

# Curriculum Vitae

## Anna Scotti

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20137, Milano (MI), Italia  
anna.scotti@polimi.it

Place of Birth: Milano, Italy  
Date of Birth: 3<sup>rd</sup> May 1982  
Nationality: Italian

## Education

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| Jan. 2007 - Mar. 2010 | <i>PhD in Mathematical Engineering</i> , MOX, Dip. di Matematica, Politecnico di Milano, Italy.   |
| Sep. 2004 - Oct. 2006 | <i>Master Degree in Aeronautic Engineering (Laurea specialistica in Ingegneria Aeronautica)</i> .<br>Politecnico di Milano, Italy. Mark: 110/110 with honors. |

## Academic titles

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| March 2017 | "Abilitazione scientifica nazionale" fascia II, Numerical Analysis area (MAT08), granted on March 28th 2017. |
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## Academic positions

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| since July 2013       | Assistant professor (Ricercatore TD tipo "A") at the Department of Mathematics of Politecnico di Milano.   |
| Jan. 2012 - June 2013 | Post Doc research assistant in the Department of Mathematics of Politecnico di Milano. Title of the research program: "Discrete fracture models for reservoir simulations"                 |
| Jan. 2010 - Dec 2012  | Post Doc research assistant in the Department of Mathematics of Politecnico di Milano. Title of the research program: "Modelling of single and multiphase flows in fractured porous media" |

## Short summary of research

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My recent research has concerned mostly on modeling and numerical aspects in the study of flows in porous media, with a particular focus on geophysical application, and more recently, on biomedical ones.

In particular, I have carried out research on:

- the study and development of numerical techniques for heterogeneous and fractured porous media,
- the study of reactive flows, with a particular focus on the processes of diagenesis (rock transformation),
- numerical techniques for fracture propagation.

As concerns the study of fractured porous media my work is based on the representation of fractures and faults as  $n - 1$  dimensional domains embedded in a surrounding  $n$  dimensional porous matrix, a technique that was already popular in literature but limited to the case of conforming grids, i.e. where the grid honors the geometry of the fractures. My original contribution consists in the use of the eXtended Finite Elements (XFEM) [8,10,11,14,15] to account for discontinuities in the coefficients and in the solution (pressure and Darcy velocity) within grid elements. Moreover, I used XFEM to handle intersecting fractures with suitable coupling conditions at the crossing points: on one hand, to enrich the fracture grids that can intersect in an arbitrary way, on the other hand to approximate the solution in elements cut by more than one interface, further enriching the FEM space.

The aforementioned enrichment of the FEM spaces in the case of saddle point problems such as Darcy in mixed form, or Stokes problem, should be inf-sup stable. This is not always guaranteed even if the original FEM pair is stable: to this aim we have analyzed the conditions on the geometry and on the grids that give inf-sup stability, and suitable stabilization techniques [3,9].

With the same aim of developing numerical methods robust with respect to geometry I have worked on the application of Mimetic Finite Differences to the problem of the flow in fractured porous media [5,18, 1]. Moreover, in the scope of project KaFRes in collaboration with Eni, I have collaborated in the study and development of techniques of numerical upscaling for the simulation of fractured reservoirs [21].

A recent evolution of this line of research consists in the coupling of the fluid flow with the mechanics of the porous medium. In the scope of project Geomech, in collaboration with Eni, we are studying the effect of fluid injection/production from the subsurface on the stability of pre-existing faults, to assess the risk of triggered earthquakes. While the main activity is based on the use of commercial software and on standard FEM/finite volume techniques, I have employed, in simple two-dimensional configuration, the XFEM to discretize both the mechanical and the fluid dynamic problem. Moreover, I have co-supervised a PhD thesis on the numerical simulation of crack growth, where the XFEM are used in conjunction with a phase-field model to obtain a physically accurate, but at the same time efficient method [2].

