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## CURRICULUM VITÆ

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### Fionn MC INERNEY Postdoc in Computer Science

LIRIS  
Université Claude Bernard Lyon 1  
Bâtiment Nautibus  
843, Bd du 11 novembre 1918  
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Born 24/05/1990 in Toronto, Canada  
Canadian and French nationalities  
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<http://www-sop.inria.fr/members/Fionn.Mc-Inerney/>

Since 07/2019: **Postdoc** at **LIRIS**, Université Claude Bernard Lyon 1, in the project-team **GOAL** and supervised by Dr. **Eric Duchêne**.

### Academic career

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- 01/2020 - 12/2020 **Postdoc** in the project-team ACRO of LIS (Aix-Marseille Université, France) under the supervision of Dr. Victor Chepoi. Financed by the ANR DISTANCIA.
- 07/2019 - 12/2019 **Postdoc** in the project-team GOAL of LIRIS (Université Claude Bernard Lyon 1, France) under the supervision of Dr. Eric Duchêne. Financed by the ANR GAG.
- 10/2016 - 07/2019 **Ph.D. student** in the project-team COATI of I3S/INRIA (Sophia-Antipolis, France) and Université Côte d'Azur (France) under the supervision of Dr. Nicolas Nisse. Financed by CORDI-S scholarship. Defended: 08/07/2019.
- 09/2013 - 08/2015 **M.Sc. student** in Applied Mathematics at Ryerson University (Toronto, Canada).
- 09/2009 - 05/2013 **B.Sc. student** in Mathematics and Its Applications with a minor in Finance at Ryerson University (Toronto, Canada).

### Academic degrees

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- 2016 - 2019 **PhD in Computer Science** – Université Côte d'Azur (Inria Sophia Antipolis - Méditerranée, France).  
Thesis title: *Domination and Identification Games in Graphs*.  
Supervised by Nicolas Nisse.  
Defended in front of the following jury:

#### Reviewers

- Paul DORBEC Prof. at IUT Caen-Normandy, GREYC (France)  
Sylvain GRAVIER Directeur de Recherches CNRS, Institut Fourier (France)

**Examiners**

Steve ALPERN Prof. at the University of Warwick (England)  
Victor CHEPOI Prof. at Aix-Marseille Université (France)  
Aline PARREAU Chargé de Recherches CNRS, LIRIS (France)

**Supervisor**

Nicolas NISSE Chargé de Recherches, Inria Sophia Antipolis (France)

2013 - 2015 **M.Sc. in Applied Mathematics** – Ryerson University.

Thesis title: *Wall Cops and Robbers*.

Supervised by Anthony Bonato.

Defended in front of the following jury:

**Reviewers**

Peter DANZIGER Prof. at Ryerson University (Canada)  
Dejan DELIĆ Prof. at Ryerson University (Canada)

**Chair**

Jean-Paul PASCAL Prof. at Ryerson University (Canada)

**Supervisor**

Anthony BONATO Prof. at Ryerson University (Canada)

2009 - 2013 **B.Sc. in Mathematics and Its Applications** – Ryerson University – *with honours*.

## Research activities

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### Research overview

My research primarily focuses on **graph theory**. In particular, I am interested in 2-player games on graphs and the **algorithmic** and **structural aspects** related to these games/problems. During my Ph.D. studies, I have mainly considered the two following problems:

