Curriculum vitae Paola Cristofori
(last update 30 December 2022)

Personal data

Born in Ferrara (Italy) on November 15, 1964
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Positions

- Since December 1, 2019. Associate Professor (MAT/03 Geometry), Department of Physics, Informatics and Mathematics, University of Modena and Reggio Emilia
- September 2000 – November 2019. Research assistant (MAT/03 Geometry), Faculty of Science (from 2012: Department of Physics, Informatics and Mathematics), University of Modena and Reggio Emilia.
- April 1995-April 1997. Post-doctoral scholarship, University of Modena.

Education

- August 5, 1994. PhD degree; dissertation: *Rappresentazioni di varieta` ed insiemi universali di ramificazione* (*Representations of manifolds and universal branching sets*); supervisor: Prof. L. Grasselli.
- October 1991-December 1992. Visiting PhD student at the Universidad Complutense and UNED of Madrid (Spain).
- March 1990-October 1993. PhD student at the University of Florence.
- November 1989-February 1990: Istituto Nazionale di Alta Matematica (INDAM) scholarship.
- November 15, 1988. First degree in Mathematics cum laude from the University of Ferrara; dissertation: *Algoritmi di semplificazione per triangolazioni di varieta` lineari a tratti* (*Simplification algorithms for triangulations of PL manifolds*), supervised by Prof. Carlo Gagliardi.

Teaching

Faculty of Science
- 2000-2001: Geometry II, degree in Mathematics.
- 2001-2002: Geometry I, Geometry II, degree in Mathematics.
- 2003-2004, 2005-2006: Geometry I/Linear Algebra (degree in Mathematics and degree in Computer Science), Geometry II/Discrete Matematics (degree in Mathematics and degree in Computer Science).
- 2004-2005, 2006-2007: Geometry III, degree in Mathematics.
- From 2007-2008 to 2011-2012 : Geometry A/Linear Algebra (degree in Mathematics and degree in Computer Science).
- 2008-2009, 2010-2011 : Geometry B, degree in Mathematics.

Faculty of Engineering
- 2001-2002: Geometry A, degree in Mechanical Engineering.
- 2003-2004: Geometry A, degree in Electronic and Telecommunications Engineering.
- From 2004-2005 to 2006-2007 : Geometry B, degree in Electronic and Telecommunications

Engineering and degree in Computer Engineering; Fundamentals of Geometry, degree in Environmental Geometry.
- 2007-2008, 2008-2009 : Geometry, degree in Civil Engineering and degree in Environmental Engineering.
- From 2009-2010 to 2011-2012 : Geometry, degree in Civil and Environmental Engineering.

Department of Physics, Computer Science, Mathematics (FIM)
- 2012-2013 : Geometry B, degree in Mathematics.
- 2017-18: Geometry, degree in Physics.
- Since 2020-21: Algebraic Topology, degree in Mathematics.
- 2020-21, 2022-23: Geometric Topology of manifolds, Master degree in Mathematics.

Department of Engineering (DIEF)
- Since 2013-2014: Geometry, degree in Civil and Environmental Engineering.
- 2016-2017 : Geometry, degree in Computer Engineering.

I supervised 8 theses for the Bachelor and 5 theses for the Master's degree in Mathematics.

I am Erasmus coordinator of Department FIM for the degrees in Mathematics.

$$\boxed{\textbf{Scientific activity}}$$

My researches fit into geometric topology. The obtained results may be subdivided into the following main subjects.

Representation theory for PL n-manifolds by means of (n+1)-coloured graphs:
- study of a combinatorial invariant (regular genus) of PL n-manifolds by proving its coincidence in dimension 3 with the Heegaard genus and by providing upper bounds for particular classes of 3-manifolds;
- generalization of the concept of regular genus to the case of 3-manifolds with disconnected boundary;
- comparison of different notions of complexity for compact 3-manifolds and search for upper bounds for Matveev's complexity through combinatorial invariants;
- automatic generation of catalogues of 3- and 4-manifolds of a given complexity with possible bounds on the genus;
- search and implementation of algorithms for the recognition of the manifolds in the catalogues by their suitable partition into homeomorphism classes. Generation and analysis of the catalogues are performed by exploiting CINECA supercomputing resources within ISCRA-projects (project of type B: "Cataloguing PL-manifolds in dimension 3 and 4 via crystallization theory").

3-manifolds and knot theory:
- study of strongly-cyclic branched coverings of (g,1)-knots, by establishing necessary and sufficient conditions for their existence, computing their number up to equivalence and obtaining a g-cyclic presentation for their fundamental groups;
- relations between strongly-cyclic branched coverings of (2,1)-knots and Heegaard diagrams admitting a cyclic symmetry;
- study of families of closed 3-manifolds which are cyclic or strongly-cyclic coverings of links in lens spaces.

