Curriculum Vitæ et Studiorum

Alessio Fumagalli, Ph.D.

Department of Mathematics, Politecnico di Milano, Italy

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Personal data

Citizenship Italian

E-mail alessio.fumagalli@polimi.it `[mailto]`

      alessio.fumagalli1984@gmail.com `[mailto]`

Birth 4 Dec. 1984. Lecco, LC, Italy

Phone +39 02 2399 4645

Author Identifiers

ResearcherID C-5125-2017 `[link]`

ORCID 0000-0003-3039-5309 `[link]`

MATHSCINET 1003609 `[link]`

Scopus Author ID 55660592100 `[link]`

Google Scholar hvVAbjUAAAAJ `[link]`

Professional experience

2019, Dec. – 2022, Nov. Assistant Professor Tenure Track (RTD-B) at the Department of Mathematics, Politecnico di Milano, Italy.

2018, Oct. – 2019, Aug. Visiting Professor at the Department of Mathematical Sciences (DISMA), Politecnico di Torino, Italy.

2015, Oct. – 2018, Sep. Postdoctoral fellowship at the Department of Mathematics, University of Bergen, Norway. Responsible Eirik Keilegavlen and Inga Berre. Project *An integrated geological and mathematical framework for the characterization, modelling and simulation of fractured geothermal reservoir*. In collaboration with the Department of Earth Science, University of Bergen, Bergen, Norway.

2014, Mar. – 2015, Sep. Postdoctoral fellowship at the Department of Mathematics, Politecnico di Milano, Italy. Responsible Luca Formaggia. Project *Numerical methods for upscaling in fractured and heterogeneous porous media*. In collaboration with MOXOFF S.p.a. and ENI S.p.a. Exploration & Production Division.

2013, Mar. – 2014, Feb. Postdoctoral fellowship at the Department of Technologie, Informatique et Mathématiques Appliquées, Institut Française du Pétrole - Energies nouvelles (IFP - Energies nouvelles), Rueil-Malmaison, Paris, France. Responsible Isabelle Faille. Project *Hybrid schemes for conductive fault modelling*. In collaboration with the research group POMDAPI at Institut national de recherche en informatique et en automatique (Inria) Paris-Rocquencourt: Jérôme Jaffré and Jean E. Roberts.

2012, May – 2013, Feb. Postdoctoral fellowship at the Department of Mathematics, Politecnico di Milano, Italy. Responsible Luca Formaggia. Project *Three-dimensional numerical modelling for two-phases flows in fractured porous media and in parallel computing framework*. In collaboration with ENI S.p.a. Exploration & Production Division.

2010, Sep. and 2011, Feb. Scientific collaboration with Michel Kern, Inria-Roquencourt, Paris France, in writing and testing a three-dimensional two-phase flow solver in a parallel computing framework.

Education

2009, Jan. – 2012, May Doctor of Philosophy in Mathematical Models and Methods in Engineering at Politecnico di Milano, Italy. Thesis *Numerical Modelling of Flows in Fractured Porous Media by the XFEM Method*. Advisor Luca Formaggia. External examiner Paolo Ruffo and Jérôme Jaffré.
Members of the dissertation committee: Maurizio Falcone, Miguel Fernandez, Jérôme Jaffré, Paolo Ruffo, Enrico Zio. Defence 8 May 2012.
In collaboration with ENI S.p.a. Exploration & Production Division.

2006, Sep. – 2008, Dec. Master degree in Mathematical Engineering at Politecnico di Milano, Italy. Thesis *A free discontinuity problem for an elastic-plastic cantilever*. Advisor Franco Tomarelli.

2003, Sep. – 2006, Sep. Bachelor degree in Mathematical Engineering at Politecnico di Milano, Italy. Thesis *Adaptive algorithms for the Black & Scholes equation*. Advisor Alessandro Veneziani.

Participation to research projects

2015, Oct. – 2018, Sep. Participation to the research project founded by The Research Council of Norway. Coordinator Atle Rotevatn. Project *ANIGMA: An integrated geological and mathematical framework for the characterization, modelling and simulation of fractured geothermal reservoir*. University of Bergen, Norway.

2014, Dec. – 2015, Nov. Participation to the research project founded by ENI S.p.a.. Coordinator Luca Formaggia. Project *Industrialization of the MSR-Upscaling software*. Politecnico di Milano, Italy.

2014, Apr. – 2014, Sep. Participation to the research project founded by ENI S.p.a.. Coordinator Luca Formaggia. Project *Upscaling for fractured reservoir*. Politecnico di Milano, Italy.

2011, Oct. – 2013, Oct. Participation to the research project founded by the Italian Ministry of Education, Universities and Research - Research projects of national interest (PRIN) 2009. Coordinator Alfio Quarteroni. Project *Numerical models for scientific computing and advanced applications*. Politecnico di Milano, Italy.

2011, Jun – 2013, May Participation to the research project founded by ENI S.p.a.. Coordinator Alfio Quarteroni and Luca Formaggia. Project *iMigro3: development of a numerical method for the simulation of generation and expulsion of hydrocarbons in a fractured source rock*. Politecnico di Milano, Italy.

Italian national scientific qualification

Valid from the 31 Aug. 2018 to 31 Aug. 2024 for the academic discipline 01/A5 - Numerical Analysis (MAT/08), Associate Professor.

