UNIVERSITÀ DEGLI STUDI DI MILANO selezione pubblica per n. 2 posti di Ricercatore a tempo determinato ai sensi dell'art.24, comma 3, lettera b) della Legge 240/2010 per il settore concorsuale 01/B1 - Informatica, settore scientifico-disciplinare INF/01 - Informatica presso il Dipartimento di INFORMATICA "GIOVANNI DEGLI ANTONI", (avviso bando pubblicato sulla G.U. n. 781/2022 del 14/02/2022) Codice concorso 4957

Andrea Munaro CV

Contatto

School of Mathematics and Physics
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Data di Nascita

14 Settembre 1988

Interessi di Ricerca

Teoria dei grafi, Algoritmi, Complessità computazionale, Ottimizzazione combinatoria

Posizioni Ricoperte

School of Mathematics and Physics, Queen's University Belfast, UK

Lecturer **08/2019 -**

Department of Mathematics, West Virginia University, USA

Visiting Assistant Professor **08/2018 - 05/2019**

Department of Informatics, University of Fribourg, Svizzera

Postdoc **02/2018 - 06/2018**

Faculty of Mathematics, Natural Sciences and Information Technologies, University of Primorska, Slovenia

Postdoc - Instructor **10/2017 - 01/2018**

Institute of Optimization and Operations Research, Ulm University, Germania

Postdoc - Teaching Assistant **04/2017 - 08/2017**

Istruzione e Formazione

G-SCOP Laboratory, Grenoble Alps University, Francia

Ph.D., Mathematics and Computer Science **10/2013 - 12/2016**

- Tesi: On Some Classical and New Hypergraph Invariants
- Advisors: Prof. András Sebő, Prof. Matěj Stehlík

University of Bonn, Germania

M.Sc., Mathematics **10/2010 - 11/2012**

- Tesi: Some New Bounds for VC-Dimension and ε-Nets Constructions
- Advisors: Prof. Marek Karpinski, Prof. Nitin Saxena

Università di Trento, Italia

B.Sc., Mathematics **09/2007 - 07/2010**

- Tesi: Bounds for the Orders of Finite Groups of Matrices
- Advisor: Prof. Sandro Mattarei

Liceo Scientifico Statale Nicolò Tron, Schio, Italia

Diploma Liceo Scientifico **09/2002 - 06/2007**

Pubblicazioni in Rivista

- N. Brettell, J. Horsfield, A. Munaro, G. Paesani, and D. Paulusma, "Bounding the mim-width of hereditary graph classes", *Journal of Graph Theory*, vol. 99, no. 1, pp. 117–151, 2022. DOI: 10.1002/jgt.22730
- N. Brettell, J. Horsfield, A. Munaro, and D. Paulusma, "List k-colouring P_t-free graphs: A mim-width perspective", *Information Processing Letters*, vol. 173, 2022, article number 106168. DOI: 10.1016/j.ipl.2021.106168
- M. Bonamy, F. Dross, T. Masařík, A. Munaro, W. Nadara, M. Pilipczuk, and M. Pilipczuk, "Jones' Conjecture in subcubic graphs", *The Electronic Journal of Combinatorics*, vol. 28, no. 4, 2021, article number P4.5. DOI: 10.37236/9192
- J. Long, K. Milans, and A. Munaro, "Sublinear longest path transversals", *SIAM Journal on Discrete Mathematics*, vol. 35, no. 3, pp. 1673–1677, 2021. DOI: 10.1137/20M1362577
- N. Champseix, E. Galby, A. Munaro, and B. Ries, "CPG graphs: Some structural and hardness results", *Discrete Applied Mathematics*, vol. 290, pp. 17–35, 2021. DOI: 10.1016/j.dam.2020.11.018
- E. Galby, A. Munaro, and B. Ries, "Semitotal Domination: New hardness results and a polynomial-time algorithm for graphs of bounded mim-width", *Theoretical Computer Science*, vol. 814, pp. 28–48, 2020. DOI: 10.1016/j.tcs.2020.01.007
- A. Munaro, "Triangle packings and transversals of some K_4-free graphs", *Graphs and Combinatorics*, vol. 34, no. 4, pp. 647–668, 2018. DOI: 10.1007/s00373-018-1903-y
- A. Munaro, "Boundary classes for graph problems involving non-local properties", *Theoretical Computer Science*, vol. 692, pp. 46–71, 2017. DOI: 10.1016/j.tcs.2017.06.012
- A. Munaro, "Bounded clique cover of some sparse graphs", *Discrete Mathematics*, vol. 340, no. 9, pp. 2208–2216, 2017. DOI: 10.1016/j.disc.2017.04.004
- A. Munaro, "On line graphs of subcubic triangle-free graphs", *Discrete Mathematics*, vol. 340, no. 6, pp. 1210–1226, 2017. DOI: 10.1016/j.disc.2017.01.006

