James C. A. Main

PhD in mathematics

✉ *james.main@umons.ac.be*
🌐 *https://alexandermain.github.io/*

Positions

October 2021– September 2025	**PhD candidate**, *UMONS – Université de Mons* Thesis title: *The Many Faces of Strategy Complexity* (Submitted). Supervisor: Mickael Randour (F.R.S-FNRS & UMONS). Funded by the F.R.S.-FNRS (Research Fellow grant)

Education

2019–2021	**Master's degree in Mathematics (Research Focus)**, *UMONS*, Belgium, *Summa cum laude* Received the Maurice Boffa Award from the Department of Mathematics.
2016–2019	**Bachelor's degree in Mathematics**, *UMONS*, Belgium, *Summa cum laude* Academic minor in Computer Science. Award of the Department of Mathematics.

Internships

September 2020–June 2021	**Research internship**, *UMONS* Subject: Extending window objectives to timed automata and games. Supervisors: Mickael Randour (collaboration with Jeremy Sproston).
August 2019	**Research initiation internship**, *UMONS* Subject: Efficient algorithms for parity games with few colours. Supervisor: Mickael Randour.

Publications

Extended versions are available on arXiv and are linked on my website whenever available.

Invited contributions in international conference proceedings

[BGMR23] Thomas Brihaye, Aline Goeminne, James C. A. Main, Mickael Randour. **Reachability Games and Friends : A Journey through the Lens of Memory and Complexity**. *Keynote lecture given by Thomas Brihaye at FSTTCS'23*. 43rd IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2023, LIPIcs 284, Schloss Dagstuhl, pages 1:1–1:26, 2023.

Peer-reviewed journals

[MR24] James C. A. Main, Mickael Randour. **Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem Under Finite-Memory Assumptions**. Information and Computation, 2024.

International peer-reviewed conference proceedings

[AMNR25] Michal Ajdarów, James C. A. Main, Petr Novotný, Mickael Randour. **Taming Infinity One Chunk at a Time: Concisely Represented Strategies in One-Counter MDPs**. 52nd International Colloquium on Automata, Languages, and Programming, ICALP 2025, LIPIcs 334, Schloss Dagstuhl, pages 138:1-138:19, 2025.

[Mai24] James C. A. Main. **Arena-independent Memory Bounds for Nash Equilibria in Reachability Games**. 41st International Symposium on Theoretical Aspects of Computer Science, STACS 2024, LIPIcs 298, Schloss Dagstuhl, pages 50:1-50:18, 2024.

[MRS22] James C. A. Main, Mickael Randour, Jeremy Sproston. **Timed Games with Bounded Window Parity Objectives**. Formal Modeling and Analysis of Timed Systems - 20th International Conference, FORMATS 2022, LNCS 13465, pages 165–182, Springer, 2022.

[MR22] James C. A. Main, Mickael Randour. **Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem Under Finite-Memory Assumptions**. 33rd International Conference on Concurrency Theory (CONCUR 2022), LIPIcs 243, Schloss Dagstuhl, pages 22:1–22:18, 2022.

[MRS21] James C. A. Main, Mickael Randour, Jeremy Sproston. **Time Flies When Looking out of the Window: Timed Games with Window Parity Objectives**. 32nd International Conference on Concurrency Theory (CONCUR 2021), LIPIcs 203, Schloss Dagstuhl, pages 25:1–25:16, 2021.

Preprints

[MR25] James C. A. Main, Mickael Randour. **Mixing Any Cocktail with Limited Ingredients: On the Structure of Payoff Sets in Multi-Objective POMDPs and its Impact on Randomised Strategies**.

PhD thesis

Title	**The Many Faces of Strategy Complexity**
Supervisor	Mickael Randour (F.R.S.-FNRS & UMONS).
Jury	Nathalie Bertrand (Reviewer – Université de Rennes, INRIA, CNRS, IRISA), Thomas Brihaye (Jury secretary – UMONS), Véronique Bruyère (Jury president – UMONS), Nathanaël Fijalkow (Reviewer – CNRS, LaBRI & Université de Bordeaux), Antonín Kučera (Reviewer – Masaryk University), Mickaël Randour (Supervisor)
Graduation	September 23, 2025.

Talks

The slides of my talks are available on my website.

Invited talks and seminars

2025	*The Many Faces of Strategy Complexity*, Seminar in ISTA, 02/12, Klosterneuburg, Austria.
2024	*On the Structure of Expected Payoff Sets in Multi-Objective Markov Decision Processes*, MoVe Seminar, Laboratoire d'Informatique et Systèmes, 04/10, Marseille, France.
2023	*Different Strokes in Randomised Strategies*, Seminar given at Masaryk University, 12/06, Brno, Czech Republic.
2022	*Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions*, Seminar given at the University of Turin, 31/05, Turin, Italy.