As concerns the study of reactive flows and their effects on the evolution of sedimentary basins, I have studied the coupling of the fluid dynamic problem with the heat and the compaction of the media that occurs over millions of years, accounting for mineral dissolution/precipitation/transformation. One of the major difficulties consists in the coupling among the equations, that has been handled both by means of iterative splittings and monolithically. Another case of reactive flow of particular interest is the process of oil generation in the source rock, which is the subject of several research

projects in collaboration with Eni from 2007 to 2015. Here, a particular attention was devoted to computational efficiency in conjunction with reliability to develop a numerical tool that was suitable for industrial use. Indeed, numerical integration should preserve mass conservation and positivity of the solution [6,12,16] even in the presence of stiff ODEs, or in the case of ODEs with discontinuous right hand side which require ad hoc techniques both for the numerical integration, as well as for the analysis [4].

## Participation to grant projects

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<b>SRP-NUPUS</b>	From Sept. 2016, scientific coordinator for Politecnico di Milano in Stuttgart Research Partnership SRP-NUPUS ( <a href="https://www.srpnupus.uni-stuttgart.de/">https://www.srpnupus.uni-stuttgart.de/</a> ).
<b>GNCS 2017</b>	Participation in the project <i>Analisi e sviluppo di metodologie numeriche per certi tipi non classici di sistemi dinamici</i> , coordinator S.Maset.
<b>GNCS 2015</b>	Participation in the project <i>Metodi numerici non-standard per la geofisica</i> , coordinator P.F.Antonietti.
<b>Rocca 2012-2013</b>	Project <i>Coupled flow and geomechanics of faults – Application to CO2 sequestration</i> in collaboration with the Department of Civil and Environmental Engineering of MIT, PI L. Formaggia and R. Juanes.
<b>PRIN 2009</b>	Participation in the research program <i>Modelli numerici per il calcolo scientifico ed applicazioni avanzate</i> , coordinator A. M. Quarteroni.
<b>PRIN 2008</b>	Participation in the research program <i>Approssimazione Numerica con Tecniche Adattive e Non-Conformi di Problemi Multifisica</i> , coordinator F.Brezzi.
<b>PRIN 2007</b>	Participation in the research program <i>Modellistica matematica e numerica per applicazioni cardiovascolari e in dinamica dei fluidi</i> , coordinator A. M. Quarteroni.

## Participation in industrial projects

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2017 IntRho	Scientific coordinator for the research project financed by Eni Spa titled <i>Algoritmi per il calcolo della densità in TMGAS</i> , with the responsibility of a research assistant (from 17/3/17).
2016 - 2017 Simba3dfrac	Scientific coordinator for the research project financed by Eni Spa titled <i>Modellazione di fratturazione e effetti 3D</i>

	<i>nella source</i> , with the responsibility of a research assistant (from 11/4/17).
2015 - 2016 BioGen	Scientific coordinator for the research project financed by Eni Spa titled <i>Modelling of biogenic gas generation in the source rock</i> , with the responsibility of a research assistant (from 01/11/2015 to 30/06/2016).
2014 - 2015 GasSystem	Participation in the research project financed by Eni Spa titled <i>Modelling of organic porosity</i> (from 16/04/2014 to 31/12/2014).
2017 Geomech4	Participation in the research project financed by Eni Spa titled <i>Modelling of seismicity induced by fault slip</i> (from 15/5/17).
2015-2016 Geomech3	Participation in the research project financed by Eni Spa titled <i>Modelling of seismicity induced by fault slip</i> (from 06/11/2015 to 14/12/2016).
2015 Geomech2	Participation in the research project financed by Eni Spa titled <i>Modelling of seismicity induced by fault slip</i> (from 19/12/2014 to 19/06/2015).
2014 Geomech	Participation in the research project financed by Eni Spa titled <i>Modelling of seismicity induced by fault slip</i> (from 16/01/2014 to 31/12/2014).
2012 - 2014 SimbaGe1Ds	Participation in the research project financed by Eni Spa titled <i>Models of secondary compaction of the source rock</i> .
2012 - 2013 KaFRes	Participation in the research project financed by Eni Spa titled <i>Karstified and Fractured Reservoir Simulation (KaFres)</i> .
2010 - 2013 CompGeo	Participation in the research project financed by Eni Spa titled <i>Modelling of geochemical compaction processes at the basin scale</i> .
2008 - 2012 iMigro	Participation in the research project financed by Eni Spa titled <i>iMigro</i> .
2007-2010 PMOD+	Participation in the research project financed by Eni Spa titled <i>Expulsion and primary migration of hydrocarbons</i> .

