https://hal.archives-ouvertes.fr/hal-01493276

[34] Z. SU, B. BAYNAT, T. BEGIN. *A new model for DPDK-based virtual switches*, in "IEEE Conference on Network Softwarization (IEEE NetSoft 2017)", Bologna, Italy, July 2017, https://hal.archives-ouvertes.fr/hal-01493275

[35] Z. SU, T. BEGIN, B. BAYNAT. *Towards including batch services in models for DPDK-based virtual switches*, in "IEEE Global Information Infrastructure and Networking Symposium (GIIS 2017)", Saint Pierre, France, October 2017, https://hal.inria.fr/hal-01632879

Conferences without Proceedings

[36] Y. BEZINSKA, I. NOVAKOVA, J.-P. CHEVROT. *Grammaticalization of the French and Bulgarian Causative Constructions. Some Diachronic and Developmental Aspects*, in "La linguistique contrastive : méthodologies, applications et perspectives", Lublin, Poland, November 2017, https://hal.inria.fr/hal-01675954

[37] L. BUSON, A. NARDY, A. SOUQUE, E. CHARLES, J.-P. CHEVROT. *Acquisition of sociolinguistic style – Exploring how children process variation*, in "Many Paths to Language (MPaL)", Nijmegen, Netherlands, October 2017, https://hal.inria.fr/hal-01675950

[38] A. BUSSON, E. FLEURY, N. M. PHUNG. *A simple method to infer Wi-Fi conflict graph*, in "Rencontres Francophones sur la Conception de Protocoles, l'Évaluation de Performance et l'Expérimentation des Réseaux de Communication", Quiberon, France, May 2017, https://hal.archives-ouvertes.fr/hal-01518742

[39] J.-P. CHEVROT, V. LACOSTE. *Constraints on the acquisition of sociolinguistic variation in monolingual and multilingual contexts*, in "14th International Congress for the Study of Child Language", Lyon, France, July 2017, https://hal.inria.fr/hal-01675039

[40] J.-P. CHEVROT, A. NARDY, A. GHIMENTON, E. FLEURY, M. KARSAI. *Language acquisition and sociolinguistic variation: the social, the cognitive, and the network*, in "Variation in Language Acquisition (ViLA3)", Salzburg, Germany, University of Salzburg, February 2017, https://hal.inria.fr/hal-01456304

[41] J.-P. CHEVROT, R. SAMANTHA, S. WAUQUIER. *Liaison acquisition, theoretical issues and available results*, in "14th International Congress for the Study of Child Language", Lyon, France, July 2017, https://hal.inria.fr/hal-01675040

[42] C. CRESPELLE, D. LOKSHTANOV, T. H. D. PHAN, E. THIERRY. *Faster and Enhanced Inclusion-Minimal Cograph Completion*, in "11th Annual International Conference on Combinatorial Optimization and Applications – COCOA 2017", Shanghai, China, December 2017, https://hal.archives-ouvertes.fr/hal-01672076

[43] R. GAUTIER, J.-P. CHEVROT. *A longitudinal analysis of personal network and of the development of sociolinguistic competence during a study abroad*, in "18th World Congress of Applied Linguistic: Innovation and Epistemological Challenges (AILA 2017)", Rio de Janeiro, Brazil, July 2017, https://hal.inria.fr/hal-01676772

[44] J. LEVY ABITBOL, M. KARSAI, J.-P. CHEVROT, J.-P. MAGUÉ, E. FLEURY. *How social, economic and demographic forces shape linguistic variation on Twitter*, in "POPLANG 2017 - Workshop Population effects on languages: Modelling population dynamics and language transmission from the perspective of language learning, contact and change", Lyon, France, November 2017, https://hal.inria.fr/hal-01675037

[45] J. LEVY ABITBOL, M. KARSAI, J.-P. CHEVROT, J.-P. MAGUÉ, E. FLEURY. *Socioeconomic and network dependencies of linguistic patterns in Twitter*, in "COMPLEX NETWORKS 2017 - 6th International Conference on Complex Networks and Their Applications", Lyon, France, November 2017, https://hal.inria.fr/hal-01674632

[46] J. LEVY ABITBOL, M. KARSAI, J.-P. MAGUÉ, J.-P. CHEVROT, E. FLEURY. *Optional realisation of the French negative particle (ne) on Twitter: Can big data reveal new sociolinguistic patterns?* , in "CCS 2017 - Conference on Complex Systems", Cancun, Mexico, September 2017, https://hal.inria.fr/hal-01675038

[47] M. MORINI, S. DE NIGRIS. *A Simple Model of Coevolution for Macroscopic and Microscopic Levels*, in "International Conference on Synthetic Populations", Lucca, Italy, IMT School For Advanced Studies, February 2017, https://hal.inria.fr/hal-01475323