- A. Munaro, "The VC-dimension of graphs with respect to k-connected subgraphs", *Discrete Applied Mathematics*, vol. 211, pp. 163–174, 2016. DOI: 10.1016/j.dam.2016.04.016

Pubblicazioni in Atti Convegno

- F. Bonomo-Braberman, N. Brettell, A. Munaro, and D. Paulusma, "Solving problems on generalized convex graphs via mim-width", in *Algorithms and Data Structures - 17th International Symposium (WADS 2021)*, ser. Lecture Notes in Computer Science, vol. 12808, Springer, 2021, pp. 200–214. DOI: 10.1007/978-3-030-83508-8_15
- E. Galby and A. Munaro, "Approximating Independent Set and Dominating Set on VPG graphs", in *37th European Workshop on Computational Geometry (EuroCG'21)*, 2021, 46:1–46:7. [Online]. Available: http://eurocg21.spbu.ru/accepted-papers
- N. Brettell, J. Horsfield, A. Munaro, G. Paesani, and D. Paulusma, "Bounding the mim-width of hereditary graph classes", in *15th International Symposium on Parameterized and Exact Computation (IPEC 2020)*, ser. Leibniz International Proceedings in Informatics (LIPIcs), vol. 180, Schloss Dagstuhl–Leibniz-Zentrum für Informatik, 2020, 6:1–6:18. DOI: 10.4230/LIPIcs.IPEC.2020.6
- Z. Deniz, E. Galby, A. Munaro, and B. Ries, "On contact graphs of paths on a grid", in *Graph Drawing and Network Visualization - 25th International Symposium (GD 2018)*, ser. Lecture Notes in Computer Science, vol. 11282, Springer, 2018, pp. 317–330. DOI: 10.1007/978-3-030-04414-5_22

Lavori Sottomessi

- E. Galby and A. Munaro, *Approximating Independent Set and Dominating Set on VPG and EPG graphs*
- J. Long, K. Milans, and A. Munaro, *Non-empty intersection of longest paths in H-free graphs*. [Online]. Available: https://andreamunaro.github.io

Lavori in Preparazione

- M. Milanič and A. Munaro, *Equistable claw-free graphs*
- A. Munaro and S. Yang, *Mim-width of (H_1, H_2)-free graphs: The case of H_1 complete or edgeless*
- F. Bonomo-Braberman, N. Brettell, A. Munaro, and D. Paulusma, *Classifying the thinness of H-graphs*
- N. Brettell, A. Munaro, and D. Paulusma, *Equivalence of width parameters on graph classes*

Problems and Solutions

3 Problemi proposti in Mathematical Reflections

70 Soluzioni proposte in:

- The American Mathematical Monthly
- The College Mathematics Journal
- Mathematical Reflections
- Crux Mathematicorum
- La Gaceta de la Real Sociedad Matemática Española

ATTIVITÀ DIDATTICA

Algorithmic Thinking, BSc
- Tutor (6h), Queen's University Belfast **2021/2022**

Introduction to Probability & Statistics, BSc
- Docente (52h), Queen's University Belfast **2021/2022**

Mathematical Reasoning, BSc
- Tutor (12h), Queen's University Belfast **2021/2022**
- Tutor (12h), Queen's University Belfast **2020/2021**

