

Ecodep Conference 2021, Networks Reconstruction

June 22-24, 2022

<http://doukhan.u-cergy.fr/ecodep.html>

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<http://doukhan.u-cergy.fr/conference2022.html>

The conference will be totally free but **registration** is mandatory. Please register as soon as possible, other informations about AGM may be consulted online <https://cyagm.cyu.fr/ecodep-activities>.

The conference is essentially face to face so we suggest the link <https://www.traveldoc.aero/> to determine wether you are allowed to travel to the conference place.

After/During all this pandemic time our idea was to propose a real physical conference so that the organisation committee will do his very best to welcome you in the best conditions if your institution allows for it.

Six sessions of around 3 hours will aim at organising adequate orientations of the reconstruction networks part of the project ECODEP. One of the session will be include posters, each poster may be presented with a few slides in the conference room.

The conference will be online and physical: one may attend the talk through a link to be found on the [ecodep calendar in the homepage https://doukhan.u-cergy.fr/conference2022.html](https://doukhan.u-cergy.fr/conference2022.html) of the conference.

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1 Schedule

Paris Time is indicated and the duration of talks does include questions.
The online abstracts book version will be updated and will include the correct information.
Small changes in the schedule are always possible.

- June 22

- Morning

- * 10:00-10:40 **Camille Coron** (University Paris-Saclay, Orsay)
 - * 10:40-11:20 **Marie-Pierre Etienne** (Agroparitech, Rennes)
 - * 11:20-12:00 **Coffee.**
 - * 12:00-12:40 **Guillaume Franchi** (ENSAI, Rennes)

- Afternoon

- * 14:40-15:30 **Pablo Marquet** (Catholic University, Santiago)
 - * 15:30-16:10 **Daniel Valencia** (Catholic University, Las Cruces, Chile)
 - * 16:10-16:50 **Mara Freilich** (Scripps Institution of Oceanography, University of California San Diego)
 - * 16:50-17:30 **Posters**
 - * 17:30-20:15 **Welcome cocktail**

- June 23

- Morning

- * 10:00-10:40 **Pierre Jacob** (ESSEC, Cergy)
 - * 10:40-11:20 **Pierre Alquier** (Riken AIP, Tokyo)
 - * 11:20-12:00 **Coffee**
 - * 12:00-12:40 **Guilherme Ost** (UFRJ, Rio de Janeiro)

- Afternoon

- * 14:40-15:30 **Frederico Maddanu** (CY University)
 - * 15:30-16:10 **Anton Klimovsky** (University of Stuttgart)
 - * 16:10-16:40 **Coffee.**
 - * 16:40-17:20 **Julien Randon Furling** (University Panthéon Sorbonne, Paris)
 - * 17:20-18:00 **Catherine Aaron** (University Clermont-Auvergne)
 - * 20:00 **Conference dinner l'Entracte des Gobelins** (please register)

- June 24

- Morning

- * 10:00-10:40 **Jean-Marc Bardet** (Paris-Panthéon Sorbonne)
 - * 10:40-11:20 **Denys Pommeret** (Marseille University and ISFA Lyon)
 - * 11:20-11:40 **Coffee**
 - * 11:40-12:20 **Felix Cheysson** (LPSM, Paris)
 - * 12:20-13:00 **Arnaud Dragicevic** (INRAE, Aubière and CIRANO, Montréal)

2 Abstracts

- **Catherine Aaron** (University of Clermont Auvergne)

Local Convex Hull density, support and level set estimation

In "A local nearest-neighbor convex-hull construction of home ranges and utilization distribution", Getz and Wilmer proposed an algorithm for home range and utilization distribution (core area) estimation. We aim to theoretically study this method. With Olivier Bodart, in 2016 we proved that the home range (support) estimator is consistent (and minimax when regularity conditions are satisfied). More recently, we proved, with Ricardo Fraiman, that the core area (level set) estimator has to be slightly modified to achieve minimax rates. In the talk we will present the initial algorithm, the proposed modifications, why they are expected to improve the initial method and the associated asymptotic results.