Research outline

Starting from my Ph.D., the central thread of my research is to introduce, extend, and analyse advanced mathematical models and non-standard numerical schemes, to facilitate and increase the knowledge of flow in fractured porous media. Keeping in mind real applications, I focused my research mainly on 2 aspects. 1) To derive appropriate reduced order models (hybrid-dimensional approach) for accurately describe the scalar transport, single-phase and multi-phase flow in a complex system of fractures. Particular attention is devoted to the mutual interaction between fractures and between a fracture and the surrounding rock matrix. 2) To facilitate the numerical solution of such models by studying non-standard numerical schemes (*e.g.* XFEM, VEM), where the structural geometrical constraints imposed by the fractures are consistently relaxed. This allow the solution of more complex problems in an affordable amount of time and lighten the gridding process. Given my background and interests, I expect my future research to contribute in this field overcoming more difficulties related to complex problems in fractured porous media.

Scientific activities

Articles published

[A28] Alessio Fumagalli and Anna Scotti. "A mathematical model for thermal single-phase flow and reactive transport in fractured porous media". In: *Journal of Computational Physics* 434 (2021). DOI: 10.1016/j.jcp.2021.110205.
URL: https://www.sciencedirect.com/science/article/pii/S0021999121001005

[A27] Elyes Ahmed, Alessio Fumagalli, Ana Budiša, Eirik Keilegavlen, Jan M. Nordbotten, and Florin A. Radu. "Robust linear domain decomposition schemes for reduced non-linear fracture flow models". In: *SIAM Journal on Numerical Analysis* 59.1 (2021), pp. 583–612. DOI: 10.1137/19M1268392.
URL: https://epubs.siam.org/doi/abs/10.1137/19M1268392

[A26] Inga Berre, Wietse M. Boon, Bernd Flemisch, Alessio Fumagalli, Dennis Gläser, Eirik Keilegavlen, Anna Scotti, Ivar Stefansson, Alexandru Tatomir, Konstantin Brenner, Samuel Burbulla, Philippe Devloo, Omar Duran, Marco Favino, Julian Hennicker, I-Hsien Lee, Konstantin Lipnikov, Roland Masson, Klaus Mosthaf, Maria Giuseppina Chiara Nestola, Chuen-Fa Ni, Kirill Nikitin, Philipp Schädle, Daniil Svyatskiy, Ruslan Yanbarisov, and Patrick Zulian. "Verification benchmarks for single-phase flow in three-dimensional fractured porous media". In: *Advances in Water Resources* 147 (2020). ISSN: 0309-1708. DOI: 10.1016/j.advwatres.2020.103759. URL: http://www.sciencedirect.com/science/article/pii/S0309170820301603

[A25] Eirik Keilegavlen, Runar Berge, Alessio Fumagalli, Michele Starnoni, Ivar Stefansson, Jhabriel Varela, and Inga Berre. "PorePy: An Open-Source Software for Simulation of Multiphysics Processes in Fractured Porous Media". In: *Computational Geosciences* (2020). ISSN: 1573–1499. DOI: 10.1007/s10596-020-10002-5. URL: https://link.springer.com/article/10.1007%2Fs10596-020-10002-5

[A24] Andrea Borio, Alessio Fumagalli, and Stefano Scialò. "Comparison of the response to geometrical complexity of methods for unstationary simulations in discrete fracture networks with conforming, polygonal, and non-matching grids". In: *Computational Geosciences* (2020). DOI: 10.1007/s10596-020-09996-9. URL: https://link.springer.com/article/10.1007/s10596-020-09996-9

[A23] Luca Formaggia, Anna Scotti, and Alessio Fumagalli. "Numerical Methods, Flow in Fractured Porous Media". In: *Encyclopedia of Solid Earth Geophysics, 2nd Edition* (2020). Accepted. Available at arXiv:2003.14279 [physics.comp-ph]. URL: https://arxiv.org/abs/2003.14279

[A22] Alessio Fumagalli, Anna Scotti, and Luca Formaggia. "Performances of the mixed virtual element method on complex grids for underground flow". In: *SEMA SIMAI Springer Series* (2020). Accepted. Available at arXiv:2002.11974 [math.NA]. URL: https://arxiv.org/abs/2002.11974

[A21] Alessio Fumagalli and Anna Scotti. "A multi-layer reduced model for flow in porous media with a fault and surrounding damage zones". In: *Computational Geosciences* 24.3 (2020), pp. 1347–1360. ISSN: 1573-1499. DOI: 10.1007/s10596-020-09954-5. URL: https://link.springer.com/article/10.1007%2Fs10596-020-09954-5

[A20] Elyes Ahmed, Alessio Fumagalli, and Ana Budiša. "A Multiscale Flux Basis for Mortar Mixed Discretizations of Reduced Darcy-Forchheimer Fracture Models". In: *Computer Methods in Applied Mechanics and Engineering* 354 (2019), pp. 16–36. DOI: 10.1016/j.cma.2019.05.034. URL: https://www.sciencedirect.com/science/article/pii/S0045782519303044

[A19] Alessio Fumagalli and Eirik Keilegavlen. "Dual Virtual Element Methods for Discrete Fracture Matrix Models". In: *Oil & Gas Science and Technology - Revue d'IFP Energies nouvelles* 74.41 (2019), pp. 1–17. DOI: 10.2516/ogst/2019008. URL: https://ogst.ifpenergiesnouvelles.fr/articles/ogst/full_html/2019/01/ogst170210/ogst170210.html

[A18] Alessio Fumagalli, Eirik Keilegavlen, and Stefano Scialò. "Input and benchmarking data for flow simulations in discrete fracture networks". In: *Data in Brief* 21 (2018), pp. 1135–1139. ISSN: 2352-3409. DOI: 10.1016/j.dib.2018.10.088. URL: http://www.sciencedirect.com/science/article/pii/S2352340918313052

