Giulio Caviglia

Research Interests
Commutative algebra and its interactions with combinatorics, computational algebra and algebraic geometry. Recent work involves Castelnuovo-Mumford regularity, Betti numbers, syzygies, properties of initial ideals, Gröbner bases, Hilbert functions and Hilbert schemes.

Education
UNIVERSITY OF KANSAS, Lawrence, KS, 2000 - 2004.
Ph.D. in Mathematics, August 2004.
Dissertation: *Koszul algebras, Castelnuovo-Mumford regularity and generic initial ideals*.
Advisor: Craig Huneke.

UNIVERSITY OF GENOA, Genoa, Italy, 1995 - 2000.
Laurea *Summa cum Laude* in Mathematics, April 2000.
Thesis: *On a class of Gorenstein algebras that are Koszul* (in Italian).
Undergraduate advisors: Giuseppe Valla.

Appointments
PURDUE UNIVERSITY, WEST LAFAYETTE, IN, 2014 - Present.
Associate Professor.

PURDUE UNIVERSITY, WEST LAFAYETTE, IN, 2007 - 2014.
Assistant Professor.

UNIVERSITY OF CALIFORNIA, BERKELEY, CA, 2005 - 2007.
Charles B. Morrey Jr., Assistant Professor.

MATHEMATICAL SCIENCES RESEARCH INSTITUTE (MSRI), Berkeley, CA, 2004 - 2005.
Postdoctoral Fellow.

Memberships
MATHEMATICS DEPARTMENT, UNIVERSITY OF GENOA, Visiting Professor, Spring 2016.

MATHEMATICAL SCIENCES RESEARCH INSTITUTE (MSRI), Berkeley, general membership for the Commutative Algebra program, Fall 2012.

Awards internal
Purdue PRF research grant 2020/2021, Cheng Meng (expected Ph.D. Purdue 2023).

Purdue PRF research grant 2020/2021, Yihui Liang (expected Ph.D. Purdue 2022).

Spira 2018-2019 award for *Excellence in Undergraduate Teaching and Graduate Service Teaching*.

Purdue PRF research grant 2015/2016, Alessio Sammartano (Ph.D. Purdue 2018).

Purdue PRF research grant 2009/2010, Melissa Lindsey (Ph.D. Purdue 2011).

Purdue PRF Summer Grant (2010).

Awards external
Simons Collaboration Grant for Mathematicians, (2020 - 2025). *Uniform Bounds in Commutative Algebra* $42,000.

NSA (MSP Standard Grant), 2015 - 2016. *Problems on free resolutions and Hilbert functions.* $38,717.

Simons Collaboration Grant for Mathematicians (2011 - 2015, extended to 2016 - 2017). *Syzygies and Hilbert functions* $35,000.

US Junior Oberwolfach Fellow (April 14 - April 25, 2009) (sponsored by NSF).

Publications

[23] *A Cayley-Bacharach theorem for points in $\mathbb{P}^n$* (with A. De Stefani), Bull. London Math. Soc. (2021). https://doi.org/10.1112/blms.12492. (PDF) (arXiv)

[22] *Decomposition of local cohomology tables of modules with large E-depth* (with A. De Stefani), J. Pure Appl. Algebra, 225 issue (6) (2021) art. 106635. (PDF) (arXiv)

[21] *Regularity of prime ideals* (with M. Chardin, J. McCullough, M. Varbaro and I. Peeva), Mathematische Zeitschrift, 291, (2019), 421-435. (PDF)

[20] *Depth and regularity modulo a principal ideal* (with T.Ha, J. Herzog, M.Kummini, N.Terai and N.V.Trung, Journal of Algebraic Combinatorics, 49, (2018), 1-20. (PDF) (arXiv)

[19] *On the Lex-Plus-Power conjecture* (with A. Sammartano), Advances in Math. 340, (2018), 284-299. (PDF) (arXiv)

[18] *The Lex-Plus-Powers inequality for local cohomology modules* (with E. Sbarra), Mathematische Annalen, 364 (2016), 225-241. (PDF) (arXiv)

[17] *On Hilbert functions of general intersection of ideals* (with S. Murai), Nagoya Math. Journal, Vol. 222, Issue 1 (2016), 61-73. (PDF) (arXiv)

[16] *Zero-Generic initial ideals* (with E. Sbarra), Manuscripta Math. Vol. 148 (2015), Issue 3, 507-520. (PDF) (arXiv)

[15] *Componentwise regularity (I)* (with M. Varbaro), Journal of Pure and Applied Algebra, Vol. 219, Issue 1 (2015), 175-182. (PDF) (arXiv)