Stochastic Processes and Risk, BSc
- Docente (60h), Queen's University Belfast **2020/2021**
- Docente + TA (60h + 12h), Queen's University Belfast **2019/2020**

Mathematical Modelling, BSc
- Tutor (6h), Queen's University Belfast **2020/2021**

Algorithmic Graph Theory, MSc/PhD
- Docente (48h), West Virginia University **2018/2019**

Introduction to Cryptography, BSc
- Docente (48h), West Virginia University **2018/2019**

Calculus 2 (tre sezioni), BSc
- Docente (180h), West Virginia University **2018/2019**

Analysis III - Functions of Many Variables, BSc
- Docente (60h), University of Primorska **2017/2018**

Graph Theory 2, MSc
- Assistente (22h), Ulm University **2016/2017**

Anno	Modulo	Corso Laurea	Ore	Tipologia
2021/2022	Introduction to Probability & Statistics	BSc Math, Math & Finance, Math & OR, Actuary	52h	Docente
2021/2022	Algorithmic Thinking	BSc Math, Math & OR, Math & CS	6h	Tutor
2021/2022	Mathematical Reasoning	BSc Math, Math & OR, Math & CS	12h	Tutor
2020/2021	Stochastic Processes and Risk	BSc Math, Math & Finance, Math & OR	60h	Docente
2020/2021	Mathematical Reasoning	BSc Math, Math & OR, Math & CS	12h	Tutor
2020/2021	Mathematical Modelling	BSc Math, Math & OR, Math & CS	6h	Tutor
2019/2020	Stochastic Processes and Risk	BSc Math, Math & Finance, Math & OR	60h + 12h	Docente + TA
2018/2019	Algorithmic Graph Theory	MSc/PhD Math	48h	Docente
2018/2019	Introduction to Cryptography	BSc Math	48h	Docente
2018/2019	Calculus 2 (three sections)	BSc Engineering	180h	Docente
2017/2018	Analysis III - Functions of many variables	BSc Math	60h	Docente
2016/2017	Graph Theory 2	MSc Math, CS	22h	TA

Supervisione Studenti

- Shizhou Yang, PhD Mathematics, Queen's University Belfast **2021 -**
- Yun Chen, BSc Mathematics and Computer Science, Queen's University Belfast **2021/2022**
- Xin Wang, BSc Mathematics, Queen's University Belfast **2021/2022**
- Matthew Leonard, MSci Mathematics, Queen's University Belfast **2020/2021**
- James Tennyson, MSci Mathematics, Queen's University Belfast **2019/2020**

Presentazioni e Seminari

Solving problems on generalized convex graphs via mim-width

- 17th Algorithms and Data Structures Symposium (WADS 2021), Dalhousie University **08/2021**

Bounding the mim-width of hereditary graph classes

- 15th International Symposium on Parameterized and Exact Computation (IPEC 2020), Hong Kong Polytechnic University **12/2020**

Width parameters and graph classes: the case of mim-width

- Mathematical Research Seminar, University of Primorska (invito) **06/2020**
- Minisymposium "Algorithmic Graph Theory" in 8th European Congress of Mathematics, Portorož (invito) **06/2021**
- 28th British Combinatorial Conference, Durham University **07/2021**

Semitotal Dominating Set

- Algorithms and Complexity Seminar, Durham University (invito) **11/2019**

Semitotal Domination: New hardness results and a polynomial-time algorithm for graphs of bounded mim-width

- 50th Southeastern International Conference on Combinatorics, Graph Theory & Computing, Florida Atlantic University (invito) **03/2019**

On Semitotal Domination in graphs

- Veszprém Discrete Mathematics and Applications Conference, University of Pannonia **06/2018**

Boundary classes for graph problems involving non-local properties

- Mathematical Research Seminar, University of Primorska (invito) **03/2017**
- Research Seminar, Ulm University (invito) **05/2017**
- Computer Science Research Seminar, Università di Verona (invito) **09/2017**

