

# Francis Valiquette

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## EXPERIENCE

- 2018 – present Assistant Professor, Monmouth University.
- 2013 – 2018 Assistant Professor, State University of New York (SUNY) at New Paltz.
- 2011 – 2013 Atlantic Association for Research in the Mathematical Sciences (AARMS) Postdoctoral Fellow, Dalhousie University.
- 2009 – 2011 Natural Sciences and Engineering Research Council (NSERC) of Canada Postdoctoral Fellow, McGill University.

## RESEARCH VISIT

- 05/2017 Department of Mathematics and Statistics, Memorial University of Newfoundland.

## EDUCATION

- 2009 Ph.D. in Mathematics, University of Minnesota, Twin Cities.  
**Thesis:** Applications of Moving Frames to Lie Pseudo-Groups
- 2007 M.Sc. in Mathematics, University of Minnesota, Twin Cities.
- 2005 M.Sc. in Physics, Université de Montréal.
- 2003 B.Sc. in Mathematics and Physics, Université de Montréal.

## RESEARCH INTERESTS

Differential geometry, discrete geometry, differential equations, finite difference equations, Lie pseudo-groups, moving frames, symmetry, variational calculus.

## RESEARCH

### *Peer-Reviewed Journal Articles*

- [1] (With Olver, P.J. and Sabzevari, M.) Normal forms, moving frames, and differential invariants for nondegenerate hypersurfaces in  $\mathbb{C}^2$ , *J. Geo. Anal.* (2023), to appear, [arXiv:2202.12869](https://arxiv.org/abs/2202.12869).
- [2] (With Bihlo, A., and Jackaman, J.) Invariant variational schemes for ordinary differential equations, *Stud. App. Math.* **148** (2022), 991–1020.

- [3] (With Arnaldsson, Ö) Invariants of surfaces in three-dimensional affine geometry, *SIGMA* **17** (2021), 033, 25 pages.
- [4] (With Benson, J.) Discrete curve flows in two-dimensional Cayley–Klein geometries, *Proceeding of the Symposium Quantum Theory and Symmetry XI July 1st to 5th, 2019*, CRM Series in Mathematical Physics, Springer (2021), 157–167.
- [5] (With Benson, J.) Geometric curve flows in low dimensional Cayley–Klein geometries, *J. Int. Sys.* **5** (2020), xyaa003.
- [6] (With Bihlo, A., and Jackaman, J.) On the development of symmetry-preserving finite element schemes for ordinary differential equations, *J. Comp. Dyn.* **7** (2020), 339–368.
- [7] (With Bihlo, A.) Symmetry-preserving finite element schemes: An introductory investigation, *SIAM J. Sci. Comput.* **41** (2019), A3300–A3325.
- [8] (With Benson, J.) Invariant discrete flows, *Stud. Appl. Math.* **143** (2019), 81–119.
- [9] (With Olver, P.J.) Recursive moving frames for Lie pseudo-groups, *Results in Math.* **73** (2018), 57.
- [10] Symmetry reduction of ordinary differential equations using moving frames, *J. Nonlin. Math. Phys.* **25** (2018), 211–246.
- [11] (With Thompson, R.) Group foliation of finite difference equations, *Commun. Nonlinear Sci. Numer. Simul.* **59** (2018), 235–254.
- [12] (With Benson, J.) Symmetry reduction of ordinary finite difference equations using moving frames, *J. Phys. A: Math. Theor.* **50** (2017), 195201.
- [13] (With Miro, B.<sup>†</sup>, Rose, D.<sup>†</sup>) Equivalence of one-dimensional second-order linear finite difference operators, *J. of Diff. Eq. and Appl.* **22** (2016), 1524–1541.
- [14] (With Thompson, R.) Group foliation of differential equations using moving frames, *Forum of Mathematics: Sigma* **3** (2015), e22.
- [15] (With Rebelo, R.) Invariant discretization of partial differential equations admitting infinite-dimensional symmetry groups, *J. Diff. Eq. and Appl.* **21** (2015), 285–318.
- [16] (With Milson, R.) Point equivalence of second-order ODEs: Maximal invariant classification order, *J. Symb. Comp.* **67** (2015), 16–41.
- [17] (With Rebelo, R.) Symmetry preserving numerical schemes for partial differential equations and their numerical tests, *J. of Diff. Eq. and Appl.* **19** (2013), 738–757.
- [18] Solving local equivalence problems with the equivariant moving frame method, *SIGMA* **9** (2013), 029.
- [19] Inductive moving frames, *Results in Math.* **64** (2013), 37–58.
- [20] Geometric affine symplectic curve flows in  $\mathbb{R}^4$ , *J. Diff. Geo. and its Appl.* **30** (2012), 631–641.
- [21] (With Thompson, R.) On the cohomology of the invariant Euler–Lagrange complex, *Acta Applicandae Math.* **116** (2011), 199–226.
- [22] Equivariant moving frame method and the local equivalence of  $u_{xx} = r(x, u, v, u_x, v_x)$  under fiber-preserving transformations, *J. of Dynamical and Control Systems* **17** (2011), 555–589.