[A17] Alessio Fumagalli, Eirik Keilegavlen, and Stefano Scialò. "Conforming, non-conforming and non-matching discretization couplings in discrete fracture network simulations". In: *Journal of Computational Physics* 376 (2019), pp. 694–712. DOI: 10.1016/j.jcp.2018.09.048. URL: https://www.sciencedirect.com/science/article/pii/S0021999118306508

[A16] Jan Martin Nordbotten, Wietse Boon, Alessio Fumagalli, and Eirik Keilegavlen. "Unified approach to discretization of flow in fractured porous media". In: *Computational Geosciences* 23.2 (2019), pp. 225–237. ISSN: 1573–1499. DOI: 10.1007/s10596-018-9778-9. URL: https://link.springer.com/article/10.1007/s10596-018-9778-9

[A15] Alessio Fumagalli. "Dual virtual element method in presence of an inclusion". In: *Applied Mathematics Letters* 86 (Dec. 2018), pp. 22–29. DOI: 10.1016/j.aml.2018.06.004.
URL: https://www.sciencedirect.com/science/article/pii/S0893965918301812

[A14] Alessio Fumagalli and Isabelle Faille. "A double-layer reduced model for fault flow on slipping domains with hybrid finite volume scheme". In: *SIAM Journal on Scientific Computing* 77 (June 2018), pp. 1–26. DOI: 10.1007/s10915-018-0740-8.
URL: https://link.springer.com/article/10.1007%2Fs10915-018-0740-8

[A13] Bernd Flemisch, Inga Berre, Wietse Boon, Alessio Fumagalli, Nicolas Schwenck, Anna Scotti, Ivar Stefansson, and Alexandru Tatomir. "Benchmarks for single-phase flow in fractured porous media". In: *Advances in Water Resources* 111 (Jan. 2018), pp. 239–258. DOI: 10.1016/j.advwatres.2017.10.036.
URL: https://www.sciencedirect.com/science/article/pii/S0309170817300143

[A12] Alessio Fumagalli and Eirik Keilegavlen. "Dual Virtual Element Method for Discrete Fractures Networks". In: *SIAM Journal on Scientific Computing* 40.1 (2018), B228–B258. DOI: 10.1137/16M1098231.
URL: https://epubs.siam.org/doi/abs/10.1137/16M1098231

[A11] Alessio Fumagalli, Stefano Zonca, and Luca Formaggia. "Advances in computation of local problems for flow-based upscaling in fractured reservoirs". In: *Mathematics and Computers in Simulation* 137 (July 2017), pp. 299–324. DOI: 10.1016/j.matcom.2017.01.007.
URL: https://www.sciencedirect.com/science/article/pii/S0378475417300320

[A10] Marco Del Pra, Alessio Fumagalli, and Anna Scotti. "Well posedness of fully coupled fracture/bulk Darcy flow with XFEM". in: *SIAM Journal on Numerical Analysis* 55.2 (2017), pp. 785–811. DOI: 10.1137/15M1022574.
URL: https://epubs.siam.org/doi/10.1137/15M1022574

[A9] Bernd Flemisch, Alessio Fumagalli, and Anna Scotti. "A Review of the XFEM-Based Approximation of Flow in Fractured Porous Media". In: *Advances in Discretization Methods: Discontinuities, Virtual Elements, Fictitious Domain Methods*. Ed. by Giulio Ventura and Elena Benvenuti. Vol. 12. SEMA SIMAI Springer Series. Cham: Springer International Publishing, 2016. Chap. Advances in Discretization Methods, pp. 47–76. ISBN: 978-3-319-41246-7. DOI: 10.1007/978-3-319-41246-7_3.
URL: https://link.springer.com/chapter/10.1007/978-3-319-41246-7_3

[A8] Alessio Fumagalli, Luca Pasquale, Stefano Zonca, and Stefano Micheletti. "An upscaling procedure for fractured reservoirs with embedded grids". In: *Water Resources Research* 52.8 (2016), pp. 6506–6525. ISSN: 1944-7973. DOI: 10.1002/2015WR017729.
URL: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2015WR017729

[A7] Isabelle Faille, Alessio Fumagalli, Jérôme Jaffré, and Jean Elisabeth Roberts. "Model reduction and discretization using hybrid finite volumes of flow in porous media containing faults". In: *Computational Geosciences* 20.2 (2016), pp. 317–339. ISSN: 1573-1499. DOI: 10.1007/s10596-016-9558-3.
URL: https://link.springer.com/article/10.1007/s10596-016-9558-3

[A6] Alberto Ferroni, Luca Formaggia, and Alessio Fumagalli. "Numerical analysis of Darcy problem on surfaces". In: *ESAIM: Mathematical Modelling and Numerical Analysis* (2015). DOI: 10.1051/m2an/2015095.
URL: https://www.esaim-m2an.org/articles/m2an/abs/2016/06/m2an150040/m2an150040.html

[A5] Mauro Castelli and Alessio Fumagalli. "An evolutionary system for exploitation of fractured geothermal reservoirs". In: *Computational Geosciences* 20.2 (2016), pp. 385–396. ISSN: 1573-1499. DOI: 10.1007/s10596-015-9552-1.
URL: https://link.springer.com/article/10.1007/s10596-015-9552-1