On Tuza's Conjecture

- Journées Graphes et Algorithmes, University of Burgundy **11/2014**

On the VC-dimension of a hypergraph

- Séminaire de Mathématiques Discrètes, G-SCOP Laboratory (invito) **06/2013**

The VC-dimension of graphs with respect to k-connected subgraphs

- 12th Cologne-Twente Workshop on Graphs and Combinatorial Optimization, University of Twente **05/2013**
- Journées Graphes et Algorithmes, Paris-Sud University **10/2013**

Workshop ad Invito

Dagstuhl Seminar "Vertex Partitioning in Graphs: From Structure to Algorithms"

- Schloss Dagstuhl, rinviato dal 2021 **11/2022**

10th Workshop on Graph Classes, Optimization, and Width Parameters - GROW 2022

- University of Primorska, rinviato dal 2021 **09/2022**

Conferenze Organizzate

Workshop "Graph Width Parameters: from Structure to Algorithms (GWP 2022)" co-organizzato con Flavia Bonomo-Braberman, Nick Brettell e Daniël Paulusma

- In 49th International Colloquium on Automata, Languages, and Programming (ICALP 2022), Université de Paris **07/2022**

Workshop "Graph Width Parameters: from Structure to Algorithms (GWP 2021)" co-organizzato con Flavia Bonomo-Braberman, Nick Brettell e Daniël Paulusma

- In 48th International Colloquium on Automata, Languages, and Programming (ICALP 2021), University of Glasgow **07/2021**

Partecipazione a Conferenze

EuroCG 2021, 37th European Workshop on Computational Geometry

- Saint-Petersburg University **04/2021**

ICGT 2018, 10th International Colloquium on Graph Theory and Combinatorics

- Claude Bernard University Lyon 1 **07/2018**

ECCO XXXI

- University of Fribourg **06/2018**

SGT 2015, School on Topological Methods in Graph Theory

- CNRS, Nice Sophia Antipolis University **05/2015**

ICGT 2014, 9th International Colloquium on Graph Theory and Combinatorics

- Grenoble INP, Joseph Fourier University **06/2014**

European Conference on Combinatorics, Graph Theory and Applications - EuroComb 2013

- CNR Pisa **09/2013**

Kolloquium über Kombinatorik

- University of Magdeburg **11/2011**

Workshop on block ciphers and their security

- Università di Trento **12/2009**

Soggiorni di Ricerca

University of Primorska, Slovenia

- Collaborazione con Martin Milanič, Clément Dallard e Matjaž Krnc **01/2022**
- Collaborazione con Martin Milanič **02/2017 - 03/2017**

Durham University, UK
- Collaborazione con Daniël Paulusma, Nick Brettel e Giacomo Paesani **11/2019**

University of Fribourg, Svizzera
- Collaborazione con Bernard Ries ed Esther Galby **06/2019**

Domanda Finanziamento

Progetto "Graph Width Parameters: from Structure to Algorithms"
- co-richiedente con Daniël Paulusma (PI), Matthew Johnson (co-richiedente) e Nick Brettell (co-richiedente): la durata proposta del progetto è 3 anni e la somma richiesta 190,603 GBP **sottomessa**

Premi, Borse e Finanziamenti

QUB Start-Up Grant for early-career researchers
- Assegnato da Queen's University Belfast **08/2019**
- Budget: 10,000 GBP

Post-Doctoral Grant
- Assegnato da University of Fribourg con estensione di 1 mese a carico del Dipartimento di Informatica **02/2018 - 06/2018**
- Budget: 10,800 CHF

Ph.D. Fellowship
- Assegnato da Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation **2013 - 2016**

DAAD Study Scholarship **10/2011 - 09/2012**

17th International Mathematics Competition for University Students
- Third Prize **07/2010**

16th International Mathematics Competition for University Students
- Honorable Mention **07/2009**

Rimborso parziale tasse per merito
- Assegnato da Università di Trento **2008 - 2009**

Rimborso parziale tasse per merito
- Assegnato da Università di Trento **2007 - 2008**

Albo Nazionale delle Eccellenze
- Assegnato da Ministero dell'Istruzione, dell'Università e della Ricerca **09/2007**