- **Pierre Alquier** (Riken AIP, Tokyo)

A Theoretical Analysis of Catastrophic Forgetting through the NTK Overlap Matrix

Continual learning (CL) is a setting in which an agent has to learn from an incoming stream of data during its entire lifetime. Although major advances have been made in the field, one recurring problem which remains unsolved is that of Catastrophic Forgetting (CF). While the issue has been extensively studied empirically, little attention has been paid from a theoretical angle. In this paper, we show that the impact of CF increases as two tasks increasingly align. We introduce a measure of task similarity called the NTK overlap matrix which is at the core of CF. We analyze common projected gradient algorithms and demonstrate how they mitigate forgetting. Then, we propose a variant of Orthogonal Gradient Descent (OGD) which leverages structure of the data through Principal Component Analysis (PCA). Experiments support our theoretical findings and show how our method can help reduce CF on classical CL datasets.

- **Jean-Marc Bardet** (University Paris 1, Panthéon-Sorbonne)

Efficient and consistent model selection procedures for time series

This talk deals with the problem of model selection in a large class of causal time series models that includes ARMA or AR(∞) processes as well as GARCH or ARCH(∞), APARCH, ARMA-GARCH - and many other processes. First, we study the asymptotic behavior of the ideal penalty that minimizes the risk defined from a quasi-likelihood estimation among a finite family of models containing the true model. We then establish general conditions on the penalty term to obtain properties of consistency and efficiency. In particular, we prove that consistent model selection criteria outperform the classical AIC criterion in terms of efficiency. Finally, we derive the usual BIC criterion from a Bayesian approach and, retaining all second-order terms of the Laplace approximation, a data-driven criterion, which we call KC'. Monte Carlo experiments illustrate the asymptotic results obtained and show that the KC' criterion performs better than the AIC and BIC criteria in terms of consistency and efficiency.

- **Felix Cheysson** (LPSM, Paris, France)

Comparing CART trees by subsampling

CART trees are appealing non parametric methods for classification and regression problems, as they can often model complex covariate-outcome relationships without prior knowledge, and the decision process is akin to how humans make decisions. However, they are highly sensitive to the learning set, and established theoretical properties for CART are few and far between, which may cause some issues when trying to compare the trees built from two different samples. We propose a test for the comparison of CART trees, based on a U-statistic framework, where the critical threshold of the hypothesis test is estimated via subsampling without replacement. Notably, we prove a central limit theorem for this estimator.

A short simulation study and an application to Covid-19 data illustrate the performances of the proposed method.

- **Camille Coron** (University Paris Saclay)
Biodiversity monitoring using citizen data

This presentation based on Giraud et al (2016) and Coron et al (2018) aims at estimating relative abundances of common bird species by combining datasets with different protocols. The first dataset, provided by Vigie-Nature, is composed of all observations made by scientists at a precise location and for a fixed amount of time. The second dataset, provided by the Ligue pour la Protection des Oiseaux, is composed of some observations made by citizens, whose location and observation duration are unknown. The second dataset is much larger than the first one, but provides few associated information concerning the observation protocol. Our work consists in introducing a probabilistic modeling of these two datasets, that allows to benefit both from the information brought by the first dataset, and the abundance of the second one, and thus improving estimations made using only the first dataset.

References

C. Coron, C. Calenge, C. Giraud, R. Julliard (2018) Estimation of species relative abundances and habitat preferences using opportunistic data. *Env. and Ecol. Stat.* 25, 71–93.
C. Giraud, C. Calenge, C. Coron, R. Julliard (2016) Capitalizing on opportunistic data for monitoring species relative abundances. *Biometrics* 72 (2), 649-58.

- **Arnaud Dragicevic** (INRAE, Aubière and CIRANO, Montréal)
Stochastic Control of Ecological Networks

The paper models the maintenance of ecological networks in forest environments, built from bioreserves, patches and corridors, when these grids are subject to random processes such as extreme natural events. It also outlines a management plan to support the optimized results. After presenting the random graph-theoretic framework, we apply the stochastic optimal control to the graph dynamics. Our results show that the preservation of the network architecture cannot be achieved, under stochastic control, over the entire duration. It can only be accomplished, at the cost of sacrificing the links between the patches, by increasing the usage of the control devices. This would have a negative effect on the species migration by causing congestion among the channels left at their disposal. The optimal scenario, in which the shadow price is at its lowest and all connections are well-preserved, occurs at half of the course, be it the only optimal stopping moment found on the stochastic optimal trajectories. In such a scenario, the optimal forestry management policy has to integrate agility, integrated response, and quicker response time.