- **The Eternal Domination game** is played on a graph  $G$  where a team of  $k$  guards that occupy vertices of  $G$  play against one attacker. Each turn, first the attacker attacks one vertex and then each of the guards may move to an adjacent vertex from their current positions. If for an infinite number of turns, at the end of each turn, there is a guard at the vertex that has just been attacked on that turn, then the guards win. Otherwise, the attacker wins. The goal is to determine  $\gamma_{all}^{\infty}(G)$  which is the minimum number of guards needed to guarantee winning against the attacker on  $G$ . Our main contribution to this game was the design of a new technique to obtain asymptotic bounds for  $\gamma_{all}^{\infty}$  for grids in general and more specifically, truncated Cayley graphs obtained from abelian groups. Otherwise, we have mainly studied a generalization of this game, called the **Spy Game**, where the attacker moves on the graph at speed  $s \geq 1$  and the guards need to maintain that at least one guard is at distance at most  $d \geq 0$  from the attacker at the end of each turn. Here,  $gn_{s,d}(G)$  denotes the minimum number of guards needed to guarantee winning in  $G$ . We showed that the associated decision problem is NP-Hard, we gave exact values of  $gn_{s,d}$  for paths, and tight bounds for cycles. Notably, we showed the equivalence of fractional and integral strategies in trees which allowed us to use Linear Programming and a fractional relaxation of the problem to design a polynomial-time algorithm for computing  $gn_{s,d}$  and a corresponding strategy in trees. Similar techniques allowed us to obtain bounds for grids and tori.
- The second problem is the one of distinguishing the vertices of a graph by using a smallest subset of its vertices. Specifically, you want to distinguish every vertex by their distances to each vertex of this subset. The size of the smallest such subset is called the **metric dimension** of the graph. We have studied this game in digraphs where we seek the orientation that maximizes the metric dimension. We obtained bounds for graphs of bounded-degree, grids, and asymptotically tight bounds for Eulerian tori. We have also studied a generalization of this parameter in non-oriented graphs where the problem is equivalent to finding an invisible target hidden at a vertex of the graph through multiple turns of selecting subsets of its vertices. Specifically, at each turn, one can choose a subset of  $k$  vertices to “probe” and the distances between these vertices and the hidden target will be returned. The goal is to minimize either the number of turns it takes to guarantee locating the target, wherever it be, given that you can probe  $k$  vertices each turn or to minimize  $k$  given a maximum number of turns  $\ell$  in which you want to locate the target. We showed that both problems are NP-complete even when one of  $k$  and  $\ell$  is fixed. Notably, we showed that the problem is NP-complete in trees, but that the difficulty only comes from the first turn which allowed us to design a polynomial-time (+1)-approximation algorithm to solve the problem in trees.

I have also studied other problems in graphs such as:

- **Hyperopic Cops and Robbers**, which is a variant of the game of Cops and Robbers where the robber is invisible if and only if it is at distance 1 from all the cops.

- **The Orthogonal Colouring game on graphs**, which is a 2-player scoring game played on two isomorphic copies of a graph  $G$  each of which is assigned to one of the players. Both players take turns colouring vertices of either copy of  $G$  with a colour in  $[k]$  while maintaining that the partial colouring is proper. When no player can colour a vertex without breaking the partial colouring condition or if all vertices are coloured, the player with the most coloured vertices in their copy of  $G$  wins.

## Journal publications

More details on my research works can be found at <http://www-sop.inria.fr/members/Fionn.Mc-Inerney/>.

- [5] J. Bensmail, F. Mc Inerney, and Kasper Szabo Lyngsie. On  $\{a, b\}$ -edge weightings of bipartite graphs with odd  $a, b$ . To appear in *Discussiones Mathematicae Graph Theory*.
- [4] S. D. Andres, M. Huggan, F. Mc Inerney, and R. J. Nowakowski. The Orthogonal Colouring Game on Graphs. To appear in *Theoretical Computer Science*.
- [3] A. Bonato, N. Clarke, D. Cox, S. Finbow, F. Mc Inerney, and M. E. Messinger. Hyperopic Cops and Robbers. To appear in *Theoretical Computer Science*.
- [2] N. Cohen, F. Mc Inerney, N. Nisse, and S. Pérennes. Study of a combinatorial game in graphs through Linear Programming. To appear in *Algorithmica*.
- [1] N. Cohen, N. Martins, F. Mc Inerney, N. Nisse, S. Pérennes, and R. Sampaio. Spy-Game on graphs: complexity and simple topologies. *Theoretical Computer Science*, Volume 725, pages 1-15, 2018.

## International Conferences

- [5] J. Bensmail, F. Mc Inerney, and N. Nisse. Metric Dimension: from Graphs to Oriented Graphs. *In Proceedings of the 10th Latin & American Algorithms, Graphs and Optimization Symposium (LAGOS 2019)*, 2019.
- [4] F. Mc Inerney, N. Nisse, and S. Pérennes. Eternal Domination in Grids. *In Proceedings of the 11th International Conference on Algorithms and Complexity (CIAC 2019)*, 2019.
- [3] J. Bensmail, D. Mazauric, F. Mc Inerney, N. Nisse, and S. Pérennes. Sequential Metric Dimension. *In Proceedings of the 16th Workshop on Approximation and Online Algorithms (WAOA 2018)*, Lecture Notes in Computer Science, vol. 11312, Springer, 2018.
- [2] N. Cohen, F. Mc Inerney, N. Nisse, and S. Pérennes. Study of a combinatorial game in graphs through Linear Programming. *In Proceedings of the 28th International Symposium on Algorithms and Computation (ISAAC 2017)*, LIPIcs 92, Schloss Dagstuhl, 22:1-22:13, 2017.
- [1] A. Bonato, F. Mc Inerney. The game of Wall Cops and Robbers. *In Proceedings of the 2nd International Conference on Computational Models, Cyber Security, Computational Intelligence (ICC3)*, Advances in Intelligent Systems and Computing, vol 412. Springer, 2015.