[14] *Distractions of Shakin rings* (with E. Sbarra), Journal of Algebra, 419 (2014), 318-331. (PDF) (arXiv)

[13] *Poset Embedding of Hilbert functions and Betti numbers* (with M. Kummini), Journal of Algebra, Vol. 410 (2014) 244-257. (PDF) (arXiv)

[12] *On a conjecture by Kalai* (with A. Constantinescu and M. Varbaro), Israel Journal of Mathematics, 2014, Vol 204 (1), 469-475. (PDF) (arXiv)

[11] *Betti tables of p-Borel-fixed ideals* (with M. Kummini), J. Algebraic Combin. (2014) Vol. 39 (3), 711-718. (PDF) (arXiv)

[10] *Sharp Upper Bounds of the Betti numbers for a given Hilbert polynomial* (with S. Murai), Algebra and Number Theory, Vol. 7 (2013), No. 5, 1019-1064. (PDF) (arXiv)

[9] *Generic circuits sets and general initial ideals with respect to weights* (with E. Sbarra), J. of Commutative Algebra (2013), Vol. 5, No. 1, 49-62. (PDF) (arXiv)

[8] *Koszul property of projections of the Veronese cubic surface* (with A. Conca), Advances. in Math. (2013), **234**, 404-413. (PDF) (arXiv)

[7] *Poset embddings of Hilbert functions* (with M. Kummini), Mathematische Zeitschrift (2013), **274** , Issue 3-4, 805-819. (PDF) (arXiv)

[6] *The pinched Veronese is Koszul*, J. Algebraic Combin. (2009), no. 4, 539–548. (PDF) (arXiv)

[5] *Some ideals with large projective dimension* (with M. Kummini), Proc. Amer. Math. Soc. **136** (2008), no. 2, 505–509. (PDF) (arXiv)

[4] *Some cases of the Eisenbud-Green-Harris conjecture* (with D. Maclagan), Math. Res. Lett. **15** (2008), no. 3, 427–433. (PDF) (arXiv)

[3] *Bounds on the Castelnuovo-Mumford regularity of tensor products*, Proc. Amer. Math. Soc. **135** (2007), 1949–1957. (PDF) (arXiv)

[2] *A Theorem of Eakin and Sathaye and Green's Hyperplane Restriction Theorem*, Commutative algebra, 1–5, Lect. Notes Pure Appl. Math. **244**, Chapman & Hall/CRC, Boca Raton, FL, (2006). (PDF) (arXiv)

[1] *Characteristic-free bounds for the Castelnuovo-Mumford regularity* (with E. Sbarra), Compositio Math. **141** (2005), 1365–1373. (PDF) (arXiv)

Articles Submitted	[S7] *Upper bounds on minimal generators of prime ideals* (with A. De Stefani), (14 pages). (PDF) (arXiv)
	[S6] *Syzygies in Hilbert schemes of complete intersections* (with A. Sammartano), arXiv:1903.08770, (26 pages). (PDF) (arXiv)
	[S5] *Linearly presented modules and bounds on the Castelnuovo-Mumford regularity of ideals.* (with A. De Stefani) (8 pages) (PDF) (arXiv)
	[S4] *A hyperplane restriction theorem and applications to reductions of ideals* (8 pages). (PDF) (arXiv)
	[S3] *The Eisenbud-Green-Harris Conjecture* (with A. De Stefani and E. Sbarra) (25 pages). (PDF)
	[S2] *The Eisenbud-Green-Harris conjecture for fast-growing degree sequences* (with A. De Stefani) (8 pages). (PDF) (arXiv)
	[S1] *Explicit Stillman bounds for all degrees* (with Y. Liang) (10 pages). (PDF) (arXiv)

Invited Lectures at Advanced International Schools	Series of 5 lectures on *Generic initial ideals* at the *School on Local Rings and Local Study of Algebraic Varieties* International Centre for Theoretical Physics, Trieste (Italy), May 24 - May 28, 2010.
	Series of 3 lectures on *Free resolutions and generic initial ideals* at the Workshop in Combinatorial Algebra and mini course in Commutative Algebra. Halifax, Nova Scotia, Canada, June 2013.

Summer Schools	Atlantic Association for Research in the Mathematical Sciences (AARMS) Summer School at Dalhousie University, Canada. *Gröbner bases*. Series of lectures, July 21- August 15, 2014.

