

VISU MAKAM

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School of Mathematics
Institute for Advanced Study
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RESEARCH INTERESTS

- Invariant Theory
- Representation Theory
- Computational Complexity
- Tensors
- Coding theory

EMPLOYMENT

Wurru-wurru Research Fellow University of Melbourne , Melbourne, Australia.	Jul. 2020-Jul. 2024
Member Institute for Advanced Study , Princeton, NJ, USA.	Sep. 2018-Jul. 2020
Research Associate University of Michigan , Ann Arbor, MI, USA.	Jul. 2018-Aug. 2018

EDUCATION

PhD in MATHEMATICS, University of Michigan , Ann Arbor, MI Advisor: Prof. Harm Derksen	Sep. 2013-Apr. 2018
BSc (with Honors) in MATHEMATICS and COMPUTER SCIENCE Chennai Mathematical Institute , Chennai, India CGPA: 9.75/10	Aug. 2010-May. 2013

HONORS AND AWARDS

- **Sumner Myers award** 2018
Awarded for the best dissertation, Department of Mathematics, University of Michigan.
- **KVPY fellowship** 2010
Prestigious Indian science fellowship for pursuing sciences at the undergraduate level.

PUBLICATIONS AND PREPRINTS

- [1] [Hilbert series and degree bounds for matrix \(semi\)-invariants](#)
Visu Makam
J. Algebra **454** (2016), 14–28.

- [2] [Polynomial degree bounds for matrix semi-invariants](#)
Harm Derksen and Visu Makam
Advances in Mathematics **310** (2017), 44–63.
- [3] [Generating invariant rings of quivers in arbitrary characteristic](#)
Harm Derksen and Visu Makam
J. Algebra **489** (2017), 435–445.
- [4] [On non-commutative rank and tensor rank](#)
Harm Derksen and Visu Makam
Linear and Multilinear Algebra **66** (2018), no. 6, 1069–1084.
- [5] [Degree bounds for semi-invariant rings of quivers](#)
Harm Derksen and Visu Makam
J. Pure and Applied Algebra **222** (2018), no. 10, 3282–3292.
- [6] [Explicit tensors of border rank at least \$2d - 2\$ in \$K^d \otimes K^d \otimes K^d\$ in arbitrary characteristic](#)
Harm Derksen and Visu Makam
Linear and Multilinear Algebra **67** (2019), no. 10, 2104–2116.
- [7] [More barriers for rank methods, via a “numeric to symbolic” transfer](#)
Ankit Garg, Visu Makam, Rafael Oliveira and Avi Wigderson
60th IEEE Annual Symposium on Foundations of Computer Science, FOCS (2019), 824–844.
- [8] [Weyl’s polarization theorem in positive characteristic](#)
Harm Derksen and Visu Makam
Accepted to Transformation Groups.
- [9] [The regularity lemma is false over small fields](#)
Harm Derksen and Visu Makam
Communications in Algebra, published online, 2019.
- [10] [Highly entangled tensors](#)
Harm Derksen and Visu Makam
Linear and Multilinear Algebra, published online, 2019.
- [11] [Extensions between Verma modules for dihedral groups](#)
Gurbir Dhillon and Visu Makam
[arXiv:1712.05299](#) [math.RT].
- [12] [On the tensor rank of the \$3 \times 3\$ permanent and determinant](#)
Siddharth Krishna and Visu Makam
[arXiv:1801.00496](#) [math.CO].
- [13] [Algorithms for orbit closure separation for invariants and semi-invariants of matrices](#)
Harm Derksen and Visu Makam
[arXiv:1801.02043](#) [math.RA].
- [14] [An exponential lower bound for the degrees of invariants of cubic forms and tensor actions](#)
Harm Derksen and Visu Makam
[arXiv:1902.10773](#) [math.RT].
- [15] [Singular tuples of matrices is not a null cone \(and, symmetries of algebraic varieties\)](#)
Visu Makam and Avi Wigderson
[arXiv:1909.00857](#) [math.RT].
- [16] [Invariant theory and wheeled PROPs](#)
Harm Derksen and Visu Makam
[arXiv:1909.00443](#) [math.RT].

- [17] [Search problems in algebraic complexity, GCT, and hardness of generators for invariant rings](#)
Ankit Garg, Visu Makam, Rafael Oliveira and Avi Wigderson
[arXiv:1910.01251](#) [cs.CC].
- [18] [Maximally recoverable tensor codes](#)
Josh Brakensiek, Sivakanth Gopi and Visu Makam
(in preparation)