## Publications

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### Papers

1. Formaggia, L., Scotti, A., Sottocasa, F., *Analysis of a mimetic finite difference approximation of flows in fractured porous media*, ESAIM: Mathematical Modelling and Numerical Analysis DOI: 10.1051/m2an/2017028
2. Giovanardi, B., Scotti, A., Formaggia, L., *A hybrid XFEM - Phase Field (Xfield) method for crack propagation in brittle materials*, Computer Methods in Applied Mechanics and Engineering, Volume 320, 396-420, (2017), DOI:10.1016/j.cma.2017.03.039.
3. Del Pra M., Fumagalli A., Scotti A., *Well posedness of fully coupled fracture/bulk Darcy flow with non-matching grids*, SIAM Journal on Numerical Analysis, Volume 55, Issue 2, 445-1133 (2017), DOI:10.1137/15M1022574.
4. Agosti A., Giovanardi B., Formaggia L., Scotti A., *A numerical procedure for geochemical compaction in the presence of discontinuous reactions*, Advances in Water Resources, Volume 94 (2016), pp. 332-344, DOI:10.1016/j.advwatres.2016.06.001
5. Antonietti P.F., Formaggia L., Scotti A., Verani M., Verzotti N., *Mimetic finite difference approximation of flows in fractured porous media*, ESAIM: Mathematical Modelling and Numerical Analysis, Volume 50, Issue 3, 809-832 (2016), DOI: 10.1051/m2an/2015087.
6. Giovanardi, B., Scotti, A., Formaggia, L., Ruffo, P., *A general framework for the simulation of geochemical compaction*, Computational Geosciences, Volume 19, Issue 5, 1027-1046 (2015), DOI: 10.1007/s10596-015-9518-3.
7. Agosti, A., Formaggia, L., Scotti, A., *Analysis of a model for precipitation and dissolution coupled with a Darcy flux*, Journal of Mathematical Analysis and Applications, Volume 431, Issue 2, (2015), pp. 752-781.
8. Fumagalli A., Scotti A., *An efficient XFEM approximation of Darcy flow in arbitrarily fractured porous media*, Oil and Gas Sciences and Technologies - Revue d'IFP Energies Nouvelles 69.4 (2014), pp. 555-564
9. Cattaneo L., Formaggia L., Iori G. F., Scotti A., Zunino P., *Stabilized extended finite elements for the approximation of saddle point problems with unfitted interfaces*, Calcolo (2014), pp 130.
10. Formaggia L., Fumagalli A., Scotti A. Ruffo P. *A reduced model for Darcys problem in networks of fractures*, ESAIM: Mathematical Modelling and Numerical Analysis 48 (2014), pp. 1089-1116.
11. Fumagalli, A., Scotti, A., *A numerical method for two-phase flow in fractured porous media with non-matching grids*, Advances in Water Resources, Volume 62, p. 454-464 (2013)  
10.1016/j.advwatres.2013.04.001.
12. Formaggia, L., Guadagnini, A., Imperiali, I., Lever, V., Porta, G., Riva, M., Scotti, A., Tamellini, L., *Global sensitivity analysis through polynomial chaos expansion*

- of a basin-scale geochemical compaction model*, Computational Geosciences, 2013, Vol 17(1) pp 25-42, DOI: 10.1007/s10596-012-9311-5.
13. Tamellini, L. Formaggia, L., Miglio, E., Scotti, A., *An Uzawa iterative scheme for the simulation of floating bodies*, Computers & Fluids, Vol. 68, pp. 148-158, (2012).
  14. Fumagalli, A. and Scotti, A., *Numerical modelling of multiphase subsurface flow in the presence of fractures*, Communications in Applied and Industrial Mathematics, 2011, 10.1685/journal.caim.380, (2012).
  15. D'Angelo C., Scotti, A., *A mixed finite element method for Darcy flow in fractured porous media with non matching grids*, ESAIM: Mathematical Modelling and Numerical Analysis, Vol. 46, pp. 465-489, (2012).
  16. Formaggia L., Scotti, A., *Positivity and conservation properties of some integration schemes for mass action kinetics*, SIAM Journal on Numerical Analysis 49, pp. 1267-1288, (2011).