Quite recently, in Mathematical Physics, a link between colored graphs and random tensors has been established through Colored Tensor Models (CTM), that generalize to higher dimension the 2-dimensional Quantum Gravity model realized in the theory of random matrices; in fact, the Feynman graphs of a d-dimensional CTM are (d + 1)-colored graphs. Some results have already been obtained in the study of a PL invariant the Gurau degree, defined on colored graphs, that, in the context of CTM's, is important in order to recover information about the topology and geometry of the pseudo-manifolds encoded in the 1/N-expansion, which is empowered precisely by the Gurau degree.

Since November 2005 I am reviewer for Mathematical Reviews.

Conferences, talks, poster

- 3/06/2022: *Combinatorics 2022* (Mantova, 30/05-3/06/2022). *From Kirby diagrams to edge-colored graphs representing PL 4-manifolds*.
- 24/06/2021: *8th European Congress of Mathematics* (20-26/06/2021, Portoroz, Slovenia) - minisymposium ``Applied Combinatorial and Geometric Topology". Talk (online): *Classifying compact PL 4-manifolds according to generalized regular genus and G-degree* (invitation by the Organizing Committee).
- 3/06/2020: *Séminaire Tensor Journal Club*. Invited talk (online): *Crystallizations of compact 4-manifolds minimizing combinatorially defined PL-invariants* (http://math.univ-lyon1.fr/homes-www/vignes/TJC/Now)
- 5-9/11/2018: *Nagoya workshop on Physics and Mathematics of Discrete Geometries*, Nagoya University. *Topological aspects of colored tensor models* (invitation by the Organizing Committee).
- 17-20/09/2018: *Joint Meeting UMI-SIMAI-PTM*, Wroclaw, special session: *Computational Aspects of Applied Topology*. Talk: *Topological aspects of Colored Tensor Models in Quantum Gravity*.
- 7-9/06/2018: *101th Encounter between Mathematicians and Theoretical Physicists "Geometry, topology of manifolds, and physics"*, Institut de Recherche Mathématique Avancée (University of Strasbourg and CNRS). Poster: *Topology in colored tensor models* (joint with M.R. Casali and L. Grasselli).
- 30/01-03/02/2017: *Congreso Bienal de la Real Sociedad Matemática Española*, Sesión Especial: Topología Geométrica, Zaragoza. Invited talk: *Topology in colored tensor models via crystallization theory.*
- 2nd French-Russian Conference "Random Geometry and Physics", Paris, Institut Henri Poincarè, 17-21/10/2016, plenary conference *"Representing PL-manifolds by edge-colored graphs: basic concepts and recent results"* (invitation by the Organizing Commitee)
- Workshop "Colored Graphs and Random Tensors" - LPT Orsay, 14-15/01/2016; conferences *"Complexity notions on colored graphs"* and *"Crystallization theory: extensions to the singular and boundary case"* (after an invitation by V. Rivasseau).
- XX Convegno U.M.I. - Siena, 7-12/09/2015; talk "*Classifying PL 4-manifolds by regular genus and gem-complexity*".
- Combinatorics 2012 - Perugia, September 9-15, 2012; talk "*Colored graphs representing PL 4-manifolds*".
- XIX Convegno U.M.I. - Bologna, September 12-17, 2011; talk "*Estimations of Matveev complexity of a 3-manifold: generalized Heegaard diagrams and colored graphs*".
- XVII Convegno U.M.I. - Milano, Sptember 8-13, 2003; talk "*A generalization of Dunwoody manifolds*".
- November 28, 2001: Département de Mathématique de l'Ecole Polytechnique Fédérale de Lausanne, conference "*Representing manifolds by crystallization theory*" (after an invitation by P. Buser).
- XV Convegno UMI - Padova, September 11-16, 1995: talk "*Heegaard and regular genus for orientable 3-manifolds with boundary*".

- IV Convegno del gruppo nazionale di Topologia, Padova, June 2-3, 1989: talk "*Simplification algorithms for triangulations of PL manifolds*".

Participation in courses and schools

- School in Low-Dimensional Geometry and Topology: Discrete and Algorithmic Aspects, Institut Henri Poincaré, Paris, June 18-22, 2018.
- Advanced School and Conference on Knot Theory and its Applications to Physics and Biology, International Centre for Theoretical Physics, Trieste, May 11-19, 2009.
- *Parallel Programming using MPI*, CINECA 2008.
- *Dal C alla programmazione ad oggetti in C++*, CINECA, November 14-16, 2007.
- *Algebraic Topology* (Proff. J.M. Kister and R. Piccinini) - Scuola Matematica Interuniversitaria, Cortona, 1991.
- PhD course by Prof. J.M. Montesinos, Universidad Complutense di Madrid, 1991-1992.
- INDAM: *Analisi Funzionale, Analisi Numerica, Geometria Algebrica*, Roma, November 1989-February 1990.
- *Algebraic Topology* (Prof. R. Piccinini), *Differential Geometry* (Prof. C. Le Brun) – Scuola Matematica Interuniversitaria, Perugia, 1989.