XXIII Olimpiade Italiana di Matematica
- Medaglia d'Argento **05/2007**

Attività Amministrative

Queen's University Belfast
- Advisor of Studies per corsi di Matematica **2021 -**

- Partecipazione a gruppi di lavoro su riforma curriculum e istituzione nuovo programma MSci Applied Mathematics **2020 - 2021**

REVIEWER Theoretical Computer Science; Discrete Applied Mathematics; Discrete Mathematics; International Workshop on Graph-Theoretic Concepts in Computer Science (WG); Latin and American Algorithms, Graphs and Optimization Symposium (LAGOS)

LINGUE Italiano (lingua madre), inglese (ottimo), francese (ottimo)

REFERENZE

Martin Milanič
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Cover Letter

I am currently a Lecturer (Assistant Professor) at Queen's University Belfast, UK. My research interests lie primarily in the fields of Graph Theory, Algorithmics, Computational Complexity and Combinatorial Optimization.

I did my Master studies in Mathematics at the University of Bonn (Germany), supported by a DAAD Study Scholarship, and wrote my Master thesis entitled "Some New Bounds for VC-Dimension and ε-Nets Constructions" under the supervision of Prof. Marek Karpinski and Prof. Nitin Saxena. I then moved to France, where I obtained a Ph.D. in Mathematics and Computer Science in December 2016 at Université Grenoble Alpes, supported by a 3-year Ph.D. Fellowship of the French Ministry of Higher Education and Research. My thesis, entitled "On Some Classical and New Hypergraph Invariants", was written under the supervision of Prof. András Sebő and Prof. Matěj Stehlík. It resulted in 5 single-authored publications in Discrete Applied Mathematics, Discrete Mathematics, Theoretical Computer Science and Graphs and Combinatorics, thus showing an acquired scientific maturity and independence. An additional joint work (Bonamy et al., Electron. J. Comb. 2021) is based on one of the results in my thesis.

I then obtained four short postdoctoral positions which allowed me to establish a research network of ongoing fruitful collaborations with leading mathematicians and computer scientists. I was first at the University of Ulm (Germany), in the group of Prof. Dieter Rautenbach, and then at the University of Primorska (Slovenia), supervised by Prof. Martin Milanič. In February 2018, I was awarded a Post-Doctoral Grant (10,800 CHF) by the University of Fribourg (Switzerland), where I worked in the group of Prof. Bernard Ries. This 3-month grant was extended to 4 months by the Department of Informatics. In this period, I started working on two central topics in Graph Theory and Algorithmics: graph width parameters and intersection graphs of curves in the plane. I finally moved to West Virginia University (USA), working with Prof. Kevin G. Milans on a project about longest path transversals.

Since August 2019 I am a Lecturer (Assistant Professor) at Queen's University Belfast (UK). Upon arrival, I obtained a Start-Up Grant (10,000 GBP) for early career researchers which allowed me to fund research stays at Durham University and University of Primorska, and the visit of a longtime collaborator (Esther Galby). At QUB, I have supervised the final-year projects of 2 M.Sci. students and, since May 2021, I am the Ph.D. supervisor of Shizhou Yang, a student coming from Oxford and working on a project about mim-width. I am learning a lot from this first Ph.D. supervision and we have recently finalized our first joint paper. I had previously collaborated with 5 graduate students (N. Champseix, E. Galby, J. Horsfield, J. A. Long, G. Paesani) on a total of 8 papers.

In my significant experience as instructor and teaching assistant of undergraduate and graduate courses, I have been a staunch promoter of strengthening links between teaching and research. For example, in my tutorials for the graduate course "Graph Theory 2" at the University of Ulm, I assigned some special cases of recently published results as bonus questions and assisted students in attacking these problems. They reacted with enthusiasm and in some cases brilliant solutions were proposed. I have also been involved in professional service and administrative duties. For example, at QUB, I participated in working groups on curriculum reform and on the design of a new Master programme in Applied Mathematics. Since 2021, I am also one of four Advisors of Studies for Mathematics programmes and my job consists in advising students on courses and programmes choices, a demanding but important job with direct consequences on students' careers.