## Proceedings

17. Agosti, A., Formaggia, L., Giovanardi, B., Scotti, A., *Numerical simulation of geochemical compaction with discontinuous reactions*, Proceeding of the VI conference on Coupled Problems in Science and Engineering (2015)
18. Formaggia L., Antonietti P., Panfili P., Scotti A., Turconi L., Verani M. and Cominelli A., *Optimal Techniques to Simulate Flow in Fractured Reservoir*, EC-MOR XIV-14th European conference on the mathematics of oil recovery, (2014).
19. Calì F., Scotti A., *Mathematics: method and creativity in fabric design creation*, CIMODE 2014, (2014).
20. Ruffo P., Porta G.M., Colombo I., Scotti A., Guadagnini A., *Global Sensitivity Analysis of Geochemical Compaction in a Sedimentary Basin*, First EAGE Basin & Petroleum Systems Modeling Workshops, (2014).
21. Panfili, P., Cominelli, A., Scotti, A., *Using Embedded Discrete Fracture Models (EDFMs) to Simulate Realistic Fluid Flow Problems*, Second EAGE Workshop on Naturally Fractured Reservoirs, (2013).
22. Scrofani G., Ruffo P., Porta G.M., Riva M., Lever V., Scotti A., Imperiali I., *Preliminary Analysis of Diagenetic Effects on Basin Scale Over Pressure Dynamics*, IPTC 2013: International Petroleum Technology Conference , (2013).
23. Formaggia, L., Guadagnini, A., Imperiali, I., Lever, V., Porta, G., Riva, M., Scotti, A., Tamellini, L., *Uncertainty analysis of basin scale compaction processes*, EGU General Assembly 2012, (2012).

24. Porta G.M., Lever V., Scotti A., Imperiali I., Riva M., *Uncertainty propagation in sandstone compaction modeling*, XXXIII Convegno Nazionale di Idraulica e Costruzioni Idrauliche, (2012).
25. Fumagalli, A., Scotti, A., *An unfitted method for two-phase flow in fractured porous media*, CMWR2012 Proceedings, // <http://cmwr2012.cce.illinois.edu/Proceedings.html>, (2012).
26. Fumagalli, A. and Scotti, A., *A reduced model for flow and transport in fractured porous media with non-matching grids*, Proceedings of ENUMATH 2011, 2012, issue 03/2012, pp. 499508.

### Book chapters

27. Notaro, D., Cattaneo, L., Formaggia, L., Scotti, A., Zunino, P., *A Mixed Finite Element Method for Modeling the Fluid Exchange Between Microcirculation and Tissue Interstitium*, Advances in Discretization Methods, Volume 12 of the series SEMA SIMAI Springer Series, pp 3-25, (2016), DOI:10.1007/978-3-319-41246-7\_1
28. Flemisch, B., Fumagalli, A., Scotti, A., *A Review of the XFEM-Based Approximation of Flow in Fractured Porous Media*, Advances in Discretization Methods, Volume 12 of the series SEMA SIMAI Springer Series, pp 47–76, (2016), DOI:10.1007/978-3-319-41246-7\_3
29. Scotti, A., Villa, A. *Predictive numerical models of basin evolution and petroleum generation*, Applied and Industrial Mathematics in Italy III, E. De Bernardis, R. Spigler and V. Valente (Eds) , Series on Advances in Mathematics for Applied Science, Vol. 82, World Sci. Publ., pp. 554-566, 2009. ISBN: 978-981-4280-29-7
30. Formaggia L., Miglio, E., Mola, A., Scotti, A., *Numerical simulation of the dynamics of boats by a variational inequality approach*, Variational Analysis and Aerospace Engineering, Buttazzo, G., Frediani, A. (ed.). 213–227, Springer, 2009. ISBN 0387958576, 9780387958576.