[48] A. NARDY, J.-P. CHEVROT, E. FLEURY, M. KARSAI. *Social interactions and language development at preschool: benefits from interdisciplinarity and big data*, in "Many Paths to Language (MPaL)", Nimègue, Netherlands, October 2017, https://hal.inria.fr/hal-01676764

[49] C. ROSSI, J.-P. CHEVROT, I. SAHAKYAN, C. BATAILLER. *Teaching complex grammar: Do less advanced learners prefer examples?*, in "Thinking, Doing, Learning Conference", Munich, Germany, April 2017, https://hal.inria.fr/hal-01675274

Scientific Books (or Scientific Book chapters)

[50] C. CHERIFI, H. CHERIFI, M. KARSAI, M. MUSOLESI. *Complex Networks & Their Applications VI*, Springer, 2017, XXV, 1288 p. [*DOI :* 10.1007/978-3-319-72150-7], https://hal.inria.fr/hal-01675087

[51] J.-P. CHEVROT, A. GHIMENTON. *Bilingualism and bidialectalism*, in "The Cambridge Handbook of Bilingualism", L. ORTEGA, A. DE HOUWER (editors), Cambridge University Press, 2018, forthcoming, https://hal.inria.fr/hal-01674604

[52] É. GUICHARD. *La philosophie des techniques revue à l'aune de l'internet et du numérique*, in "Le numérique en débat. Des nombres, des machines et des hommes", G. CHAZAL (editor), Editions Universitaires de Dijon, September 2017, pp. 173-189, https://hal.archives-ouvertes.fr/hal-01672737

[53] É. GUICHARD. *L'histoire et l'écriture numérique. Approche technique, politique, épistémologique*, in "Histoire et numérique", S. LAMASSÉ, G. BONNOT (editors), Presses de la Sorbonne, 2018, pp. 1-18, forthcoming, https://hal.archives-ouvertes.fr/hal-01673099

[54] É. GUICHARD. *Proximités intellectuelles entre François Dagognet et Jack Goody à l'heure de l'internet*, in "Science, technique, société: hommage à François Dagognet", Presses de l'Université Libano-française, 2018, pp. 1-16, forthcoming, https://hal.archives-ouvertes.fr/hal-01672738

[55] G. IÑIGUEZ, Z. RUAN, K. KASKI, J. KERTÉSZ, M. KARSAI. *Service adoption spreading in online social networks*, in "Spreading Dynamics in Social Systems", 2018, https://hal.inria.fr/hal-01675084

[56] M. KARSAI, H.-H. JO, K. KASKI. *Bursty Human Dynamics*, Springer, January 2018, XIV, 121 p. [*DOI :* 10.1007/978-3-319-68540-3], https://hal.inria.fr/hal-01675082

[57] M. KARSAI, N. PERRA. *Control Strategies of Contagion Processes in Time-Varying Networks*, in "Temporal Network Epidemiology", N. MASUDA, P. HOLME (editors), Springer, 2017 [*DOI :* 10.1007/978-981-10-5287-3], https://hal.inria.fr/hal-01675083

[58] N. TREMBLAY, P. GONÇALVES, P. BORGNAT. *Design of graph filters and filterbanks*, in "Cooperative and Graph Signal Processing", 2018, forthcoming, https://hal.inria.fr/hal-01675375

[59] T. VENTURINI, L. BOUNEGRU, M. JACOMY, J. GRAY. *How to Tell Stories with Networks: Exploring the Narrative Affordances of Graphs with the Iliad*, in "Datafied Society", M. T. SCHÄFER, K. VAN ES (editors), Amsterdam University Press, 2017, https://hal.archives-ouvertes.fr/hal-01672295

[60] T. VENTURINI, M. JACOMY, L. BOUNEGRU, J. GRAY. *Visual Network Exploration for Data Journalists*, in "The Routledge Handbook to Developments in Digital Journalism Studies (forthcoming)", Routledge, 2018, forthcoming, https://hal.archives-ouvertes.fr/hal-01672282

[61] T. VENTURINI, A. K. MUNK, M. JACOMY. *Actor-Network VS Network Analysis VS Digital Networks Are We Talking About the Same Networks?*, in "DigitalSTS: A Handbook and Fieldguide", 2018, forthcoming, https://hal.archives-ouvertes.fr/hal-01672289

[62] T. VENTURINI, A. MUNK, A. MEUNIER. *Data-Sprinting: a Public Approach to Digital Research*, in "Interdisciplinary Research Methods", 2018, forthcoming, https://hal.archives-ouvertes.fr/hal-01672288