TALKS

- [1] Feb 2020, *Is the variety of singular tuples of matrices a null cone?*, CSDM Seminar, Institute for Advanced Study.
- [2] Feb 2020, *An invitation to invariant theory*, CSDM Seminar, Institute for Advanced Study.
- [3] Jan 2020, *Invariant theory meets P vs NP*, Special Colloquium, UC Irvine.
- [4] Jan 2020, *Hardness of generators for invariant rings*, Rutgers/DIMACS Theory seminar.
- [5] Jan 2020, *Adventures in 21st century invariant theory*, Auburn University.
- [6] Nov 2019, *A complexity-theoretic view of invariant theory*, ETH-ITS, Zurich.
- [7] Nov 2019, *Weyl's polarization theorem in positive characteristic*, Combinatorics seminar, LaCIM, Montreal.
- [8] Nov 2019, *Barriers for lifting techniques for tensor rank lower bounds*, CS theory seminar, Purdue University.
- [9] Nov 2019, *Singular tuples of matrices is not a null cone*, Algebraic Geometry seminar, Purdue University.
- [10] Nov 2019, *More barriers for rank methods, via a "numeric to symbolic" transfer*, FOCS 2019.
- [11] Nov 2019, *Interactions between invariant theory and complexity*, University of Bonn.
- [12] Oct 2019, *Singular tuples of matrices is not a null cone*, CAGE seminar, University of Pennsylvania.
- [13] Sep 2019, *Singular tuples of matrices is not a null cone*, TU Berlin.
- [14] Apr 2019, *A recent perspective in invariant theory*, Members seminar, Institute for Advanced Study.
- [15] Mar 2019, *Invariant theory, tensors and computational complexity*, Sumner Myers Colloquium, University of Michigan.
- [16] Mar 2019, *Exponential degree lower bounds for invariant rings*, Geometry seminar, Texas A&M University.
- [17] Feb 2019, *Why can't we prove tensor rank and Waring rank lower bounds?*, CSDM seminar, Institute for Advanced Study.
- [18] Feb 2019, *Non-commutative rank*, CSDM seminar, Institute for Advanced Study.
- [19] Dec 2018, *Generic vs symbolic behaviour and power series*, Algebraic Methods, Simons institute, Berkeley.
- [20] Nov 2018, *Weyl's polarization theorem in positive characteristic*, Sixth conference on geometric methods in representation theory, University of Iowa.
- [21] Oct 2018, *Degree lower bounds for SL_n invariants*, AMS Special Session on Commutative algebra and complexity, Ann Arbor.

- [22] Jun, 2018, *Algorithms in invariant theory*, Optimization, Complexity and Invariant Theory, Institute for Advanced Study.
- [23] Apr 2018, *Algorithms for orbit closure separation for invariants and semi-invariants of matrices*, AMS Special Session on Algebraic Geometry, Representation Theory, and Applications, Nashville.
- [24] Nov 2017, *Degree bounds for invariant rings of quivers*, Commutative Algebra and Algebraic Geometry seminar, UC Berkeley.
- [25] Oct 2017, *Degree bounds for invariant rings of quivers*, Geometry seminar, UIUC.
- [26] Sep 2017, *Degree bounds for invariant rings of quivers*, Geometry seminar, Texas A&M University.
- [27] Apr 2017, *Polynomial degree bounds for matrix semi-invariants*, Graduate student combinatorics conference 2017, University of Kansas.
- [28] Nov 2016, *Generating invariants in positive characteristic*, Fourth conference on geometric methods in representation theory, University of Missouri.
- [29] Oct 2016, *Linear matrices and their applications to complexity*, CS Colloquium, Rice University.
- [30] Aug 2016, *Polynomial degree bounds for matrix semi-invariants*, ICRA 2016, Syracuse University
- [31] Jun 2016, *Linear matrices and their applications to semi-invariants of quivers*, Chennai Mathematical Institute.
- [32] Apr 2016, *Polynomial degree bounds for matrix semi-invariants*, Algebra and Number Theory seminar, Louisiana State University.
- [33] Apr 2016, *Rank computation of linear matrices and applications to circuit complexity*, CS Theory seminar, NYU.
- [34] Apr 2016, *Polynomial degree bounds for matrix semi-invariants*, Algebra and Representation Theory seminar, University of Oklahoma.
- [35] Feb 2016, *Polynomial degree bounds for matrix semi-invariants*, Combinatorics seminar, University of Michigan.

TEACHING EXPERIENCE

University of Michigan:

- Instructor for Calculus 1, Math 115, Fall 2017.
- Instructor for Calculus 2, Math 116, Fall 2016.
- Instructor for Calculus 2, Math 116, Winter 2016.
- Teaching assistant for Differential Equations, Math 216, Winter 2015.
- Instructor for Calculus 2, Math 116, Fall 2014.
- Instructor for Calculus 1, Math 115, Winter 2014.
- Instructor for Pre-calculus, Math 105, Fall 2013.

Chennai Mathematical Institute:

- Teaching assistant for Complex Analysis, Winter 2013.

SERVICE

- Organizer for AMS special session on tensors and complexity. Mar. 2020
- Organizer for AMS special session on commutative algebra and complexity. Oct. 2018
- Organizer for Student Representation theory seminar at University of Michigan.

- Reviewer for Algebra and Number Theory, STOC, Linear Algebra and its Applications, Quantum, and SIGMA.
- Taught enumerative combinatorics in the Michigan math circle program for middle and high school students.
- Part of the team that created the [examshop](#) website for math 105 (precalculus) that has problems from all previous exams sorted by topic.

REFERENCES

- **Avi Wigderson**, Institute for Advanced Study, *avi@ias.edu*.
- **Harm Derksen**, University of Michigan at Ann Arbor, *hderksen@umich.edu*
- **Joseph Landsberg**, Texas A&M University, *jml@math.tamu.edu*
- **Peter Bürgisser**, Technical University, Berlin, *pbuerg@math.tu-berlin.de*
- **Jerzy Weyman**, University of Connecticut, *jerzy.veyman@uconn.edu*
- **Paul Kessenich** (teaching), University of Michigan at Ann Arbor, *paulkess@umich.edu*