Conferences Organized	*Special session: Combinatorial Techniques in Commutative Algebra* (organized with J. Schweig) AMS Spring Central Sectional Meeting, Purdue University April 4-5, 2020. (**cancelled**)
	New Trends in Syzygies Banff International Research Station, June 24-29 2018 (organized with J. McCullough)
	Special session: Syzygies at the Joint Mathematics Meetings in San Antonio, Texas, January 10-13, 2015 (organized with I. Peeva and J.McCullough)
	Session on Cummutative Algebra at the First Joint International Meeting Italy-Spain RSME-SCM-SEMA-SIMAI-UMI, Bilbao Spain, June 30-July 4, 2014. (organized with M.Rossi)

Selected invited Talks	*IIT Bombay Virtual Commutative Algebra Seminar*, November 17, 2020.
	Algebra Seminar, University of Genoa, July 17, 2019.
	Conference on Commutative Algebra and its Interaction with Algebraic Geometry in honor of Bernd Ulrich, University of Notre Dame, June 16-21 2019.
	AMS Sectional Meeting Special session on Commutative Algebra, Univ. of Arkansas, Nov 3-4, 2018.
	Stillman's Conjectures and other Progress on Free Resolutions, U.C. Berkeley Jul 17-21 2017.
	C.M.S. Winter Meeting 2017, special session on Applications of Combinatorial Topology in Commutative Algebra, Dec 8-11 2017, Waterloo, Canada.
	Asymptotic Phenomena in Local Algebra and Singularity Theory Oberwolfach, Germany, December 11-17, 2016.
	Commutative Algebra and Its Interactions with Algebraic Geometry, University of Michigan, July 7-12, 2016.
	Homological and computational methods in Commutative Algebra, Cortona, Italy May 29-June 4 2016.

Seminar, Chennai Mathematical Institute, India March 15 and 18, 2016.

Algebra Seminar, I.I.T. Bombai, India, March 08, 2016.

Welcome Workshop for the special Spring Semester in Algebra, University of Genoa, 1-3 February 2016.

AMS Central Fall Sectional Meeting Special session in Commutative Algebra, Chicago, October 03, 2015.

Southwest Local Algebra Meeting Oklahoma State, 28 February- 1 March 2015.

Colloquium at Oklahoma State University, February 27, 2015.

International conference on commutative Algebra and its interaction to Combinatorics and Geometry, December 16-20, 2013, Institute of Mathematics Hanoi, Vietnam.

AMS special session "Combinatorial Commutative Algebra" on October 5-6, 2013 University of Louisville, Louisville, KY.

Representation Theory, Homological Algebra, and Free Resolutions, MSRI, Berkeley, February 11-17 2013.

MSRI Colloquium, Berkeley, Oct 18, 2012.

Commutative Algebra Seminar U.C. Berkeley, October 9, 2012.

Joint seminar: Algebra and Linguistics University of Genoa (Italy), July 9, 2012.

Algebra seminar, University of Pisa, (Italy), June 19, 2012.

Conference on Commutative Algebra and related topics, University Genoa (Italy), June 08-09 2012.

Mathematisches Institut colloquium, Universität Basel, Basel (Switzerland), May 31, 2012.

AMS Sectional Meeting, Univ. of Kansas, March 30 - April 1, 2012.

CMS Winter Meeting, Toronto, Ontario (Canada), December 9-12, 2011.

Route 81 conference, Cornell, September 24, 2011.

Midwest Commutative Algebra and Geometry Conference, Purdue, May 22 -26, 2011.

Commutative Algebra and its Interaction with Algebraic Geometry, CIRM (Centre International de Rencontres Mathematiques), Luminy (France), November 2010.

Workshop on *Local Rings and Local Study of Algebraic Varieties* Trieste ICTP (Italy), June 4 - June 11, 2010.

National Meeting of Modern Algebra, Rome (Italy), May 24-28, 2010.

Workshop on *Kommutative Algebra* at Mathematisches Forschungsinstitut Oberwolfach (Germany), April 2009.

A Macaulay 2 Conference, Cornell University, March 16-19, 2008.

Commutative algebra and its interaction with algebraic geometry, CIRM, Luminy (France), October 2008

Hilbert functions and syzygies in commutative algebra and combinatorics, a conference in honor of Juergen Herzog on the occasion of his 65th birthday, Cortona (Italy), September 2007.

Workshop on *Syzygies and Hilbert Functions* at the Banff International Research Station (Canada), October 2006.

Commutative Algebra and its Interaction with Algebraic Geometry, CIRM (Centre International de Rencontres Mathematiques), Luminy (France), May 2006.

Special Session on *Combinatorial Algebraic Geometry*, at the 2006 Spring Central Sectional Meeting of the AMS, University of Notre Dame, April 2006.