- **Marie-Pierre Etienne** (AgroParisTech, Rennes)
Statistical methods for understanding movement data

Movement of organisms is one of the main mechanisms who govern relations between species. Advances in biologging open promising perspectives in the study of animal movements at numerous scales. It is now possible to record time series of animal locations over extended areas and long durations with a high spatial and temporal resolution. One question addressed with this sort of data is the habitat preference selection, which can be defined as the relationship between the environmental covariates and the stationary distribution, known in ecology as resource selection function. Using some ergodicity assumptions, it is possible to estimate this relationship by long-term monitoring of an individual movement. We explore the use of Langevin model for modelling animal movement in order to estimate the resource selection function.

Reference. T Michelot, P Gloaguen, P. G. Blackwell, M-P Étienne (2019) The Langevin diffusion as a continuous-time model of animal movement and habitat selection. *Methods in Ecology and Evolution*.

- **Guillaume Franchi** (ENSAI, Rennes)
Modelling of abundances through a GLM model

Relative abundance is defined as the vector of proportions of each species in a whole ecosystem. Compared to standard abundance, it is a good indicator of biodiversity. However, modeling issues arise due to the constraints inherent to the structure of the data, which are contained in the border of a compact set. We aim to build a time series model for relative abundance which is easily interpretable, in order to better understand an ecosystem and its dynamic. Statistical properties of the model and estimation strategies are central to our work and will be discussed in the talk.

- **Mara Freilich** (Scripps Institution of Oceanography, University of California San Diego)
Inferring ecological networks using spatiotemporal data: Insights from intertidal observations and a stochastic model

Ecosystems functioning is based on an intricate web of interactions among living entities. Most of these interactions are difficult to observe, especially when the diversity of interacting entities is large and they are of small size and abundance. To sidestep this limitation, it has become common to infer the network structure of ecosystems from co-occurrence of species in space and time, but it is not clear how well networks can be reconstructed, especially in the presence of environmental and demographic variability that propagates through ecological networks. We first test the efficacy of statistical methods for network reconstruction by comparing an inferred network constructed using spatially intensive co-occurrence data from the rocky intertidal zone in central Chile to a well-resolved, empirically based, species interaction network from the same region. We find that co-occurrence networks do not represent classical ecological networks in which edges indicate a pairwise interaction. Co-occurrence networks most likely provide information about the joint spatial effects of environmental conditions, recruitment, and, to some extent, biotic interactions, and among the latter, they tend to better detect niche-expanding positive non-trophic interactions. We then evaluate the effects of intrinsic noise and network topology on the performance of different methods of inferring network structure from time-series data, demonstrating the co-occurrence networks are non-random, but do not necessarily correspond to the known interaction network. Patterns of interactions in co-occurrence networks must be interpreted with caution, especially when extending interaction-based ecological theory to interpret network variability and stability.

- **Pierre Jacob** (ESSEC, Cergy-Pontoise)
Bayesian inference with models made of modules

In many cases, models employed in statistics are made of different "modules" that relate to specific parts of the analysis, or specific sources of data. For example, there might be a primary module with the parameters of interest, but also: a module for the imputation of missing data, a module for the estimation of propensity scores, a module that estimates unobserved covariates using external data, a module that handles some pre-processing step, a module that captures measurement error, etc. An appeal of the standard Bayesian approach is the ability to perform inference on all unknown quantities jointly, leading to a coherent treatment of uncertainty across all modules. However, misspecification of any module can motivate departures from the standard joint inference approach and has led practitioners to employ "modularized" strategies, designed to "cut the feedback" from some modules onto others, leading to "cut distributions" instead of standard posterior distributions. This talk reviews the arguments proposed to defend and to condemn modularization in Bayesian analysis, describes some statistical properties of the "cut distributions" and presents algorithms to approximate them.

- **Anton Klimovsky** (University of Stuttgart)
Stochastic modelling of evolving networks using graph limits

Majority of complex networks change over time. We report on some recent results on the probabilistic fundamentals of evolving networks. We focus discuss notions of convergence of graph sequences and their limiting objects.

- **Federico Maddanu** (CY University)

Time trends in atmospheric ethane

Understanding the dynamics underlying ethane (C_2H_6) trends is of uttermost importance in the context of climate change. We focus on time series of ethane abundance in the atmosphere recorded at 15 ground-stations located in both the Northern and Southern Hemispheres. The trend component is hidden by both a strong persistent annual cycle and the large amount of missing data (about 70%). Our approach proposes a novel structural model where both the cycle and trend evolve stochastically and can be estimated via the Kalman filter methodology. The results suggest a global pattern in the dynamics of ethane trends in both the Northern and Southern Hemispheres. With Tommaso Proietti (Roma Torre Vergata).