### PhD thesis

31. Scotti, A. *A numerical model for generation and primary migration of hydrocarbons* (2010).

### Submitted papers

32. Colombo, I., Nobile F., Porta G., Scotti A., and Tamellini L., *Uncertainty Quantification of geochemical and mechanical compaction in layered sedimentary basins*, <http://arxiv.org/abs/1703.03845>.

33. Flemisch B., Berre I., Boon W., Fumagalli A., Schwenck N., Scotti A., Stefansson I., Tatomir A., *Benchmarks for single-phase flow in fractured porous media.*

## Talks

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### *Plenary*

*The interplay of flow, chemistry and compaction in sedimentary basins*, Workshop Flow in Deformable Porous Media, Zaragoza, 24 November, 2015

### *Invited*

*From micro to macro: evolving interfaces in porous media*, X-DMS 2017, 19 June 2017.

*XFEM approximation of flow and transport in fractured porous media*, Interpore 2017, 10 May 2017.

*Numerical simulation of discontinuous reactions in diagenesis*, SCICADE 2015, 17 September 2015. Co-authors A. Agosti, L. Formaggia, B. Giovanardi.

*Numerical simulation of fractured and heterogeneous porous media with non-matching grids*, X-DMS 2015, 10 September 2015. Co-authors A. Fumagalli, M. Del Pra, L. Formaggia.

*Xfem approximation of coupled flow and mechanics in faults*, SIAM GS 2015, 1 July 2015. Co-authors A. Fumagalli, B. Giovanardi, C. Colciago, L. Vadacca.

*XFEM for heterogeneous problems with time dependent inclusions*, Workshop on unfitted FEM, Aachen 2015, 15 June 2015.

*Numerical simulation of geochemical compaction with discontinuous reactions*, Coupled problems 2015, 20 May 2015. Co-authors A. Agosti, L. Formaggia, B. Giovanardi.

*Approximation of flows in fractured porous media by the XFEM*, WCCM 2014, 21 July 2014. Co-authors L. Formaggia, G.F. Iori.

*Simulation of fractured porous media using Extended Finite Elements*, CompGeo Workshop, University of Pittsburgh, 22-23 May 2014.

*An XFEM based approximation for flow in heterogeneous porous media*, GAMM 2014, 10-14 March 2014. Co-authors L. Formaggia, A. Fumagalli.

*Numerical simulation of Darcy flows in fractured porous media with the XFEM*, AIMETA, 17-20 Sept. 2013, Torino. Co-authors L. Formaggia, A. Fumagalli.

### *Contributed*

*Flow in fractured porous media: matching or non-matching grids?*, POEMS 2017, 7 July 2017.



- A new hybrid method for crack propagation: Xfield*, XDMS 2017, 21 June 2017.
- Numerical simulation of hydrocarbons generation in the source rock*, Workshop: Industry and mathematics in the IHP quarter on Numerical Methods for PDEs, 22 November 2016.
- Unfitted FEM for fractures and inclusions in porous media*, Workshop on Geometrically Unfitted Finite Element Methods, Department of Mathematics, UCL, London, 7 January 2016.
- Numerical simulation of flow in compacting porous media in the presence of discontinuous reactions*, Reactive Transport Modeling in the Geological Sciences workshop, Paris. 18 November 2015.
- Mathematics: method and creativity in fabric design creation*, CIMODE 2014, 6 November 2014. Co-author F. Calì.
- Porosity and pressure evolution in the presence of discontinuous reaction*, Oberwolfach Workshop Reactive Flows in Deformable, Complex Media, 22 September 2014.
- XFEM for flow in fractured porous media*, SIAM Annual meeting 2014, 8 July 2014. Co-authors L. Formaggia, A. Fumagalli.
- Numerical simulation of flow and transport in fractured porous media with the XFEM*, CMWR14, 12 June 2014. Co-authors L. Formaggia, A. Fumagalli.
- Numerical simulation of Darcy flows in fractured porous media with the XFEM*, 2nd NUPUS international conference, 30 Sept-2 Oct. Bergen. Co-authors L. Formaggia, A. Fumagalli.
- A numerical method for two-phase flow in fractured porous media with non-matching grids*, SIAM GS13, 19 June 2013. Co-authors L. Formaggia, A. Fumagalli.
- Numerical simulation of Darcy flows in fractured porous media with the XFEM*, NUPUS annual meeting, 17-20 March 2013. Co-authors L. Formaggia, A. Fumagalli.
- Numerical methods for multiphase flows in fractured porous media*, SIMAI 2012 National Congress, 25-28 June 2012. Co-author A. Fumagalli.
- An unfitted method for two-phase flow in fractured porous media*, CMWR 2012, Urbana-Champaign, 17-21 June 2012. Co-author A. Fumagalli.
- A reduced model for flow in fractured porous media with non matching grids*, ENUMATH 2011, Leicester, 5-9 Sept. 2011. Co-authors A. Fumagalli, C. D'Angelo.
- Mixed finite element schemes for fluid flows in fractured porous media with reduced order modeling of fractures with non-matching grids*. ECCOMAS CFD 2010, Lisbon, 14-17 June 2010. Co-authors A. Fumagalli, C. D'Angelo.