## National Conferences

- [3] J. Bensmail, F. Mc Inerney, and N. Nisse. Dimension Métrique des Graphes Orientés. In *21es Rencontres Francophones sur les aspects d'Algorithmiques des Télécommunications (AlgoTel 2019)*, Narbonne, France, 2019.
- [2] J. Bensmail, D. Mazauric, F. Mc Inerney, N. Nisse, and S. Pérennes. Localiser une cible dans un graphe. In *20es Rencontres Francophones sur les aspects d'Algorithmiques des Télécommunications (AlgoTel 2018)*, Roscoff, France, 2018.
- [1] N. Cohen, N. Martins, F. Mc Inerney, N. Nisse, S. Pérennes, and R. Sampaio. Enquêter dans les graphes. In *19es Rencontres Francophones sur les aspects d'Algorithmiques des Télécommunications (AlgoTel 2017)*, Quiberon, France, 2017.

## Submitted

- [3] S. D. Andres, F. Dross, M. Huggan, F. Mc Inerney, and R. J. Nowakowski. On the Complexity of Orthogonal Colouring Games and the NP-completeness of Recognizing Graphs Admitting a Strictly Matched Involution. Submitted to *Discrete Applied Mathematics*.
- [2] A. Gagnon, A. Hassler, J. Huang, A. Krim-Yee, F. Mc Inerney, A. Mejía Zacarías, B. Seamone, and V. Virgile. A method for eternally dominating strong grids. Submitted to *DMTCS*.
- [1] J. Bensmail, D. Mazauric, F. Mc Inerney, N. Nisse, and S. Pérennes. Sequential Metric Dimension. Submitted to *Algorithmica*.

## Participation in scientific projects

- ANR-14-CE25-0006 GAG (2015-2019).
- Inria Associated Team AlDyNet (2013-15, extended until 2018) between COATI and Adolfo Ibanez University (Santiago, Chile).
- ANR-13-BS02-0007 STINT (2014-2017).

## Reviews

I have reviewed for the following journals: *Discrete Applied Mathematics*, *Discrete Mathematics*, and *Theoretical Computer Science*. I have also reviewed for the following conferences: *CSR 2019*, *CIAC 2019*, and *Algotel 2017*.

## Teaching activities

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### Teaching overview

In the last year of my PhD studies (2019), I taught the tutorials (TD) part of a course for first year students of the DUT INFO - ALT at the IUT - Université de Nice Sophia-Antipolis. During the two years of my M.Sc. studies and for a period just after that (2013-2016), I taught undergraduate courses as a teaching assistant for the Mathematics Department at Ryerson University. So far, I have completed 783 hours of teaching. Note that these hours include hours for marking exams and therefore, 400 hours is a rough estimate of the time spent teaching the actual classes.

Name	Academic year(s)	Number of hours
Bases de la programmation orientée objet	2019	25
Calculus and Computational Methods I	2015 - 2016	36
Discrete Mathematics II	2014 - 2015	102(2 × 51)
Modern Mathematics I	2014 - 2015	46
Mathematics for Professional Programs	2014 - 2015	62
Discrete Mathematics I	2014 - 2015	94(2 × 47)
Discrete Mathematics for Engineers	2013 - 2014	42
Calculus II	2013 - 2014 and 2015 - 2016	108 (2 × 54) and 47 and 47
Linear Algebra	2013 - 2014	50
Calculus I	2013 - 2014	124 (2 × 62)

## Presentations

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### Conference and Workshop Talks