[63] T. VENTURINI. *The Fish Tank Complex of Social Modelling on Space and Time in Understanding Collective Dynamics*, in "Frontiers of Social Science: A Philosophical Reflection", 2018, forthcoming, https://hal.archives-ouvertes.fr/hal-01672283

[64] L. WENG, M. KARSAI, N. PERRA, F. MENCZER, A. FLAMINI. *Attention on Weak Ties in Social and Communication Networks*, in "Spreading Dynamics in Social Systems", 2018, https://hal.inria.fr/hal-01675086

Research Reports

[65] A. BRANDWAJN, T. BEGIN. *Multi-server preemptive priority queue with general arrivals and service times*, Inria - Research Centre Grenoble – Rhône-Alpes, April 2017, nᵒ RR-9065, https://hal.inria.fr/hal-01515328

[66] A. BRANDWAJN, T. BEGIN, H. CASTEL-TALEB, T. ATMACA. *A Study of Systems with Multiple Operating Levels, Soft Thresholds and Hysteresis*, Inria - Research Centre Grenoble – Rhône-Alpes, April 2017, nᵒ RR-9064, https://hal.inria.fr/hal-01515312

[67] B. JIANG, P. NAIN, D. TOWSLEY, S. GUHA. *On a Class of Stochastic Multilayer Networks*, Inria Grenoble Rhône-Alpes, Université de Grenoble ; Dante, 2018, https://hal.inria.fr/hal-01669368

Scientific Popularization

[68] L. BOUNEGRU, J. GRAY, T. VENTURINI, M. MAURI. *A Field Guide to Fake News and other Information Disorders*, January 2018, https://hal.archives-ouvertes.fr/hal-01672287

Other Publications

[69] J.-P. BASSINO, P. JENSEN, M. MORINI. *Network analysis of Japanese global business using quasi-exhaustive micro-data for Japanese overseas subsidiaries*, June 2017, working paper or preprint, https://hal.inria.fr/hal-01558763

[70] M. DEHGHAN, W. CHU, P. NAIN, D. TOWSLEY, Z.-L. ZHANG. *Sharing Cache Resources among Content Providers: A Utility-Based Approach*, December 2017, working paper or preprint, https://hal.inria.fr/hal-01672961

[71] É. GUICHARD. *La science et l'enseignement supérieur face au pouvoir des algorithmes : La science contaminée par les croyances numériques*, November 2017, Version brève publiée le 30 décembre 2017 dans le journal Libération. pages 22-23. Cf. http://www.liberation.fr/debats/2017/12/29/la-science-contaminee-par-les-croyances-numeriques_1619541, https://hal.archives-ouvertes.fr/hal-01677020

[72] B. JIANG, P. NAIN, D. TOWSLEY. *On the Convergence of the TTL Approximation for an LRU Cache under Independent Stationary Request Processes* , December 2017, working paper or preprint, https://hal.inria.fr/hal-01673272

[73] M. KIVELÄ, J. CAMBE, J. SARAMÄKI, M. KARSAI. *Mapping temporal-network percolation to weighted, static event graphs*, October 2017, https://arxiv.org/abs/1709.05647 - 12 pages, 3 figures, https://hal.inria.fr/hal-01610945

[74] J. LEVY ABITBOL, J.-P. CHEVROT, M. KARSAI, J.-P. MAGUÉ, Y. LÉO, A. NARDY, E. FLEURY. *The study of optional realization of the French negative particle (ne) on Twitter: Is Sociolinguistics compatible with the Big Data?* , November 2017, New Ways of Analyzing Variation 46 (NWAV46), Poster, https://hal.inria.fr/hal-01676770

[75] M. MORINI, P. FLANDRIN, E. FLEURY, T. VENTURINI, P. JENSEN. *Revealing evolutions in dynamical networks*, July 2017, working paper or preprint, https://hal.inria.fr/hal-01558219

[76] S. UNICOMB, G. IÑIGUEZ, M. KARSAI. *Threshold driven contagion on weighted networks*, October 2017, https://arxiv.org/abs/1707.02185 - 24 pages, 11 figures, https://hal.inria.fr/hal-01610938

References in notes

[77] R. ALBERT, A.-L. BARABÁSI. *Statistical mechanics of complex networks*, in "Reviews of Modern Physics", 2002, vol. 74

[78] A.-L. BARABÁSI. *The origin of bursts and heavy tails in human dynamics*, in "Nature", 2005, vol. 435, 207 p.