[A4] Alessio Fumagalli and Anna Scotti. "An Efficient XFEM Approximation of Darcy Flows in Arbitrarily Fractured Porous Media". In: *Oil and Gas Sciences and Technologies - Revue d'IFP Energies Nouvelles* 69.4 (Apr. 2014), pp. 555–564. DOI: 10.2516/ogst/2013192.
URL: https://ogst.ifpenergiesnouvelles.fr/articles/ogst/abs/2014/04/ogst130007/ogst130007.html

[A3] Luca Formaggia, Alessio Fumagalli, Anna Scotti, and Paolo Ruffo. "A reduced model for Darcy's problem in networks of fractures". In: *ESAIM: Mathematical Modelling and Numerical Analysis* 48 (July 2014), pp. 1089–1116. ISSN: 1290-3841. DOI: 10.1051/m2an/2013132.
URL: https://www.esaim-m2an.org/articles/m2an/abs/2014/04/m2an130132/m2an130132.html

[A2] Alessio Fumagalli and Anna Scotti. "A numerical method for two-phase flow in fractured porous media with non-matching grids". In: *Advances in Water Resources* 62, Part C.0 (2013). Computational Methods in Geologic CO2 Sequestration, pp. 454–464. ISSN: 0309-1708. DOI: 10.1016/j.advwatres.2013.04.001.
URL: https://www.sciencedirect.com/science/article/pii/S0309170813000523

[A1] Alessio Fumagalli and Anna Scotti. "Numerical modelling of multiphase subsurface flow in the presence of fractures". In: *Communications in Applied and Industrial Mathematics* 3.1 (2011). ISSN: 2038-0909. DOI: 10.1685/journal.caim.380.
URL: http://caim.simai.eu/index.php/caim/article/view/380

Conference proceedings

[P6] Alessio Fumagalli and Anna Scotti. "Reactive Flow in Fractured Porous Media". In: *Finite Volumes for Complex Applications IX - Methods, Theoretical Aspects, Examples*. Ed. by Robert Klöfkorn, Eirik Keilegavlen, Florin A. Radu, and Jürgen Fuhrmann. Cham: Springer International Publishing, 2020, pp. 55–73. ISBN: 978-3-030-43651-3.

[P5] Eirik Keilegavlen, Alessio Fumagalli, Runar Berge, and Ivar Stefansson. "Implementation of Mixed-Dimensional Models for Flow in Fractured Porous Media". In: *Numerical Mathematics and Advanced Applications ENUMATH 2017*. Ed. by Florin Adrian Radu, Kundan Kumar, Inga Berre, Jan Martin Nordbotten, and Iuliu Sorin Pop. Vol. 126. Springer International Publishing, 2019, pp. 573–580. ISBN: 978-3-319-96415-7. DOI: 10.1007/978-3-319-96415-7_52.
URL: https://link.springer.com/chapter/10.1007/978-3-319-96415-7_52

[P4] Alessio Fumagalli and Stefano Zonca. "An efficient upscaling procedure for highly fractured reservoirs". In: *Proceedings of the 6th International Conference on Approximation Methods and Numerical Modelling in Environment and Natural Resources*. 2015.

[P3] Luca Formaggia, Anna Scotti, and Alessio Fumagalli. "The Challenge of Complexity in Sedimentary and Reservoir Simulations". In: *Proceedings of the 23rd Conference on Computational Mechanics ACME-UK 2015*. Ed. by Antonio J. Gil and Rubén Sevilla. Apr. 2015, pp. 33–36. ISBN: 978-0-9567462-4-5.
URL: http://eng-intranet-web.swan.ac.uk/acme2015/ACMEUK2015.pdf

[P2] Alessio Fumagalli and Anna Scotti. "A Reduced Model for Flow and Transport in Fractured Porous Media with Non-matching Grids". In: *Numerical Mathematics and Advanced Applications 2011*. Ed. by Andrea Cangiani, Ruslan L. Davidchack, Emmanuil Georgoulis, Alexander N. Gorban, Jeremy Levesley, and Michael V. Tretyakov. Springer Berlin Heidelberg, 2013, pp. 499–507. ISBN: 978-3-642-33133-6. DOI: 10.1007/978-3-642-33134-3_53.
URL: https://link.springer.com/chapter/10.1007/978-3-642-33134-3_53

[P1] Alessio Fumagalli and Anna Scotti. "An unfitted method for two-phase flow in fractured porous media". In: *CMWR 2012 Proceedings*. 2012.
URL: http://cmwr2012.cee.illinois.edu/Papers/Special%20Sessions/CO2%20Sequestration/Scotti.Anna.pdf

Articles submitted for review

[S3] Alessio Fumagalli and Francesco Saverio Patacchini. "Model adaptation in a discrete fracture network: existence of solutions and numerical strategies". Submitted to Computer Methods in Applied Mechanics and Engineering. Available at arXiv:2103.01668 [math.NA]. 2021.
URL: https://arxiv.org/abs/2103.01668

[S2] Luca Formaggia, Alessio Fumagalli, and Anna Scotti. "A multi-layer reactive transport model for fractured porous media". Submitted to Mathematics in Engineering. Available at arXiv:2011.04227 [math.NA]. 2020.
URL: https://arxiv.org/abs/2011.04227

[S1] Franco Dassi, Alessio Fumagalli, Davide Losapio, Stefano Scialò, Anna Scotti, and Giuseppe Vacca. "The Mixed Virtual Element Method on curved edges in two dimensions". Submitted to Computer Methods in Applied Mechanics and Engineering. Available at arXiv:2007.13513 [math.NA]. 2020. URL: https://arxiv.org/abs/2007.13513

Open-source software development

2017, May – Core developer of *PorePy: A Simulation Tool for Fractured and Deformable Porous Media written in Python*. PorePy is developed by the Porous Media Group at the University of Bergen, Norway. See http://github.com/pmgbergen/porepy.