Contributed talks

2025   *Taming Infinity One Chunk at a Time: Concisely Represented Strategies in One-Counter MDPs*, Highlights of Logic, Games and Automata 2025, 02/09, Saarland University, Saarbrücken, Germany

Taming Infinity One Chunk at a Time: Concisely Represented Strategies in One-Counter MDPs, ICALP 2025: 52nd EATCS International Colloquium on Automata, Languages, and Programming, 08/07, Aarhus University, Aarhus, Denmark.

Teaching controller synthesis using AI and formal methods, Storm Days, March 31, 2025, Van der Valk Hotel, Nijmegen (Lent), the Netherlands.

The Many Faces of Strategy Complexity, Seminar given at the Max Planck Institute for Software Systems, 05/03, Saarbrücken, Germany.

2024   *Verification and Synthesis of Concisely Represented Counter-Based Strategies in One-Counter Markov Decision Processes*, UMONS Formal Methods Reading Group, 16/12, UMONS, Mons, Belgium.

Arena-Independent Memory Bounds for Nash Equilibria in Reachability Games, LAMAS&SR 2024, 11/12, online.

Verifying Concisely Represented Strategies in One-Counter Markov Decision Processes, Journées Annuelles du GT Vérif 2024, Université de Lille, 20/11, Lille, France.

On the Structure of Expected Payoff Sets in Multi-Objective Markov Decision Processes, CFV, ULB, 11/10, Brussels, Belgium.

All You Have Ever Wanted to Know About the Structure of Expected Payoff Sets in Multi-Objective Markov Decision Processes, UMONS Formal Methods Reading Group, 23/09, UMONS, Mons, Belgium.

A Single Dice Roll to Satisfy All Goals: Randomisation Requirements for Strategies in Multi-Objective Markov Decision Processes, Highlights of Logic, Games and Automata 2024, 19/09, Université de Bordeaux, Bordeaux, France.

Complexity and Representations of Controllers in Reactive Synthesis, Dagstuhl Seminar on Stochastic Games, 04/06, Dagstuhl, Germany.

Arena-independent Memory Bounds for Nash Equilibria in Reachability Games, MOVEP'24: 16th school on modelling and verification of parallel processes, 29/05, INRIA Rennes, Rennes, France.

Arena-independent Memory Bounds for Nash Equilibria in Reachability Games, STACS 2024: 41st International Symposium on Theoretical Aspects of Computer Science, 12/03, Université Clermont-Auvergne, Clermont-Ferrand, France.

Arena-independent Memory Bounds for Nash Equilibria in Reachability Games, CFV, 09/02, ULB, Bruxelles, Belgium.

2023   *Arena-independent Memory Bounds for Nash Equilibria in Reachability Games*, Journées Annuelles du GT Vérif 2023, 30/11, IRIF (Université Paris-Cité), Paris, France.

Arena-independent Memory Bounds for Nash Equilibria in Reachability Games, UMONS Formal Methods Reading Group, 09/10, UMONS, Mons, Belgium.

Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions, LAMAS&SR 2023, 01/10, Jagiellonian University, Krakow, Poland.

2022   *Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions*, CONCUR 2022: The 33rd International Conference on Concurrency Theory, 14/09, University of Warsaw, Warsaw, Poland.

Timed Games with Bounded Window Parity Objectives, FORMATS 2022: 20th Conference on Formal Modeling and Analysis of Timed Systems, 14/09, University of Warsaw, Warsaw, Poland.

Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions, Journées Nationales du GT Vérif 2022, 11/07, Université de Bordeaux, Bordeaux, France.

Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions, Highlights 2022 of Logic, Games and Automata, 30/06, Université Paris-Cité, Paris, France.

Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions, UMONS Formal Methods Reading Group, 19/05, UMONS, Mons, Belgium.

Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions, PhD Day (of the Belgian Mathematical Society), 13/05, Université de Liège, Liège, Belgium.

Different Strokes in Randomised Strategies: Revisiting Kuhn's Theorem under Finite-Memory Assumptions, Current Trends in Graph and Stochastic Games (GAMENET workshop), 07/04, Maastricht University, Maastricht, the Netherlands.

Timed Automata, Weights and Abstractions, UMONS Formal Methods Reading Group, 13/01, UMONS, Mons, Belgium.

2021   *Timed Games with Window Parity Objectives*, Journées du GT Vérif, 18/11, ENS Paris-Saclay, Gif-sur-Yvette, France.

Timed Games with Window Parity Objectives, UMONS Formal Methods Reading Group, 07/10, UMONS, Mons, Belgium.

Time Flies When Looking Out of the Window: Timed Games with Window Parity Objectives, Highlights 2021 of Logic, Games and Automata, 16/08, Online.

Time Flies When Looking Out of the Window: Timed Games with Window Parity Objectives, CONCUR 2021: The 32nd International Conference on Concurrency Theory, 26/08, Online.