- Sequential Metric Dimension. *8th Graph Searching in Canada Workshop (GRASCan 2019)*, Fields Institute, Toronto, Canada, August 2019.
- Metric Dimension: from Graphs to Oriented Graphs. *10th Latin & American Algorithms, Graphs and Optimization Symposium (LAGOS 2019)*, Belo Horizonte, Brazil, June 2019.
- Eternal Domination in Grids. *11th International Conference on Algorithms and Complexity (CIAC 2019)*, Rome, Italy, May 2019.
- The Orthogonal Colouring Game. *Combinatorial Game Theory Colloquium III (CGTC III)*, Lisbon, Portugal, January 2019.
- Eternal Domination in Grids. *20es Journées Graphes et Algorithmes (JGA 2018)*, Grenoble, France, November 2018.
- Sequential Metric Dimension. *9th Workshop on GRaph Searching, Theory & Applications (GRASTA 2018)*, Technische Universität Berlin, Germany, September 2018.
- Sequential Metric Dimension. *16th Workshop on Approximation and Online Algorithms (WAOA 2018)*, Helsinki, Finland, August 2018.
- Sequential Metric Dimension. *10th International Colloquium on Graph Theory and Combinatorics (ICGT 2018)*, Lyon, France, July 2018.
- Localiser une cible dans un graphe. *20es Rencontres Francophones sur les aspects Algorithmiques des Télécommunications (AlgoTel 2018)*, Roscoff, France, May 2018.
- Spy Game on Graphs. *Games and Graphs Workshop (GAG)*, Université Claude Bernard Lyon 1, Lyon, France, October 2017.
- Spy Game on Graphs. *6th Graph Searching in Canada Workshop (GRASCan 2017)*, Grenfell Campus, Memorial University, Corner Brook, Newfoundland, Canada, August 2017.

- Enquêter dans les graphes. *19es Rencontres Francophones sur les aspects Algorithmiques des Télécommunications (AlgoTel 2017)*, Quiberon, France, June 2017.
- Introduction to Designs and Steiner Triple Systems. *17èmes Journées Combinatoires et Algorithmes du Littoral Méditerranéen (JCALM17)*, Sophia-Antipolis, France, May 2017.

## Seminar Talks

- Sequential Metric Dimension. *Séminaire Graphes@Lyon*, LIRIS, Lyon, France, May 2019.
- Sequential Metric Dimension and Oriented Metric Dimension. *Séminaire de l'équipe ACRO*, LIS, Marseille, Luminy, France, March 2019.
- The Orthogonal Colouring Game. *Séminaire de l'équipe COATI*, I3S/INRIA, Sophia-Antipolis, France, March 2019.
- Sequential Metric Dimension. *Séminaire de l'équipe COATI*, I3S/INRIA, Sophia-Antipolis, France, October 2018.
- Spy Game on Graphs. *Seminario del Doctorado en Ingeniería de Sistemas Complejos*, Universidad Adolfo Ibáñez, Santiago, Chile, November 2017.
- The Game of Cops and Robbers on Graphs. *The PhD Seminars of Inria Sophia-Antipolis - Méditerranée*, INRIA, Sophia-Antipolis, France, November 2017.
- Spy Game on Graphs. *Séminaire de l'équipe COATI*, I3S/INRIA, Sophia-Antipolis, France, June 2017.
- Wall Cops and Robbers. *Séminaire de l'équipe COATI*, I3S/INRIA, Sophia-Antipolis, France, November 2016.

## Scientific Dissemination and Popularization

- Café-In: Graphes et Algorithmes pour tous, Inria Sophia-Antipolis - Méditerranée, France, April 29, 2019.
- INRIA stand, Fête de la Science: Village des Sciences et de l'Innovation, Juan les Pins, October 20-21, 2018.
- Presentation and assisting with activities, Stage MathC2+, Inria Sophia-Antipolis - Méditerranée, France, June 19-22, 2018.
- Supervised internship of a high school student (lycéenne en seconde), Inria Sophia-Antipolis - Méditerranée, France, June 18-22, 2018.
- Magie et Jeux presentation, Collège Victor Hugo, Nevers, France, March 23, 2018.
- Participation in the day "L'informatique, c'est pas génétique, filles ou garçons, les clics sont identiques!", Lycée Raoul Follereau, Nevers, France, March 22, 2018.
- Magie et Jeux presentation, École Primaire Romain Rolland, Varennes-Vauzelles, France, March 21, 2018.

## References

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## Research

- Anthony Bonato, Prof. at Ryerson University, Canada. M.Sc. supervisor. `abonato@ryerson.ca`.
- Nicolas Nisse, Inria Research Officer (CR1), France. Ph.D supervisor. `nicolas.nisse@inria.fr`.
- Victor Chepoi, Prof. at Aix-Marseille University, France. Future postdoc supervisor. `chepoi@lif.univ-mrs.fr`.

## Teaching

- Christelle Caillouet, Maître de conférence at Université Côte d'Azur, France. `christelle.caillouet@unice.fr`.
- Alexander Alvarez, Assistant professor at University of Prince Edward Island, Canada. Former Assistant Professor at Ryerson University, Canada. `alalvarez@upei.ca`.