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<sup>†</sup>Undergraduate student co-author.

- [23] (With Itskov, I., Olver, P.J.) Lie completion of pseudo-groups, *Transformation Groups* **16** (2011), 161–173.
- [24] (With Olver, P.J., Pohjanpelto, J.) On the structure of Lie pseudo-groups, *SIGMA* **5** (2009), 077.
- [25] Structure equations of Lie pseudo-groups, *J. of Lie Theory* **18** (2008), 869–895.
- [26] Comment on ‘Invariants of differential equations defined by vector fields’, *J. of Phys. A: Math. Theor.* **41** (2008), 478001.
- [27] (With Winternitz, P.) Discretization of partial differential equations preserving their physical symmetries, *J. Phys. A: Math. Gen.* **38** (2005), 9765–9783.
- [28] Discretizations preserving all Lie point symmetries of the Korteweg-de Vries equation, *Group Theoretical Methods in Physics: Proceedings of the XXV International Colloquium on Group Theoretical Methods in Physics, Cocoyoc, Mexico, 2–6 August, 2004*, Editors: G.S. Pogosyan, L.E. Vicent, and K.B. Wolf, Institute of Physics, Conference Series Number 185, CRC Press (2005), 539–544.
- [29] (With Mousseau N.) Energy landscape around a minimum in a-Si, *Phys. Rev. B* **68** (2003), 125209.
- [30] (With Mousseau N., Beaucage P.) Numerical studies of the dynamics of silicon: Relaxation, nucleation and energy landscape, invited paper, Symposium A, MRS Spring Meeting 2003, San Francisco.

### *Peer-Reviewed Book Chapter*

- [31] (With Bihlo, A.) Symmetry-preserving numerical schemes, in *Symmetries and Integrability of Difference Equations: Lecture Notes of the Abecedarian School of SIDE 12, Montréal 2016*, CRM Series in Mathematical Physics, Springer (2017), 261–324.

## UNDERGRADUATE RESEARCH SUPERVISION

- 2017 Jonathan Colón (SURE<sup>‡</sup> awardee), *Bäcklund transformations of finite difference equations*.
- 2017 Jonathan Colón (AYURE<sup>§</sup> awardee), *Point equivalence of scalar second-order ordinary finite difference equations*.
- 2015 Olivia Seirup (SURE awardee), *Discrete equi-affine invariant variational problems in the plane*.
- 2015 Bradley Miro and Dylan Rose (AYURE awardees), *Equivalence of 1-dimensional linear second-order finite difference operators*.
- 2014 Ali Immel (SURE awardee), *Numerical investigation of the group foliation method*.
- 2014 Olivia Seirup, *Applications of moving frames in the Euclidean plane*.

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<sup>§</sup>AYURE = Academic Year Undergraduate Research Experience (Competitive award).

<sup>‡</sup>SURE = Summer Undergraduate Research Experience (Competitive award).