I am currently working on two research projects, both related to graph width parameters. The main project aims at developing a unifying approach to advance on several major open problems in the area of structural and algorithmic graph theory. It started in 2019 after my fruitful research visit to Durham University and, in order to support this initiative, I have recently submitted (as co-applicant) a grant proposal (see CV). I had previously contributed to the writing of a project proposal for an ERC

Consolidator Grant. Even though the proposal was unsuccessful, it helped me in getting familiar with grant applications and management.

The second project I am currently working on is related to the recently defined width parameter called tree-independence number (Dallard et al., arxiv.org/abs/2111.04543 2021). It is a collaboration with the group of Prof. Milanič and was started during my visit to the University of Primorska in January 2022.

In relation to the active line of research on width parameters, I have co-organized in 2021 a satellite workshop of the prestigious ICALP conference series. The workshop, entitled "Graph Width Parameters: From Structure to Algorithms", aimed at bringing together researchers working on different width parameters. It consisted of 6 talks given by renowned invited speakers and an open problem session. It turned out to be extremely successful, and the fact that ICALP 2022 accepted our proposal for a second edition (see https://icalp2022.irif.fr) testifies the general interest for the research line I am pursuing. The scientific quality and recognition of my research in this area is also witnessed by an invitation to the Dagstuhl Seminar "Vertex Partitioning in Graphs: From Structure to Algorithms" and to the 10th Workshop on Graph Classes, Optimization, and Width Parameters - GROW 2022. These are *invitation only* workshops attended by leading experts in the fields of Graph Theory and Algorithmics, such as Maria Chudnovsky and Bojan Mohar, aimed at discussing recent developments and promoting new research discoveries via collaborations between participants.

Summary of current research interests

My research interests lie primarily in the fields of Graph Theory and Algorithmics. These fields have attracted enormous attention in recent decades due to their connections and applications in other disciplines of Mathematics and Computer Science and in different fields such as Biology and Social Sciences. My main research line is related to *graph width parameters* and consists in an *interdisciplinary* mix of Mathematics (Structural Graph Theory, Combinatorics) and Computer Science (Algorithmics, Computational Complexity).
Solving a discrete optimization problem means seeking an optimal solution from finitely many options, e.g. an optimal delivery route or job allocation. Most discrete optimization problems are computationally hard. To overcome this, we may restrict the input and ask:

Which input restrictions lead to "fast" algorithms?

The input is often described by a graph and knowing that this graph has small "width" is highly useful for designing efficient algorithms for many well-known problems.
My research consists in a systematic study to determine exactly which graph restrictions ensure small width for a hierarchy of width parameters. I aim at obtaining complexity dichotomies for large sets of graph problems, telling us exactly for which graph classes a certain problem can or cannot be solved efficiently. To achieve this goal, together with my main collaborators Prof. Daniël Paulusma (Durham University), Dr. Nick Brettell (Victoria University of Wellington) and Prof. Flavia Bonomo-Braberman (University of Buenos Aires), I am employing a novel and ambitious approach: performing, *for the first time*, an *extensive*, *systematic* and *comparative study* into the modelling power of a hierarchy of graph width parameters for problems under input restrictions. Our study will provide conclusive proof that boundedness of width is the key tool for designing efficient algorithms.
In a recent series of papers focusing on mim-width, one of the most powerful width parameters, and linking structural aspects to algorithmic ones, we demonstrate the effectiveness of our approach. Indeed, we generalize a large number of polynomial-time algorithms for problems restricted to hereditary classes: For example, a famous 12-year-old graph colouring result with 145 Google Scholar citations

(Hoàng et al., Algorithmica 2010) and several recent results, e.g., (Chudnovsky et al., Proc. ESA 2020; Chudnovsky et al., Discrete Math. 2020). I presented our findings at two high rank Theoretical Computer Science conferences (IPEC 2020 and WADS 2021) and was invited to give a talk at the symposium "Algorithmic Graph Theory" of the 8th European Congress of Mathematics.

Data 31/03/2022 Luogo Belfast