*Experimental Validation of Multicomponent Hydrocarbon Differential Expulsion from Source Rock*, Modeling sedimentary basins and their petroleum systems, Geological Society, London, 3-4 June 2010. Co-authors P. Ruffo, A. Consonni, L. Caldiero, D. Dolci, R. Galimberti.

*Generation, Retention and Expulsion of hydrocarbons*, SIAM GS09 congress 2009, Leipzig, 15-18 June 2009.

*A numerical model for petroleum generation and primary migration*, Convegno biennale GNCS, Montecatini, 4-6 Febr. 2009.

*Predictive numerical models of basin evolution and petroleum generation*, Co-authors A. Villa, SIMAI national congress 2008, Rome, 15-19 Sept. 2008

## Invited Seminars

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**February, 16th, 2016** *The interplay of flow, chemistry and mechanics in sedimentary basins*, University of Erlangen.

**November, 13th 2014** *Numerical simulation of porous media compaction in the presence of discontinuous reaction*, University of Bergen.

**May, 10th 2012** *Numerical methods for multiphase flows in fractured porous media with non-matching grids*. Institut für Wasser und Umweltsystemmodellierung, University of Stuttgart. Co-authors A. Fumagalli, L. Formaggia.

**October, 13th 2011** *A model reduction strategy for multiphase flows in fracture porous media with non matching grids*. SNAPLE kickoff meeting, Dipartimento di Matematica, Politecnico di Milano.

**June, 16th 2011** *Numerical models for the evolution of geological basins and oil migration*. INRIA Roquencourt, Estime group. Co-authors A. Fumagalli, L. Formaggia.

## Organization of conferences

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### Minisymposia

**June 19-21 2017** *Non-standard modeling and discretization approaches for multi-physics phenomena in porous media*, X-DMS 2017, Umea. Organizers: Luca Formaggia, Anna Scotti, Ivan Yotov, Paolo Zunino.

**May 8-11th 2017** *Poroviscohyperelastic Computational Models for Geophysic and Biomechanic Applications*, Interpore 2017, Milano. Organizers: Luca Formaggia, Anna Scotti, Paolo Zunino.

**Sept. 13-16th 2016** *Mathematical techniques for geological basin modelling*, SIMAI 2016, Milano. Organizers: Anna Scotti, Matilde Dalla Rosa.

**Sept. 13-16th 2016** *Geometrically Unfitted Finite Element Methods*, SIMAI 2016, Milano. Organizers: Anna Scotti, Sara Zahedi, Paolo Zunino.

**Sept. 9-11th 2015** *Enriched methods for flow and mechanics in heterogeneous and fractured porous media*. X-DMS 2015, Ferrara. Organizers: Anna Scotti, Alessio Fumagalli, Stefano Berrone and Oliver Sander.