## INDEPENDENT STUDIES

- 2016 Samantha Wyler, *Sturm–Liouville theory, orthogonal functions, and boundary value problems*.
- 2016 Jonathan Colón, *Applications of Lie group analysis in financial mathematics*.
- 2015 Nicholas France, *Lie groups and their applications in physics*.

## TEACHING EXPERIENCE

### *Monmouth University*

Applied Discrete Mathematics, Calculus with Analytic Geometry I, Calculus with Analytic Geometry II, Introduction to Mathematical Reasoning, Pre-Calculus Mathematics, Quantitative Analysis for Business II, Real Analysis.

### *SUNY at New Paltz*

Applied Mathematics 1, Applied Mathematics 2, Axiomatic Geometry, Calculus 2, Calculus 3, Calculus 4, College Mathematics, Foundations of Analysis, Intermediate Analysis 1, Linear Algebra, Ordinary Differential Equations, Precalculus.

### *Dalhousie University*

Applied Analysis, Intermediate Calculus 1, Intermediate Calculus 2, Introduction to Complex Variables, Matrix Theory and Linear Algebra 2.

### *McGill University*

Ordinary Differential Equations for Engineers, Advanced Calculus for Engineers, Calculus 3.

### *University of Minnesota*

Precalculus.

## SERVICES

### *Seminar and Conference Organization*

- 2022 Co-organizer, *Symmetry, Invariants, and their Applications: A Celebration of the 70th Birthday of Peter Olver*, Dalhousie University, Canada, August 3–5.
- 2021 Co-organizer, *Moving Frames and their Modern Applications*, BIRS, Canada, November 22–26.
- 2020 Co-organizer, *Moving Frames and their Modern Applications*, BIRS, Canada, July 6 – July 10. (Canceled due to Covid-19 pandemic)
- 2018 – present *Math & Cookies* (Student Seminar), Monmouth University.
- 2016 *11th Annual Spuyten Duyvil Undergraduate Mathematics Conference*, SUNY New Paltz, April 23.
- 2014 – 2018 *Math & Cookies* (Student Seminar), SUNY New Paltz.
- 2013 – 2018 *Mathematics Research Seminar*, SUNY New Paltz.

- 2013      *Computational Aspects of Moving Frames*, SIAM Conference on Applied Algebraic Geometry, Colorado State University, USA, August 1–4.
- 2013      *Pseudogroups and their Applications*, Canadian Mathematical Society Summer Meeting, Dalhousie University, Canada, June 4–7.
- 2012      *Summer Undergraduate Research Seminar*, Dalhousie University.
- 2011      *Workshop on Moving Frames in Geometry*, Centre de recherches mathématiques, Montréal, Canada, July 13–17.
- 2008 – 2009      *Mathematical Physics Research Seminar*, University of Minnesota.
- 2008 – 2009      *Junior Colloquium* (Graduate Student Seminar), University of Minnesota.
- 2008 – 2009      *Undergraduate Math Club Seminar*, University of Minnesota.

### *Refereeing Service*

- Acta Applicandae Mathematicae
- Analysis and Mathematical Physics
- Axioms
- Communications in Nonlinear Science and Numerical Simulation
- Computer Algebra in Scientific Computing
- Discrete and Continuous Dynamical Systems
- Foundations of Computational Mathematics
- International Symposium of Symbolic and Algebraic Computation
- Involve, a Journal of Mathematics
- Journal of Geometry and Physics
- Journal of Mathematical Analysis and Applications
- Journal of Mathematical Physics
- Journal of Nonlinear and Mathematical Physics
- Journal of Physics A: Mathematical and Theoretical
- Lecture Notes in Computer Science
- Letters in Mathematical Physics
- LMS Journal of Computation and Mathematics
- Mathematical Physics, Analysis and Geometry
- Mathematics
- Minnesota Journal of Undergraduate Mathematics
- Proceedings of the Institute of Applied Mathematics
- Reports on Mathematical Physics
- SIGMA (Symmetry, Integrability and Geometry: Methods and Applications)
- Symmetry
- Transactions of Mathematics and Its Applications

### *Reviewing Service*

- 2018           Innovational Research Incentives Scheme Veni, The Netherlands Organisation for Scientific Research (NWO).
- 2015           Poster on the Hill Reviewer, Council on Undergraduate Research.
- 2011 – present   Mathscinet Reviewer, American Mathematical Society (27 reviews).