2010, Jan. – 2013, Feb. Member of the administrative board and developer community of the parallel finite element library *LifeV*. LifeV is developed by the groups: CMCS (École polytechnique fédérale de Lausanne - EPFL, Switzerland), E(CM)2 (Emory University, USA), MOX (Politecnico di Milano, Italy), REO and ESTIME (Institut national de recherche en informatique et en automatique - INRIA, France). See www.lifev.org and https://github.com/lifev/lifev.

Grants

2017, Mar. – 2017, Dec. Personal grant from Akademia Agreement 2017. Grant for academic exchanges and travel expenses (12k NOK $\sim$ 1.3k EUR).

2016, Nov. – 2017, Jun. Personal grant from Akademia Agreement 2016. Grant for academic exchanges and travel expenses (25k NOK $\sim$ 2.7k EUR).

2016, Apr. – 2017, Jun. Personal grant from Meltzer Research Fund. Grant for academic exchanges and travel expenses (20k NOK $\sim$ 2.1k EUR).

2015, Dec. – 2016, Sep. Personal grant from Akademia Agreement 2015. Grant for academic exchanges and travel expenses (20k NOK $\sim$ 2.1k EUR).

2014, Sep. – 2015, Sep. Personal grant from Istituto Nazionale di Alta Matematica, Gruppo Nazionale per il Calcolo Scientifico. Grant "Contributo Progetto Giovani Ricercatori 2014", for conference and travel expenses (1.5k EUR).

2013 Personal grant from ERCIM Alain Bensoussan Fellowship Programme, co-funded by the European Commission under the FP7 Marie-Curie action named ABCDE, applied for the hosting institute Inria Paris-Rocquencourt. Call 2013-14 1st round. The grant finances a Postdoctoral fellow position of 1 year.

I turned down the grant in favour of the Postdoctoral fellowship at IFP - Energies nouvelles.

Editorial activities

2019 Alessio Fumagalli, Inga Berre, Luca Formaggia, Eirik Keilegavlen, and Anna Scotti, eds. *Numerical Methods for Processes in Fractures Porous Media*. Lecture Notes in Geosystems Mathematics and Computing. In production. Springer, 2019.

2018, Mar. – Editor of the journal GEM – International Journal on Geomathematics, Springer.

2017, Ott. – 2018, Feb. Corresponding Guest Editor for the topical collection "Numerical methods for processes in fractured porous media" of the journal GEM – International Journal on Geomathematics, Springer. Co-Guest Editors Anna Scotti, Luca Formaggia, Inga Berre, Eirik Keilegavlen. 12 papers published. [link].

Scientific refereeing activities

Reviewer of journals on numerical analysis and scientific computing: Advances in Water Resources, Communications in Computational Physics, Computational Geosciences, Computers & Mathematics with Applications, Computer Methods in Applied Mechanics and Engineering, Energies, Environmental Earth Sciences, Geofluids, Hydrogeology Journal, International Journal on Geomathematics, Journal of Ambient Intelligence and Humanized Computing, Journal of Computational and Applied Mathematics, Journal of Scientific Computing, Numerical Algorithms, Numerical Methods for Partial Differential Equations, SIAM Journal on Numerical Analysis, SPE Journal.

Academic duties

5. External reviewer of the Ph.D. thesis of Pavel Exner "Extended finite element methods for approximation of singularities". Faculty of Mechatronics, Informatics and Interdisciplinary Studies, Technical University of Liberec, Czech Republic. 11 Jun. 2019.

4. External reviewer of the Ph.D. thesis of Daqing Liu "A numerical method for analyzing fault slip tendency under fluid injection with XFEM". Department of Mathematics, Politecnico di Milano, Italy. Dec. 2017.

3. Internal examiner and member of the evaluation committee of the master thesis of Davide Illiano, "Iterative Schemes for Solving Coupled, non-Linear Flow and Transport in Porous Media". Department of Mathematics, University of Bergen, Norway. 16 Dec. 2016.

2. Member of four selection committees for Ph.D. positions in applied and computational mathematics related to "*Topp-forsk* project: Thermo-Mechanical Subsurface Energy Storage (TheMSES)". Department of Mathematics, University of Bergen, Norway. Jun. and Jul. 2016.

1. Internal examiner and member of the evaluation committee of the master thesis of David Landa Márban, "Modeling and Simulation of Microbial Enhanced Oil Recovery: a New Approach which Includes the Role of Interfacial Area". Department of Mathematics, University of Bergen, Norway. 20 Jun. 2016.

Educational activities

Teaching activities

8. A.Y. 2020-2021: lecturer of the undergraduate course *Analytical and numerical methods for engineer*, Energy Engineer, Politecnico di Milano.

7. A.Y. 2020-2021: lecturer of the Ph.D. course *Models and methods for simulations and hydro-mechanical coupling*, Department of Mathematics, Politecnico di Milano.

6. A.Y. 2019-2020, 2020-2021: lecturer of the undergraduate course *Curves and Surfaces for the Design*, Communication Design, Politecnico di Milano.

5. A.Y. 2019-2020: lecturer of the graduate course *Functional analysis and numerics for PDEs*, Department of Energy, Politecnico di Milano.