**June 29th - July 2nd 2015** *Advances in numerical methods for complex fractured porous media*. SIAM GS 2015 Stanford. Organizers: Anna Scotti, Alessio Fumagalli, Stefano Berrone and Sandra Pieraccini.

**June, 17-20th 2013** *Discrete-fracture Models for Porous Media Flow*. SIAM Conference on Mathematical and numerical issues in the geosciences, Padova. Organizers: Anna Scotti, Luca Formaggia and Jean Roberts.

**June, 28th 2012** *Beyond the mesh: handling geometry with unconventional methods*. SIMAI 2012 National Congress, Torino. Organizers: Anna Scotti and Franco Dassi.

### Organization of workshops and conferences

**2017** Member of the organizing committee of "MBFPM2017" at UiB.

**2015** Member of the organizing committee of SIMAI 2016.

**2015** Member of the organizing committee of X-DMS 2015 <http://x-dms2015.sciencesconf.org/>

**2015** Organizer of the workshop "Caprocks" at the Politecnico di Milano, in collaboration with Eni S.p.A.

### Visits to other universities and research centers

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February 2016	FAU university, Erlangen, visiting prof. P.Knabner.
November 2014	University of Bergen, Department of Mathematics, visiting prof. F.A.Radu.
June 2014	MIT, Department of Civil and Environmental Engineering, visiting prof. R.Juanes in the scope of a Rocca project.
November 2013	MIT, Department of Civil and Environmental Engineering, visiting prof. R.Juanes in the scope of a Rocca project.

October 2007

SINTEF Petroleum Research, Trondheim, visiting prof. U. Ritter for a joint project with Eni Spa.

## Teaching

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### Bachelor courses

- 2016-2017 *Generative design: metodi geometrici e numerici* (Numerical analysis), Politecnico di Milano, Credits: 5.
- 2016-2017 *Curve e superfici per il design* (Numerical analysis), Politecnico di Milano, Credits: 6.
- 2015-2016 *Generative design: metodi geometrici e numerici* (Numerical analysis), Politecnico di Milano, Credits: 5.
- 2015-2016 *Curve e superfici per il design* (Numerical analysis), Politecnico di Milano, Credits: 6.
- 2014-2015 *Curve e superfici: analisi geometrico-differenziale* (Numerical analysis), Politecnico di Milano, Credits: 10.
- 2013-2014 *Curve e superfici: analisi geometrico-differenziale* (Numerical analysis), Politecnico di Milano, Credits: 10.
- 2012-2013 *Curve e superfici: analisi geometrico-differenziale* (Numerical analysis), Politecnico di Milano, Credits: 10.

### PhD courses

- 2016 - 2017 PhD course *Consistenza, convergenza e validazione nel calcolo scientifico* (Numerical Analysis), Politecnico di Milano, Credits: 5.
- April 2014 Seminar in the PhD course *Mathematical and numerical methods for multiphase flow in porous media* (Numerical analysis), Politecnico di Milano.

### Teaching assistant

- Febr.- Mar. 2015 PhD course *Numerical methods for engineering applications*, Politecnico di Milano (8 hours).

- Sept. 2011 - Jan. 2012 *Curve e superfici: analisi geometrico-differenziale* (Numerical Analysis),  
Politecnico di Milano. Credits: 10.
- Febr. 2011 - June 2011 *Calcolo numerico ed elementi di analisi* (Analysis and numerical analysis),  
Politecnico di Milano. Credits: 10
- Sept. 2010 - Jan. 2011 *Curve e superfici: analisi geometrico-differenziale* (Numerical Analysis),  
Politecnico di Milano. Credits: 10
- Mar. 2010 - June 2010 *Calcolo numerico ed elementi di analisi* (Analysis and numerical analysis),  
Politecnico di Milano. Credits: 10
- Sept. 2009 - Jan. 2010 *Curve e superfici: analisi geometrico-differenziale* (Numerical Analysis),  
Politecnico di Milano. Credits: 10
- Mar. 2009 - June 2009 *Algebra lineare e calcolo numerico* (Numerical Analysis),  
Politecnico di Milano. Credits: 5
- Sept. 2008 - Jan. 2009 *Curve e superfici: analisi geometrico-differenziale* (Numerical Analysis),  
Politecnico di Milano. Credits: 10
- Mar. 2008 - June 2008 *Metodi numerici per il design* (Numerical Analysis),  
Politecnico di Milano. Credits: 10
- Oct. 2007 - Jan. 2007 Matlab laboratories for the course *Analisi I*,  
Politecnico di Milano.
- Oct. 2007 - Jan. 2007 Tutoring for the course *Algebra lineare e calcolo numerico* (Numerical Analysis),  
Politecnico di Milano.
- Mar. 2007 - June 2007 *Algebra lineare e calcolo numerico* (Numerical Analysis),  
Politecnico di Milano. Credits: 5