### *Editorial Service*

- 2022 – present   Guest editor, SIGMA Special Issue on Symmetry, Invariants, and their Applications in Honor of Peter J. Olver’s 70th Birthday.

### *Monmouth University Service*

- 2021 – present   Member, Honors School Council.
- 2020 – present   Member, Math Placement Test Assessment, Department of Mathematics.
- 2020 – present   Course Champion, MA118 – Quantitative Analysis for Business II.
- 2019           Conference program booklet chairperson, Metropolitan Association of College and University Biologists (MACUB) conference, October 26, 2019.
- 2019 – 2022     Chair, School of Science Scholarship Committee.
- 2019 – present   Member, Mathematics Department Sabbatical Committee

### *SUNY New Paltz Service*

- 2018           Faculty Reappointment, Tenure, and Promotion Department Sub-Committee.
- 2016 – 2018     Advisory Board Member: Undergraduate Research, Scholarship and Creative Activities.
- 2016 – 2017     Lecturer Search Committee.
- 2016           Chair, Discretionary Salary Award Department Sub-Committee.
- 2016           Open House for Accepted Students, April 2, 2016.
- 2016           Faculty Reappointment, Tenure, and Promotion Department Sub-Committee.
- 2015 – 2017     Mathematics Adjuncts Search Committee.
- 2015           Discretionary Salary Award Department Sub-Committee.
- 2015 – 2018     Precalculus Course Coordinator.
- 2015 – 2018     Robinson and Robison Mathematical Excellence Awards Committee.
- 2015           Open House for Accepted Students, March 28, 2015.
- 2014 – 2015     Faculty Advisor, Association for Women in Mathematics SUNY New Paltz Chapter.
- 2014 – 2018     Student Academic Advisor (On average 15 students per semester).
- 2014           Community Outreach Initiative at Esopus Hall, April 2, 2014.
- 2014           Open House for Incoming Students, April 5, 2014.
- 2014           “Meet the Faculty” Orientation for Incoming Students, August 22, 2014.
- 2013 – 2014     Faculty Search Committee.

2013 Fall Open House, October, 26, 2013.

*New York State Master Teacher Service*

2017 Program Interviewer, June 3, 2017.

2016 Program Interviewer, August 27, 2016.

2015 Workshop, *Mamikon's Visual Calculus*, September 14, 2015.

2015 Program Interviewer, June 20, 2015.

2014 Program Interviewer, February 15, 2014.

2014 Program Interviewer, November 15, 2014.

## GRANTS

2022 NSF-2217293: *Conference on Symmetry, Invariants, and their Applications*, Dalhousie University, Canada, August 3–5, 2022 (\$35,883 USD).

2022 Atlantic Association for Research in the Mathematical Sciences (AARMS) Conference Grant: *Symmetry, Invariants, and their Applications: A Celebration of Peter Olver's 70th Birthday*, Dalhousie University, Canada, August 3–5, 2022 (\$8,000 CAD).

## FELLOWSHIPS AND AWARDS

2011 – 2013 *AARMS Postdoctoral Fellowship*.

2009 – 2011 *NSERC Postdoctoral Fellowship (PDF)*.

2009 – 2011 *Postdoctoral Research Fellowship (B3)* (declined),  
Fond de recherche du Québec: Nature et technologies (FQRNT).

2008 – 2009 *Doctorate Dissertation Fellowship*, University of Minnesota.

2006, 2008 *Summer Fellowship*, University of Minnesota.

2005 – 2008 *Doctoral Research Scholarship (B2)*, FQRNT.

2005 – 2007 *NSERC Postgraduate Scholarship (PGS D)* (declined).

2005 *Pico Nobel* (Teaching Assistant Award),  
Department of Physics, Université de Montréal.

2004 – 2005 *Sun Life scholarship*, Sun Life.