Visiting periods

- February 21-26, 2011: after an invitation by Antonio Costa, visit at the Departamento de Matematicas Fundamentales de la U.N.E.D. (Madrid).
- November 26-29, 2001: after an invitation by Peter Buser, visit at the Département de Mathématique de l'Ecole Polytechnique Fédérale de Lausanne.

Reasearch projects and PhD boards

- 01/11/2013 - present: member of the Board of the PhD in Mathematics (University of Ferrara, University of Modena and Reggio Emilia, University of Parma).
- 2019-2021: FAR 2019 *Discrete Methods in Combinatorial Geometry and Geometric Topology*, coordinator M. R. Casali.
- 2018/19: Fondo per il finanziamento delle attività base di ricerca (FFABR)
- 01/03/2017 - 01/03/2019: FAR 2016, *Colored graphs representing pseudomanifolds: an interaction with random geometry and physics*, coordinator P. Cristofori.
- From 01/11/2012 to 31/10/2015: member of the Board of the PhD in Mathematics and Computer Science (University of Ferrara, University of Modena and Reggio Emilia), n. XXVIII
- 15/12/2011 - 15/04/2013: ISCRA-Cineca type B project: "Cataloguing PL-manifolds in dimension 3 and 4 via crystallization theory", coordinator: Prof. M.R. Casali(University of Modena and Reggio Emilia).
- PRIN 2012: "Strutture Geometriche, Combinatoria e loro Applicazioni" coordinator: Prof. G. Lunardon.
- 19/07/2010 - 19/06/2011: ISCRA-Cineca type C project: "Generation and classification of PL-manifolds catalogues via contracted coloured triangulations", coordinator: Prof. M.R. Casali(University of Modena and Reggio Emilia).
- CoFin/Prin 2007: project "Proprietà Geometriche delle Varietà Reali e Complesse", coordinator: Prof. V. Ancona (University of Florence).
- CoFin/Prin 2005: project "Proprietà Geometriche delle Varietà Reali e Complesse",

coordinator: Prof. V. Ancona (University of Florence).
- CoFin 2002: project "Proprietà Geometriche delle Varietà Reali e Complesse", coordinator: Prof. V. Ancona (University of Florence).
- CoFin 2000: project: "Proprietà Geometriche delle Varietà Reali e Complesse", coordinator: Prof. V. Ancona (University of Florence).

Publications

1. R. Chiavacci – P. Cristofori – C. Gagliardi, *Linking two minimal triangulations of CP^2* , Rendiconti dell'istituto di Matematica dell'Università di Trieste 25 (1993), 127-140.

2. P. Cristofori - C. Gagliardi - L. Grasselli, *Heegaard and regular genus of 3-manifolds with boundary*, Revista Matemática de la Universidad Complutense de Madrid 8 (1995), 379-398.

3. P. Cristofori – P. Bandieri, *Moves on coloured spines*, Rivista Matematica Univ. Parma, 4 (1995), 147-159.

4. P. Cristofori, *Heegaard and regular genus agree for compact 3-manifolds*, Cahiers de Topologie et Géométrie Différentielle Catégoriques 39 (1998), 221-235.

5. P. Cristofori, *Generalized regular genus for manifolds with boundary*, Le Matematiche 58 (2003) fasc. I, 51-65.

6. P. Cristofori, *On the genus of $S^m \times S^n$*, J.Korean Math.Soc. 41 (2004), No. 3, 407-421.

7. M.R. Casali – P. Cristofori, *Computing Matveev's complexity via crystallization theory: the orientable case*, Acta Appl. Math. 92 (2006), 113-123.

8. P. Cristofori – M. Mulazzani – A. Vesnin, *Strongly-cyclic branched coverings of knots via (g,1)-decompositions*, Acta Math. Hungar. 116 (2007), 163-176.

9. M.R. Casali – P. Cristofori, *A catalogue of orientable 3-manifolds triangulated by 30 coloured tetrahedral*, Journal of Knot Theory and its Ramifications 17 (2008), no.5, 579-599.

10. P. Bandieri – P. Cristofori – C. Gagliardi, *Non-orientable 3-manifolds admitting coloured triangulations with at most 30 tetrahedra*, Journal of Knot Theory and its Ramifications 18 (3) (2009), 381-395.