- **Pablo Marquet** (Catholic University, Santiago, Chile)

Reconstructing ecological networks

Networks are ubiquitous in almost any natural phenomenon from life to society. And although network theory is a very well-established discipline grounded in graph theory, the empirical work on networks faces several challenges, of which the challenge of reconstructing networks from partial information is paramount. Here, I will provide an overview of several approaches used to reconstruct networks and, in particular, how to deal with the issue of inferring causality. I will conclude by outlining some open challenges such as the probabilistic challenge; networks are spatially and temporally dynamic objects so information about them will always be partial and referential (i.e., the network was observed at a particular time and space) hence its nature is probabilistic.

- **Guilherme Ost** (UFRJ, Rio de Janeiro)

Sparse Markov Models for High-Dimensional Inference

Consider a sample of size n of a finite order Markov chain. In this full generality, we can only estimate the parameters of the Markov chain (the order d and the transition probabilities) in the regime $d=O(\log(n))$, limiting the practical application of these chains to small orders only. In this talk, we will discuss a way to overcome this constraint in a large subclass of Markov chains, namely the Mixture of Transition Distribution (MTD) models. In our main result, we will show that it is possible to select a priori the portion of the past that is relevant for the transition probabilities of a MTD, allowing the estimation of the model parameters even in the regime $d=O(n)$. The practical performance of our estimation procedure will be illustrated through simulations.

This is a joint work with Daniel Y. Takahashi (Brain Institute/UFRN).

- **Denys Pommeret** (Aix Marseille University & ISFA Lyon)

Mixed Deep Gaussian Mixture Models

Recently, Viroli & McLachlan (2019) proposed a generalization of the well-known Gaussian Mixture Models (GMM) which they called Deep Gaussian Mixture Models (DGMM).

Roughly speaking, DGMMs are mixtures of GMM. The architecture of a DGMM is that of a neural network: each mixture can be seen as a layer and its components are the neurons. DGMMs only work for continuous variables. Fuchs et al. (2021) proposed an extension to the mixed case (continuous and non continuous) which they call Mixed DMGG (MDGMM). The idea of a MDGMM is first to link the mixed data to a continuous latent space. Then a DGMM is applied. The latent space contains information on the dependence structure of the mixed data. MDGMMs can be used for clustering.

Another important use is data augmentation. Indeed we can modify a MDGGM to generate mixed variables. We call this algorithm MIAMI (for MIXed data Augmentation MIXture).

In this talk we show the principle of MDGMMs and we compare the MIAMI algorithm to competitors (k -modes, k -Prototypes, Hierarchical Clustering, Self-Organising Maps, DB-SCAN, CTGAN, CART, Random Forest, k -Nearest Neighbour).

We also show an application of the MDGMM in oceanography.

- **Julien Randon Furling** (University Paris 1, Panthéon-Sorbonne)

On a first hit distribution of the running maximum of Brownian motion

Let $(S_t)_{t \geq 0}$ be the running maximum of a standard Brownian motion $(B_t)_{t \geq 0}$ and $T_m = \inf\{t, m\bar{S}_t \leq t\}$ for $m \geq 0$. In this note we calculate the joint distribution of T_m and B_{T_m} . We also present results for Brownian motion with drift.

A part of the motivation behind the study presented here stems from a toy-model designed by Paul Krapivsky for animal foraging (2017). Among many applications, stochastic processes have indeed often been used to model the paths traced by animals searching for food, shelter or other necessities.

- **Lionel Truquet** (ENSAI, Rennes)

Nonparametric inference for general categorical time series with time-varying parameters

The first motivation of this paper is to construct a general framework for modeling non-stationary categorical time series with time-varying analogues of logistic, multiple choice or ordinal time series models and for which some kind of non-stationary exogenous regressors can be included in the dynamic. To this end, we develop two locally stationary notions for autoregressive categorical processes. The first one, which is adapted to strictly exogenous covariates, is based on the theory of Markov chains in random environments and the second one, which is adapted to sequentially exogenous covariates, on iterated random maps systems. In both cases, our results allow to derive asymptotic properties of localized partial sums and consistency properties of local likelihood estimators for time-varying parameters. For strictly exogenous regressors, we also develop a notion of derivative processes which is useful to control the bias of localized partial sums.