2003 – 2005 *Masters Research Scholarship (B1)*, FQRNT.

2003 – 2005 *NSERC Postgraduate Scholarship (ES A)*.

2002 *GCM Summer Scholarship for Bachelor Students*,  
Groupe de recherche en physique et technologie des couches minces.

2002 *University Research Scholarship for Undergraduate Students*, NSERC.

2000 – 2004 *Member of the Provost Honour Roll (Faculty of Arts and Sciences)*,  
Université de Montréal.

2000 *Welcome Scholarship*, Université de Montréal.

# PRESENTATIONS

## *Research Talks*

- 2023 • *Semi-plenary lecture*, Symbolic Analysis workshop, Foundations of Computational Mathematics, Université Sorbonne, Paris, France, June 19–21, 2023.
- 2020 • *Semi-plenary lecture*, Symbolic Analysis workshop, Foundations of Computational Mathematics (FoCM), Simon Fraser University, Vancouver, Canada, meeting canceled due to Covid-19 pandemic.
- 2019 • *Invariant Discrete Curve Flows*, 11<sup>th</sup> International Symposium: Quantum Theory and Symmetries, Centre de Recherche Mathématiques, Montréal, Canada.
- 2018 • *Group Foliation of Finite Difference Equations Using Equivariant Moving Frames*, Kolchin Seminar, CUNY Graduate Center, USA.
- 2017 • *Symmetry-Preserving Finite Element Methods: Preliminary Results*, Workshop on Connections in Geometric Numerical Integration and Structure-Preserving Discretization, Banff International Research Station for Mathematical Innovation and Discovery, Canada.
  - *Equivariant Moving Frames and Symmetry Reduction of Ordinary Differential Equations*, Memorial University, Canada.
- 2016 • *Symmetry-Preserving Numerical Schemes*, CMS Winter Meeting, Niagara Falls, Canada.
  - *Symmetry Reduction of Ordinary Finite Difference Equations Using Moving Frames*, 12<sup>th</sup> International Conference on Symmetries and Integrability of Difference Equations (SIDE), Sainte-Adèle, Canada.
  - *Symmetry-Preserving Numerical Schemes*, Abecedarian Summer School of SIDE, Université de Montréal, Canada.
- 2015 • *Equivariant Moving Frames*, Geometry and Symmetry based Mathematical and Computational Methods with Applications in Engineering, Science and Education, SUNY Polytechnic Institute, USA.
- 2014 • *Group Foliation of Finite Difference Equations*, 30<sup>th</sup> International Colloquium on Group Theoretical Methods in Physics, University of Ghent, Belgium.
- 2013 • *Recursive Moving Frames*, Focused Research Workshop on Exterior Differential Systems and Lie Theory, Fields Institute, Canada.
  - *What is a moving frame?*, Department Seminar, SUNY New Paltz, USA.
  - *Recursive Moving Frames*, SIAM Conference on Applied Algebraic Geometry, Colorado State University, USA.
  - *Recursive Moving Frames*, CMS Summer Meeting, Dalhousie University, USA.
  - *Symmetries, Moving Frames, and Group Foliation*, SUNY New Paltz, USA.
- 2012 • *Group Foliation of Differential Equations Using Moving Frames*, CMS Winter Meeting, Montréal, Canada.
  - *Group Foliation of Differential Equations Using Moving Frames*, Colloquium, Dalhousie University, Canada.
  - *Repère Mobiles Équivariants et la Méthode de Foliation d'une Équation par son Groupe de Symétrie*, Colloque, Université Laval, Canada.