11. P. Bandieri – P. Cristofori – C. Gagliardi, *A census of genus-two 3-manifolds up to 42 coloured tetrahedra*, Discrete Mathematics 310 (2010), 2469-2481.

12. P. Bandieri - M. R. Casali - P. Cristofori - L. Grasselli - M. Mulazzani, *Computational aspects of crystallization theory: complexity, catalogues and classifications of 3-manifolds*, Atti del Seminario Matematico e Fisico dell'Università di Modena e Reggio Emilia 58 (2011), 11-45.

13. P. Cristofori - T. Kozlovskaya - A. Vesnin, *Cyclic generalizations of two hyperbolic icosahedral manifolds*, Topology and Its Applications 159 (8) (2012), 2071–2081.

14. M.R. Casali – P. Cristofori - M. Mulazzani, *Complexity computation for compact 3-manifolds via crystallizations and Heegaard diagrams*, Topology and Its Applications 159 (13) (2012), 3042-3048.

15. M.R. Casali - P. Cristofori, *Computing Matveev's complexity via crystallization theory: The boundary case*, Journal of Knot Theory and its Ramifications, **22** (8) (2013), 1350038-1350067.

16. A. Marani – M. Rivi – P. Cristofori, *Generation of Catalogues of PL n-manifolds: Computational Aspects on HPC Systems*, Scalable Computing. Practice and Experience 14 (1) (2013), 5-15.

17. M.R. Casali - P. Cristofori, *Coloured graphs representing PL 4-manifolds*, Electronic Notes in Discrete Mathematics 40 (2013), 83-87.

18. P. Cristofori, *A code for disconnected edge-colored graphs*, JP Journal of Geometry and Topology 13 (2) (2013), 173-187.

19. M.R. Casali – P. Cristofori, *A note about complexity of lens spaces*, Forum Mathematicum 27 (6) (2015), 3173-3188.

20. M.R. Casali – P. Cristofori, *Cataloguing PL 4-manifolds by gem-complexity*, Electronic Journal of Combinatorics 22 (4) (2015), 1-25.

21. P. Cristofori – M. Mulazzani, *Compact 3-manifolds via 4-colored graphs*, RACSAM 110 (2) (2016), 395-416.

22. M.R. Casali – P. Cristofori – C. Gagliardi, *PL 4-manifolds admitting simple crystallizations: framed*

links and regular genus, Journal of Knot Theory and its Ramifications 25 (1) (2016), 1-14.

23. M.R. Casali – P. Cristofori – C. Gagliardi, *Classifying PL 4-manifolds via crystallizations: results and open problems,* in: ``A Mathematical Tribute to Professor Josè Marìa Montesinos Amilibia", Universidad Complutense Madrid (2016). ISBN: 978-84-608-1684-3

24. P. Cristofori – E. Fominykh – M. Mulazzani – V. Tarkaev, *4-colored graphs and knot/link complements*, Results in Math. 72 (2017), 471-490.

25. A.F. Costa, - P. Cristofori – A.M. Porto, *The double of the doubles of Klein surfaces*, Rev. Mat. Iberoamericana 33 (2017), 183-194.

26. P. Cristofori – E. Fominykh – M. Mulazzani – V. Tarkaev, *Minimal 4-colored graphs representing an infinite family of hyperbolic 3-manifolds,* RACSAM 112 (2018) 781-792.

27. M.R. Casali – P. Cristofori – L. Grasselli, *G-degree for singular manifolds*, RACSAM 112 (3) (2018), 693-704.

28. M.R. Casali - P. Cristofori - S. Dartois - L. Grasselli, *Topology in colored tensor models via crystallization theory*, J. Geom. Phys. 129 (2018), 142-167.

29. M.R. Casali – P. Cristofori – C. Gagliardi, *Crystallizations of compact 4-manifolds minimizing combinatorially defined PL-invariants*, Rendiconti dell'Istituto di Matematica dell'Università di Trieste 52 (2020), 1-28.

30. M.R. Casali - P. Cristofori, *Kirby diagrams and 5-colored graphs representing compact 4-manifolds*, Rev. Mat. Complut. (2022). https://doi.org/10.1007/s13163-022-00438-x

31. M.R. Casali - P. Cristofori, *Classifying compact 4-manifolds via generalized regular genus and G-degree*, Annales de l'Institut Henri Poincare D: Combinatorics, Physics and their Interactions (2022), in pubblicazione.

Preprint

- M.R. Casali - P. Cristofori, *Gem-induced trisections of compact PL 4-manifolds*, 2022. https://arxiv.org/abs/1910.08777