Research visits

– Visit to Institute of Science and Technology Austria, December 1–5, 2025.
– Visit to Joël Ouaknine at Max Planck Institute for Software Systems, Germany, March 4–7 2025.
– Visit to Petr Novotný at Masaryk University, Czech Republic, June 12–16, 2023.
– Visit to Jeremy Sproston at Università degli Studi di Torino, Italy, May 30 – June 3, 2022.

Teaching

Sept 2023 – Present	**Formal methods for system design**, *Teaching assistant*, UMONS
	Exercice sessions and project supervision for the formal methods course given by Mickael Randour.
Sept 2021 – August 2023	**Mathématiques Effectives**, *Teaching assistant*, UMONS
	Exercice sessions for the course on game theory given by Thomas Brihaye.
Sept–Oct 2018, 2019, 2020	**Elementary Mathematics**, *Student teaching assistant*, UMONS
	Supervision of in-class and remote exercise sessions; test grading.

Student supervision

Interns

Cosupervision (with Thomas Brihaye, Chloé Capon and Mickael Randour) of Baptiste Hilaire on concise representations of strategies (May to July 2024).

Jury member for master's theses

– Luca Lani (2023, UMONS)
– Nicolas Lecomte (2022, UMONS)

Attended research events

2025	Heidelberg Laureate Forum 2025, Heidelberg, Germany.
	Highlights of Logic, Games and Automata 2025, Saarland University, Saarbrücken, Germany.
	Autobóz 2025, Grenaa, Denmark.
	ICALP 2025: 52nd EATCS International Colloquium on Automata, Languages, and Programming, Aarhus University, Aarhus, Denmark.
	Storm Days, Radboud University, Nijmegen, The Netherlands.
2024	LAMAS&SR 2024 workshop, Online.
	Highlights of Logic, Games and Automata 2024, Université de Bordeaux, Bordeaux, France.
	Dagstuhl Seminar on *Stochastic Games*, Dagstuhl, Germany.
	MOVEP'24: 16th school on modelling and verification of parallel processes, INRIA Rennes, Rennes, France.
	STACS 2024: 41st International Symposium on Theoretical Aspects of Computer Science, 12/03, Université Clermont-Auvergne, Clermont-Ferrand, France.
2023	Journées Annuelles du GT Vérif 2023, IRIF (Université Paris-Cité), Paris, France.
	LAMAS&SR 2023, Jagiellonian University, Krakow, Poland.
2022	FORMATS 2022: 20th Conference on Formal Modeling and Analysis of Timed Systems, University of Warsaw, Warsaw, Poland.
	CONCUR 2022: The 33rd International Conference on Concurrency Theory, University of Warsaw, Warsaw, Poland.
	Journées Nationales du GT Vérif, Université de Bordeaux, Bordeaux, France.
	Highlights of Logic, Games and Automata 2022, Université Paris-Cité, Paris, France.

PhD Day (Belgian Mathematical Society), Université de Liège, Liège, Belgium.

Current Trends in Graph and Stochastic Games (GAMENET workshop), Maastricht University, Maastricht, The Netherlands.

2021 Journées du GT Vérif, ENS Paris-Saclay, Gif-sur-Yvette, France.

Highlights of Logic, Games and Automata 2021, Online.

CONCUR 2021: The 32nd International Conference on Concurrency Theory, Online.

2020 MOVEP 2020: 14th Summer School on Modelling and Verification of Parallel Processes, Online.

Regional Days on Model Theory and Applications, Mons.

2019 CONCUR 2019: The 30th International Conference on Concurrency Theory, Amsterdam.

Outreach and popular science

2025 *Une introduction à la théorie des jeux*, 10/03, popular science talk for university students, Mois du Doctorat 2025, UMONS, Mons, Belgium.

2024 Member of the organising committee of the *Mardi des chercheurs* 2024, 26/03, UMONS, Mons, Belgium.

2023 *À vous de jouer !*, popular science talk for secondary school students, *Journées Math-Sciences*, 23/03, UMONS, Mons, Belgium

2022 *À vous de jouer !*, popular science talk for secondary school students, *Journées Math-Sciences*, 24/03, UMONS, Mons, Belgium

Les jeux à la rescousse de l'informatique, popular science talk for university students, Mois du Doctorant 2022, 10/03, UMONS, Mons, Belgium.

Miscellaneous

Reviewing (Sub-)reviewer for Logical Methods in Computer Science, CONCUR 2025, ICALP 2025, ICALP 2024, LICS 2024, EUMAS 2023, CONCUR 2023, ICALP 2023, FoSSaCS 2023.

Academic responsibilities
– Member of the Council of the Faculty of Science at UMONS (September 2019–September 2024)

– Member of the Council of Scientific Staff at UMONS, representative of F.R.S.-FNRS staff (October 2021- September 2025)

– Member of the F.R.S.-FNRS contact committee in UMONS (October 2021- September 2025)