4. A.Y. 2018-2019: lecturer of the Ph.D. course *Models and methods for simulations and hydro-mechanical coupling*, Department of Mathematics, Politecnico di Torino.

3. A.Y. 2018-2019: assistant lecturer for the graduate course *Numerical modeling*, Mechanical Engineering, Politecnico di Torino. Lecturer Claudio Canuto.

2. A.Y. 2017-2018: lecturer for the graduate and Ph.D. course *Functional analysis*, Department of Mathematics, University of Bergen.

1. A.Y. 2017-2018: lecturer for the graduate and Ph.D. course *Flow in Porous Media*, Department of Mathematics, University of Bergen. In collaboration with Florin Adrian Radu.

Student advising

4. Martin Sandanger Dugstad. "Upscaling on Fracture Flow Models". Advisor: Kundan Kumar. Co-advisor: Alessio Fumagalli. Master Thesis. University of Bergen, June 2017.

3. Marco Del Pra. "Mixed and extended finite elements for flow in fractured porous media". Advisor: Lourenço Beirão Da Veiga, Luca Formaggia. Co-advisor: Anna Scotti, Alessio Fumagalli. Master Thesis. Università degli Studi di Milano, Feb. 2015.

2. Alberto Ferroni. "Numerical Simulation of the Darcy's Problem on Surfaces in $\mathbb{R}^3$". Advisor: Luca Formaggia. Co-advisor: Alessio Fumagalli. Master Thesis. Politecnico di Milano, July 2013.

1. Guido Iori. "Una metodologia XFEM per problemi ellittici 3D con superfici di discontinuità". Advisor: Luca Formaggia. Co-advisor: Alessio Fumagalli. Master Thesis. Politecnico di Milano, Dec. 2011.

Pedagogical training

1. A.Y. 2017-2018: attending the course *Hot Moments in Teaching and Learning: Handling Conflict or Tension in the Classroom and Supervision Situations*, Program for University Pedagogy, Faculty of Psychology, University of Bergen. Lecturer Yael Harlap. 18 hours.

Participation to conferences, workshops and seminars

Organization

12. Minisymposium title *Verification benchmarks for single-phase flow in three-dimensional fractured porous media* at SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2019, 8 participants. Houston Marriott Westchase, Houston, Texas, USA. 11–14 Mar. 2019. Co-organizers Inga Berre, Wietse M. Boon, Bernd Flemisch, Dennis Gläser, Eirik Keilegavlen, Anna Scotti, Ivar Stefansson, Alexandru Tatomir.

11. Minisymposium title *Advanced models and methods for underground flows in complex geometries with applications* at SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2019, 9 participants. Houston Marriott Westchase, Houston, Texas, USA. 11–14 Mar. 2019. Co-organizers Anna Scotti, Stefano Scialò.

10. Minisymposium title *Numerical methods for processes in fractured media* at 10th International Conference on Porous Media of the International Society of Porous Media (InterPore). 4 participants. Ernest N. Morial Convention Center, New Orleans, Louisiana, USA. 14–17 May 2018. Co-organizers Géraldine Pichot, Elyes Ahmed.

9. Minisymposium title *Mathematical aspects for flows in fractured porous media* at European Conference on Numerical Mathematics and Advanced Applications (ENUMATH) 2017. 4 participants. University of Bergen, Voss, Norway. 19–21 Sep. 2017. Co-organizer Eirik Keilegavlen.

8. Minisymposium title *Numerical methods for the characterization of geothermal reservoirs* at SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2017, 10 participants. University of Erlangen, Erlangen, Germany. 11–14 Sep. 2017. Co-organizers Luca Formaggia, Eirik Keilegavlen, Anna Scotti.

7. Minisymposium title *Enriched methods for flow and mechanics in heterogeneous porous media* at eXtended Discretization MethodS (XDMS) 2017. 13 participants. University of Umeå, Umeå, Sweden. 19–21 Jun. 2017. Co-organizers Stefano Berrone, Stefano Scialò, Stefano Zonca.

6. Chair organizer of the workshop *Modeling and Benchmarking of Fractured Porous Media: Flow, Transport and Deformation (MBFPM)- 2017*. 43 participants. University of Bergen, Bergen, Norway. 8–9 Jun. 2017. Co-organizers: Inga Berre, Wietse Boon, Bernd Flemisch, Ivar Stefansson, Anna Scotti, Alexandru Tatomir. Web site `www.uib.no/en/mbfpm2017`.

5. Member of the organization committee of the conference *eXtended Discretization MethodS* (XDMS) 2015. 112 participants. University of Ferrara, Ferrara, Italy. 9–11 Sep. 2015. Web site `x-dms2015.sciencesconf.org`.

4. Minisymposium title *Enriched methods for flow and mechanics in heterogeneous porous media* at eXtended Discretization MethodS (XDMS) 2015. 9 participants. University of Ferrara, Ferrara, Italy. 9–11 Sep. 2015. Co-organizers Stefano Berrone, Oliver Sander, Anna Scotti.

3. Minisymposium title *Advances in numerical methods for complex fractured-porous media* SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2015, 6 participants. Stanford University, Stanford, California USA. 29 Jun.–2 Jul. 2015. Co-organizers Stefano Berrone, Sandra Pieraccini, Anna Scotti.

2. Minisymposium title *Modeling and Numerical Issues for fractured-porous media* at SIAM Annual Meeting 2014, 12 participants. The Palmer House, Chicago, Illinois, USA. 7–11 Jul. 2014. Co-organizer Géraldine Pichot.