[79] R. R. COIFMAN, S. LAFON, A. B. LEE, M. MAGGIONI, B. NADLER, F. WARNER, S. W. ZUCKER. *Geometric diffusions as a tool for harmonic analysis and structure definition of data: Diffusion maps*, in "PNAS", 2005, vol. 102, n⁰ 21, pp. 7426-7431

[80] W. J. FITZGERALD, R. L. SMITH, A. T. WALDEN. *Nonlinear and Nonstationary Signal Processing*, Cambridge University Press, Cambridge, 2001

[81] S. FORTUNATO. *Community detection in graphs*, in "Physics Reports", 2010, vol. 486, pp. 75-174

[82] G. A. GALLARDO, B. BAYNAT, T. BEGIN. *Performance modeling of virtual switching systems*, in "IEEE 24th International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems, MASCOTS 2016", London, United Kingdom, September 2016, https://hal.archives-ouvertes.fr/hal-01387726

[83] P. HOLME, J. SARAMÄKI. *Temporal networks*, in "Physics Reports", 2012, vol. 519, pp. 97-125

[84] M. KARSAI, M. KIVELÄ, R. K. PAN, K. KASKI, J. KERTÉSZ, A.-L. BARABÁSI, J. SARAMÄKI. *Small But Slow World: How Network Topology and Burstiness Slow Down Spreading*, in "Phys. Rev. E", 2011, vol. 83

[85] M. KARSAI, N. PERRA, A. VESPIGNANI. *A. Random Walks and Search in Time-Varying Networks*, 2013, arXiv:1303.5966

[86] M. KIVELÄ, R. K. PAN, K. KASKI, J. KERTÉSZ, J. SARAMÄKI, M. KARSAI. *Multiscale Analysis of Spreading in a Large Communication Network*, in "J. Stat. Mech.", 2012

[87] L. KOVANEN, M. KARSAI, K. KASKI, J. KERTÉSZ, J. SARAMÄKI. *Temporal motifs in time-dependent networks*, in "J. Stat. Mech.", 2011

[88] G. KRINGS, M. KARSAI, S. BERNHARDSSON, V. BLONDEL, J. SARAMÄKI. *Effects of time window size and placement on the structure of an aggregated communication network*, in "EPJ Data Science", 2012, vol. 1, n⁰ 4

[89] Z. Q. LUO, M. GASTPAR, J. LIU, A. SWAMI. *Distributed Signal Processing in Sensor Networks*, in "IEEE Signal Processing Mag", 2006, vol. 23

[90] B. A. MILLER, N. T. BLISS, P. J. WOLFE. *Towards Signal Processing Theory for Graphs and Non-Euclidian Data*, in "ICASSP", Dallas, IEEE, 2010

[91] G. MIRITELLO, E. MORO, R. LARA. *Dynamical strength of social ties in information spreading*, in "Phys. Rev. E", 2011, vol. 83

[92] M. E. J. NEWMAN. *Networks: An Introduction,*, Oxford University Press, 2010

[93] N. PERRA, A. BARONCHELLI, D. MOCANU, B. GONÇALVES, R. PASTOR-SATORRAS, A. VESPIGNANI. *Random Walks and Search in Time-Varying Networks*, in "Physical review letters", 2012, vol. 109

[94] N. PERRA, B. GONÇALVES, R. PASTOR-SATORRAS, A. VESPIGNANI. *Activity driven modeling of time varying networks*, in "Scientific Reports", 2012, vol. 2, n° 469

[95] D. SHUMAN, S. NARANG, P. FROSSARD, A. ORTEGA, P. VANDERGHEYNST. *The emerging field of signal processing on graphs: Extending high-dimensional data analysis to networks and other irregular domains*, in "Signal Processing Magazine, IEEE", May 2013, vol. 30, n° 3, pp. 83 - 98

[96] G. TIBELY, L. KOVANEN, M. KARSAI, K. KASKI, J. KERTÉSZ, J. SARAMÄKI. *Communities and beyond: mesoscopic analysis of a large social network with complementary methods*, in "Phys. Rev. E", 2011, vol. 83

[97] Q. WANG, E. FLEURY, T. AYNAUD, J.-L. GUILLAUME. *Communities in evolving networks: definitions, detection and analysis techniques*, in "Dynamics of Time Varying Networks", N. GANGULY, A. MUKHERJEE, B. MITRA, F. PERUANI, M. CHOUDHURY (editors), Springer, 2012, http://hal.inria.fr/hal-00746195

[98] A. S. WILLSKY. *Multiresolution Statistical Models for Signal and Image Processing*, in "Proceedings of the IEEE", 2002, vol. 90

[99] K. ZHAO, M. KARSAI, G. BIANCONI. *Entropy of Dynamical Social Networks*, in "PLoS ONE", 2011, vol. 6, n° 12