- **Daniel Valencia** (Catholic University, Las Cruces, Chile)

Modeling the complexity of 'simple' pairwise species interactions in open systems: trophic and non-trophic interactions define spaces of coexistence at the core of marine ecological networks

Within natural systems, many biological species simultaneously engage in trophic and non-trophic interactions (NTIs), affecting each other population growth and the likelihood of stable coexistence. In marine metacommunities open to external influx of biomass and individuals, the fate of local population depends on the interplay between these interactions and regional scale drivers. For instance, in marine systems where most species have complex life cycles, the larval dispersion capability and its recruitment probability (forced by oceanographic conditions) could explain much of the local scale variation and, at the same time, make the system particularly sensible to climate fluctuations. Here, we model and attempt to empirically parameterize the combined effect of feeding, recruitment facilitation, and refuge provision on the local dynamic of a 'predator-prey' system. This relatively well-known biological system from the Chilean intertidal zone includes the dominant bed-forming mussel *Perumytilus purpuratus* and one of its main predators, the crab *Acanthocyclus hassleri*. Using experimental and time series data, we parametrize the model to explore the mechanisms of the NTIs and their role in the species' coexistence under varying scenarios of recruitment variability. Overall, we show that the inclusion positive NTIs, refuge provision and recruitment facilitation, together foster coexistence in limited larval environments, although when considered separately they can reduce local coexistence space. These results suggest that

incorporating NTIs on dynamic models and ecological theory is needed to gain a more complete understanding of mechanisms of species coexistence and spatial variability, and that this knowledge is critical to understand ecosystem responses to ongoing climate and global changes.

3 Social Program

Beginning such a program let us realise two things,

- first I should apologise because it is so restrictive but it is necessarily biased;
- the second point it to think about the importance of keeping all those incredibly beautiful places which justify thousands times the existence of projects in analogous lines.

The forthcoming text is full of links: [click on locations to safely travel during this complicate period.](#)

The social program ⁽¹⁾ will be free:

- Brazil: Iguazu falls, Rio-Corcovado, Amazonia Forests,
- Chile: Patagonia, Paranal, Atacama desert, Valparaiso, Caleta Portales,
- China: The great wall, Peking-Forbidden city, Hong-Kong,
- France: Lyon ⁽²⁾, Nantes-Machines de l'Ile, Paris-Plage, Paris-Tara Expedition, Vannes, Luminy,
- Germany: Aachen, Berlin, Heidelberg, Munich-Hofbraeuhaus, Oberwolfach,
- Mexico: Mexico-Frida Khalo Museum, Mexico-Coyoacan,
- New Caledonia: Nouméa,
- Poland: Torun, Varsaw-Jewish Museum,
- Spain: Barcelona-La Pedrera, Figueras-Dali Museum, Granada,
- USA : Colorado, New York City,
- Venezuela: Delta del Orinoco, Salto Angel.
- Fortunately you are welcome face to face to the conference and taste our beautiful city of Paris which you may see from the conference room at the top of Tolbiac University main building.
- Fooding is due to the reinsertion central kitchen Label Gamelle,
- The conference dinner will be at L'entracte des Gobelins, Paris 13.

¹Don't hesitate to help for improving this important feature of the conference.

²Sorry for reducing the attraction of this beautiful city to food but a social program should include a conference dinner and Lyon is the capital of Gastronomy...
Let us hope that we can meet physically in this city for a physical event!

4 Participants

Participants come from all over the world and to turn this conference in a link between researcher we thought that an easy access to all of them may be a successful tool for further contacts; people attending this conference are located in [Belgium](#), [Brazil](#), [Canada](#), [Chile](#), [China](#), [Cyprus](#), [Denmark](#), [Germany](#), [France](#), [Hong-Kong](#), [Hungary](#), [Indonesia](#), [Ivory Coast](#), [Japan](#), [Mauritius](#), [New Caledonia](#), [Pakistan](#), [Peru](#), [Poland](#), [Portugal](#), [Russia](#), [Singapore](#), [South Korea](#), [Spain](#), [Switzerland](#), [Ukraine](#), [United Kingdom](#), [United States of America](#), [Uruguay](#) and [Vietnam](#).

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