1. Minisymposium title *Numerical resolution of PDE: the potentiality of the LifeV library* at Società Italiana per la Matematica Applicata e Industriale (SIMAI) Biannual Congress, 4 participants. Politecnico di Torino, Turin, Italy. 25–26 Jun. 2012. Co-organizer Franco Dassi.

Oral presentations

31. *Mixed-virtual element methods for discrete fracture matrix models. An application to reactive transport*. Finite Volumes for Complex Applications IX, Bergen, Norway (Held Online). 15–19 Jun. 2020. Invited speaker.

30. *A multilayer model for reactive flow in fractured porous media*. Advances in the SImulation of reactive flow and TRAnsport in porous Media. University of Pau & Adour Region, Pau, France. 2–3 Dec. 2019. Co-author Anna Scotti.

29. *Flexible discretizations for mixed-dimensional Darcy-type flows in fractured porous media*. Seminar at Faculty of Mechatronics, Informatics and Interdisciplinary Studies, Technical University of Liberec, Czech Republic. 12 Jun. 2019. Organizer Jan Březina. Invited.

28. *Verification benchmarks for single-phase flow in three-dimensional fractured porous media*. SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2019. Houston Marriott Westchase, Houston, Texas, USA. 11–14 Mar. 2019. Co-authors Inga Berre, Wietse M. Boon, Bernd Flemisch, Dennis Gläser, Eirik Keilegavlen, Anna Scotti, Ivar Stefansson, Alexandru Tatomir.

27. *Mixed-dimensional partial differential equations for flow in fractured porous media, modeling and numerical schemes*. 12th Workshop On Mathematical Modeling of Environmental and Life Sciences Problems. University Ovidius of Constanţa, Constanţa, Romania. 24–28 Oct. 2018. Invited speaker.

26. *Numerical methods for embedded interfaces: applications to geoscience*. Società Italiana per la Matematica Applicata e Industriale (SIMAI) Biannual Congress. Sapienza Università di Roma, Rome, Italy. 2–6 Jul. 2018. Keynote speaker invited in minisymposium.

25. *A general framework for heterogeneous discretizations in mixed-dimensional single-phase flow*. Società Italiana per la Matematica Applicata e Industriale (SIMAI) Biannual Congress. Sapienza Università di Roma, Rome, Italy. 2–6 Jul. 2018. Co-authors Wietse Boon, Eirik Keilegavlen, Jan M. Nordbotten. Invited in minisymposium.

24. *Flexible discretizations for mixed-dimensional single-phase flow in fractured porous media*. Seminar at Department of Mathematics of the University of Padua, Padua, Italy. 2 Mar. 2018. Organizer Mario Putti. Invited.

23. *Dual virtual element method for fractured geothermal systems*. European Conference on Numerical Mathematics and Advanced Applications (ENUMATH) 2016. University of Bergen, Voss, Norway. 25–29 Sep. 2017. Co-author Eirik Keilegavlen, Pål Næverlid Sævik. Invited in minisymposium.

22. *An integrated mathematical-geological workflow for fractured geothermal system in metamorphic rocks*. SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2017. University of Erlangen, Erlangen, Germany. 11–14 Sep. 2017. Co-author Eirik Keilegavlen. Invited in minisymposium.

21. *Dual virtual element method to simulate geothermal energy extraction on realistic geologies*. Bergen-Budapest Workshop. Western Norway University of Applied Sciences, Bergen, Norway. 29–30 May 2017. Co-author Eirik Keilegavlen. Invited.

20. *A mathematical and geological approach for fractured geothermal system*. SIAM Conference on Computational Science and Engineering (SIAM-CSE). Hilton Atlanta, Atlanta, Georgia, USA. 27 Feb.–3 Mar. 2017. Co-author Eirik Keilegavlen. Invited in minisymposium.

19. *Integrated flow simulation and outcrop interpretation in fractured geothermal systems*. Seminar at Department of Applied Mathematics in SINTEF, Oslo, Norway. 21 Sep. 2016. Co-author Eirik Keilegavlen. Organizer Xavier Raynaud. Invited.

18. *An integrated geological and mathematical framework for geothermal reservoirs. from outcrops to a VEM approximation*. Seminar at Department of Mathematics of University of Milano-Bicocca, Milan, Italy. 2 Sep. 2016. Co-author Eirik Keilegavlen. Organizer Franco Dassi. Invited.

17. *An integrated geological and mathematical framework for geothermal reservoirs*. Flow & Transport in Permeable Media, Gordon Research Seminar. PGA Catalunya Business and Convention, Girona, Spain. 30–31 Jul. 2016. Co-author Eirik Keilegavlen.

16. *An integrated geological and mathematical framework for geothermal reservoirs.* 8$^{\text{th}}$ International Conference on Porous Media of the International Society of Porous Media (InterPore). Hilton Cincinnati Netherland Plaza, Cincinnati, Ohio, USA. 9–12 May 2016. Co-author Eirik Keilegavlen. Invited in minisymposium.

15. *Non-matching schemes for upscaling in fractured porous media.* eXtended Discretization MethodS (XDMS) 2015. University of Ferrara, Ferrara, Italy. 9–11 Sep. 2015. Co-authors Anna Scotti, Stefano Zonca.

14. *Upscaling techniques for highly fractured porous media with non-matching discretization.* SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2015. Stanford University, Stanford, California USA. 29 Jun.–2 Jul. 2015. Co-authors Paola Panfili, Luca Pasquale, Stefano Zonca.