- *Symmetries and Moving Frames*, Dalhousie Postdoc Research Day, Dalhousie University, Canada.
- *Recursive Moving Frames for Lie Pseudo-Groups*, Symmetries of Differential Equations: Frames, Invariants and Applications: A conference in honor of the 60th birthday of Peter Olver, University of Minnesota, USA.
- 2011 • *Inductive Moving Frames*, Colloquium, Dalhousie University, Canada.
- *Equivariant Moving Frames, Lie Pseudo-Groups, and Local Equivalence Problems*, Special Seminar, North Carolina State University, USA.
- 2010 • *Solving Local Equivalence Problems with the Equivariant Moving Frame Method*, AMS Sectional Meeting, Special Session on Geometric Flows, Moving Frames and Applications, Macalester College, USA.
- *Solving Local Equivalence Problems with the Equivariant Moving Frame Method (Extended Version)*, Mathematical Physics Seminar, University of Minnesota, USA.
- 2009 • *The Local Cohomology of the Invariant Variational Bicomplex*, Centre interuniversitaire de recherche en géométrie et topologie, Université du Québec à Montréal, Canada.
- *Comparison of Cartan's and Olver–Pohjanpelto's Structure Equations of Lie Pseudo-Groups*, Mathematical Physics Seminar, University of Minnesota, USA.
- *The Invariant Variational Bicomplex*, Mathematical Physics Seminar, University of Minnesota, USA.
- *Differential Invariant Algebra of the Infeld–Rowlands Equation*, Mathematical Physics Seminar, University of Minnesota, USA.
- 2008 • *Structure Equations of Lie Pseudo-Groups*, Mathematical Physics Seminar, University of Minnesota, USA.

### *Talks for Students*

- 2019 • *Mamikon's Visual Calculus*, Math & Cookies, Monmouth University, USA.
- 2018 • *Using linear algebra to evaluate certain indefinite integrals*, Math & Cookies, Monmouth University, USA.
- 2017 • *Lambert W Function*, Math & Cookies, SUNY New Paltz, USA.
- *Equivariant Moving Frames*, Hudson River Undergraduate Research Conference, Westfield State University, USA.
- 2016 • *Discrete Calculus*, 11<sup>th</sup> Annual Spuyten Duyvil Undergraduate Mathematics Conference, SUNY New Paltz, USA.
- 2015 • *Moving Frames*, 10<sup>th</sup> Annual Spuyten Duyvil Undergraduate Mathematics Conference, Manhattan College, USA.
- *Summability of Divergent Series*, Math & Cookies, SUNY New Paltz, USA.
- 2013 • *The Pythagorean Theorem*, Math & Cookies, SUNY New Paltz, USA.
- *Symmetries and Their Applications*, Mid-Hudson Mathematics Conference for Undergraduates, Bard College, USA.
- *Symmetry*, Amherst College, USA.
- 2011 • *An Introduction to Equivariant Moving Frames*, Graduate Student Seminar, Dalhousie University, Canada.

- 2010
- *Group Foliation of PDE Using Moving Frames*, ISM Graduate Students Seminar, McGill University, Canada.
  - *Integration of Invariant ODE Using Moving Frames*, Centre interuniversitaire de recherche en géométrie et topologie – Junior Seminar, Université du Québec à Montréal, Canada.
- 2009
- *Symmetries of Differential Equations*, Junior Colloquium, University of Minnesota, USA.
- 2008
- *Classical Invariant Theory Through an Example*, Undergraduate Math Club, University of Minnesota, USA.
  - *Differential Invariants*, Undergraduate Math Club, University of Minnesota, USA.
  - *Equivalence Problems*, Junior Colloquium, University of Minnesota, USA.
  - *Symmetry and Integration of Ordinary Differential Equations*, Junior Colloquium, University of Minnesota, USA.
- 2007
- *Moving Frames for Lie Pseudo-Groups*, Junior Colloquium, University of Minnesota, USA.
  - *Symmetries in Variational Problems*, Junior Colloquium, University of Minnesota, USA.
- 2006
- *Exterior Calculus and Maxwell's Equations*, Junior Colloquium, University of Minnesota, USA.
- 2005
- *Discrétisation invariante des équations différentielles*, Colloque panquébécois ISM des étudiants avancés en mathématiques, Canada.
  - *Théorème de Noether*, Institut des sciences mathématiques, Université du Québec à Montréal, Canada.
- 2004
- *Symétries et résolution d'équations différentielles ordinaires du premier ordre*, Séminaire des étudiants en mathématiques, Université de Montréal, Canada.