Special Session on *Syzygies in Commutative Algebra and Geometry* at the 2006 Joint Mathematics Meetings, San Antonio, January 2006.

Midwest Algebra, Geometry and their Interactions Conference (MAGIC05), University of Notre Dame, October 2005.

Workshop on *Kommutative Algebra* at Mathematisches Forschungsinstitut Oberwolfach (Germany), April 2005.

Workshop on Resolutions (part of the Route 81 Conference on Commutative Algebra and Algebraic Geometry), Cornell University, October 2004.

School on *Commutative Algebra and Interactions with Algebraic Geometry and Combinatorics*, Trieste, (Italy), June 2004.

Giornate di Geometria Algebrica ed argomenti correlati VII (Conference for young Italian algebraic geometers), Rimini, (Italy), May 2004.

Lisbon Conference on *Commutative Algebra*, Lisbon, (Portugal), June 2003.

Algèbre commutative et ses interactions avec la géométrie algébrique, CIRM (Centre International de Rencontres Mathematiques) Luminy (France), June 2003.

Postdocs	Arindam Banerjee, 2015-2017.
	Manoj Kummini, 2008-2011.
Ph.D. students	Austin Rodger, since January 2021.
	Anna-Rose Wolff, since January 2019.
	Yihui Liang, since December 2018.
	Cheng Meng, since August 2018.
	Christina Jamroz, Ph.D Thesis (Purdue 2018): *Hilbert Functions of General Hypersurface Restrictions and Local Cohomology for Modules.*
	Alessio Sammartano, Ph.D Thesis (Purdue 2017): *Infinite free resolutions and blowup algebras.*
	Gabriel Sosa, Ph.D. Thesis (Purdue 2015): *On monomial order, Koszul algebras and toric rings.*
	Melissa Lindsey, Ph.D. Thesis (Purdue 2011): *Betti numbers, Hilbert series and the strong Lefschetz property.*
Undergraduate students	Daniel Camilo Tolosa *Undergraduate Research Experiences Program for Colombian students (UREP-C)*, June-December 2016.
	Ellen Wongso, 2013.
Committees	Member of the Graduate Committee since August 2018.
	Member of the Undergraduate Majors Committee since August 2017.
	Ph.D. Advisory Committee Chair for: *Gabriel Sosa, Alessio Sammartano, Christina Jamroz.*
	Ph.D. Advisory Committee Co-Chair for: *Melissa Lindsey, Vivek Mukundan.*
	Ph.D. Advisory Committee Member for *Christine Berkesch, Paolo Mantero, Young Su Kim, Amanda Kinzel, Lan Nguyen, Jacob Boswell, Jonathan Montano* and *Rodrigo de Andrade, Matthew Toeniskoetter, Pierce Edward, Dand Tan Thien Minh, Alessandra Constantini, Monte Cooper.*
	Master Advisory Committee Member for *Shreekant Gayaka, Paolo Mantero, Joseph Frederick, Heintz Kamber, Jonathan Montano* and *Jeffrey Craig.*

Other Professional Activities	Referee for *Journal of Algebra*, *Proceeding of the AMS*, *Communications in Algebra*, *Compositio Mathematica*, *Journal of Commutative Algebra*, *Proceedings of the Abel Symposium*, *Mathematical Research Letters*, *Journal of Algebraic Combinatorics*, *Electronic Journal of Combinatorics*, *International Mathematics Research Notices*.
	Member of AMS.

Teaching at Purdue

Undegradute courses:

MA26500 *Linear Algebra*: Spring 2008 (2 sects.), Fall 2008 (2 sects.), Spring 2009, Spring 2010.

MA30100 *An Introduction To Proof Through Real Analysis*: Fall 2010, Spring 2011, Spring 2012, Spring 2013, Fall 2013, Fall 2015, Fall 2016, Fall 2017, Fall 2019, Fall 2020.

MA35300 *Linear Algebra II Appl.*: Fall 2014.

MA37500 *Introduction To Discrete Mathematics*: Spring 2011, Spring 2013, Fall 2013, Fall 2016, Fall 2017, Fall 2018, Fall 2020.

Graduate courses:

MA65000 *Commutative Algebra*: Fall 2019.

MA69000 *Topics In Algebra: Gröbner Bases*: Fall 2009. Fall 2014, Fall 2018.

MA69000 *Topics In Algebra: Polytopes, Rings, and K-Theory*: Part (1) Fall 2011, Part (2) Spring 2012.

MA57500 *Graph Theory*: Fall 2009, Fall 2010, Fall 2011, Spring 2014, Spring 2015, Fall 2015, Spring 2017, Spring 2018, Spring 2019, Spring 2020.