13. *An efficient upscaling technique for highly fractured reservoir.* International Conference on Approximation Methods and Numerical Modelling in Environment and Natural Resources (MAMERN) 2015. University of Pau, France. 1–5 Jun. 2015. Co-authors Paola Panfili, Luca Pasquale, Stefano Zonca. Invited in minisymposium.

12. *A double-layer reduced model for flow in fault zones using hybrid finite volume schemes.* SIAM Annual Meeting 2014. The Palmer House, Chicago, Illinois, USA. 7–11 Jul. 2014. Co-authors Isabelle Faille, Jérôme Jaffré, Jean E. Roberts.

11. *Double-layer reduced model for faults with the hybrid finite volume scheme.* Computational Methods in Water Resources (CMWR). University of Stuttgart, Germany. 10–13 Jun. 2014. Co-authors Isabelle Faille, Jérôme Jaffré, Jean E. Roberts. Invited in minisymposium.

10. *Numerical methods for flows in fractured porous media.* FRACINI first workshop. INRIA Rennes - Bretagne Atlantique, Rennes, France. 28–30 Apr. 2014. Co-authors Luca Formaggia, Anna Scotti. Invited in workshop.

9. *XFEM for heterogeneous porous media with networks of fractures.* XFEM 2013, thematic conference of ECCOMAS. Espace Tête d'Or, Lyon, France. 11–13 Sep. 2013. Co-authors Luca Formaggia, Anna Scotti.

8. *Assessment of an HPC two-phase flow solver in porous media for realistic cases.* SIAM Mathematical & Computational Issues on Geosciences (SIAM-GS) 2013. Department of Mathematics University of Padova, Italy. 17–20 Jun. 2013. Co-authors Antonio Cervone, Luca Formaggia. Invited in minisymposium.

7. *XFEM for Darcy problems with networks of fractures.* Società Italiana per la Matematica Applicata e Industriale (SIMAI) Biannual Congress. Politecnico di Torino, Turin, Italy. 25–26 Jun. 2012. Co-authors Luca Formaggia, Anna Scotti.

6. *Reduced models for intersecting fractures in porous media with non-matching grids.* 4$^{\text{th}}$ International Conference on Porous Media of the International Society of Porous Media (InterPore). Purdue University, Lafayette, Indiana, USA. 14–16 May 2012. Co-authors Luca Formaggia, Anna Scotti. Invited in minisymposium.

5. *Modelli ridotti per flussi in mezzi porosi fratturati con griglie di calcolo non conformi.* XIX Congresso dell'Unione Matematica Italiana (UMI). Dipartimento di Matematica dell'Università di Bologna, Bologna, Italy. 12–17 Sep. 2011. Co-author Anna Scotti.

4. *Interface Conditions for Fluid Flow in Porous Media with Reduced Order and Non Matching Fractures.* SIAM Mathematical & Computational Issues on Geosciences. Hilton Long Beach Centre, Long Beach, California, USA. 21–24 Mar. 2011. Co-author Anna Scotti.

3. *Models for oil expulsion and migration in fractured media.* Reduction Strategies for the Simulation of Complex Problems. MOX, Department of Mathematics, Politecnico di Milano, Milan, Italy. 19–21 Jan. 2011. Co-authors Luca Formaggia, Anna Scotti

2. *Darcy solvers.* Second LifeV annual meeting. MOX, Department of Mathematics, Politecnico di Milano, Milan, Italy. 3–4 Jan. 2011.

1. *Computational aspects for oil secondary migration.* Seminar held at INRIA Roquencourt, Paris, France. 16 Sep. 2010. Organizers: Jérôme Jaffré, Michel Kern. Invited.

Poster presentations

7. *Mixed-dimensional MVEM for real fractured geothermal systems.* Dobbiaco summer school - Theory and Practice of the Virtual Element Methods. Dobbiaco, Italy. 17-22 Jun. 2018. Co-author Eirik Keilegavlen.

6. *A mathematical approach for fractured geothermal system.* InterPore Norwegian Chapter, 1st National Workshop on Porous Media. University of Trondheim - NTNU, Trondheim, Norway. 19 Oct. 2017. Co-author Eirik Keilegavlen.

5. *Dual virtual element methods for real fractured geothermal systems.* Modeling and Benchmarking of Fractured Porous Media: Flow, Transport and Deformation - 2017. University of Bergen, Bergen, Norway. 8–9 Jun. 2017. Co-author Eirik Keilegavlen.

4. *Dual virtual element methods for real fractured geothermal systems.* Modeling and Benchmarking of Fractured Porous Media: Flow, Transport and Deformation - 2017. University of Bergen, Bergen, Norway. 8–9 Jun. 2017. Co-author Eirik Keilegavlen.

3. *An integrated geological and mathematical framework for geothermal reservoirs.* Flow & Transport in Permeable Media, Gordon Research Seminar and Gordon Research Conference. PGA Catalunya Business and Convention, Girona, Spain. 30–31 Jul. and 1–5 Aug. 2016. Co-author Eirik Keilegavlen.

2. *LifeV::Geophysics@EuroTUG2012.* European Trilinos user group 2012 (EuroTUG). École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. 4–6 Jun. 2012. Co-authors Antonio Cervone, Nur Fadel, Guido Iori, Michel Kern.

1. *Reduced models for fractures in porous media with non-matching grids.* 4th International Conference on Porous Media of the International Society of Porous Media (InterPore). Purdue University, Lafayette, Indiana, USA. 14–16 May 2012. Co-authors Luca Formaggia, Anna Scotti.

Torino, Italy, 31 Mar. 2021