## Theses supervision

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Master theses

- *Numerical modeling of fractured porous media subject to compaction*, Andrea Rossetti, 2014, Politecnico di Milano.
- *3D Upscaling of Reservoir Properties using the Mixed Finite Element Method on Non-Matching Grids*, Calogero Rizzo, 2014, Politecnico di Milano
- *Flusso in un mezzo poroso fratturato: approssimazione numerica tramite Differenze Finite Mimetiche*, Nicola Verzotti, 2014, Politecnico di Milano
- *Numerical modeling of porosity evolution in source rock during kerogen breakdown*, Bianca Giovanardi, 2013, Politecnico di Milano (as co-supervisor).
- *Approssimazione numerica di ODE con forzante discontinua per flussi reattivi in mezzi porosi*, Massimiliano Beccaria, 2012, Politecnico di Milano (as co-supervisor).
- *Transmissibility Upscaling for Fluid Flow in Porous Media on Non-Matching Grids*, Luca Turconi, 2012, Politecnico di Milano (as co-supervisor).

#### PhD theses

- Co-supervisor of Bianca Giovanardi within the PhD program *Modelli e metodi matematici per l'ingegneria*, Politecnico di Milano.
- Co-supervisor of Daqing Liu within the PhD program *Modelli e metodi matematici per l'ingegneria*, Politecnico di Milano (ongoing).

## Reviewing activity

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- Reviewer and opponent for a PhD thesis at the Department of Mathematics of the University of Bergen, (Norway), titled *Modeling of heat transfer in porous media in the context of geothermal energy extraction*, October 2015.
- Reviewer for the ACS Petroleum Research Fund.
- Reviewer for the following scientific journals: *Siam Journal of Scientific Computing*, *Water Resources Research*, *Journal of Petroleum and Gas Engineering*, *Journal of Mathematical Analysis and Applications*, *Computational Geosciences*, *Transport in porous media*, *Numerical Algorithms*, *Multiscale Modeling and Simulation*, *Journal of Computational Fluid Dynamics*, *Advances in Water Resources*, *Mathematics and Computers in Simulation*, *Journal of Computational Physics*, *Applied Numerical Mathematics*.

## Production of scientific software for industry

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- GeCO In the scope of the CompGeo project I developed, in collaboration other researchers, a Matlab code for the simulation of diagenetic processes in compacting sedimentary basins. The code has been used, in collaboration with Eni and the Department of Environmental and Hydraulic Engineering of Politecnico di Milano to perform direct simulations and sensitivity analysis.
- PMOD+ In the scope of project PMOD+ I developed an extension of the preexisting software PMOD (Fortran) used by Eni to simulate hydrocarbon generation, to account for retention processes and more complex chemistry. This new code is currently used by Eni e&p.
- PMOD1D During my PhD I developed a Matlab code for the simulation of the processes involved in the generation and expulsion of hydrocarbons from the source rock. An improved version of this code has been used by Eni e&p.
- PMOD1Ds In the scope of the project SimbaGE1Ds I developed an extension of the previous Pmod1D to account for the aforementioned processes in a compacting medium, i.e., in a deforming domain. This code is currently used by Eni e&p.
- EDFM In the scope of project KaFRes I developed part of a code called EDFM for the computation of geometric and hydraulic properties of a fractured reservoir discretized with a Corner Point type grid. This software is currently used by Eni.