

# Rami M. Younis

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## Professional Appointments

### The University of Tulsa, Tulsa, Oklahoma

2012 - current Assistant Professor, McDougall School of Petroleum Engineering

2014 - current Founder and Director, Future Reservoir Simulation Systems & Technology consortium

### Stanford University, Stanford, California

2011 - 2012 Postdoctoral Research Fellow, Department of Energy Resources Engineering

## Education

### Stanford University, Stanford, California

Ph.D. (2011), Petroleum Engineering, Department of Energy Resources Engineering

M.S. (2005), Scientific Computing and Computational Mathematics

M.S. (2002), Petroleum Engineering, Department of Petroleum Engineering

### McGill University, Montreal, Canada

B.Eng. (2000), Honors in Mechanical Engineering

## Honors and Awards

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|------|---|---------------------|
| 2015 | Chevron Faculty Fellow<br><i>Awarded to faculty with most notable achievements in research (\$5,000).</i>                     | University of Tulsa |
| 2012 | Early-Career Faculty Research Award<br><i>Professional society award supporting untenured faculty research (\$40,000).</i>    | Soc. of Pet. Eng.   |
| 2012 | Faculty Development Summer Award<br><i>University-wide award to fund proposals for short-term summer research (\$15,000).</i> | University of Tulsa |
| 2008 | Ramey Research Award<br><i>Awarded to most prominent graduate research in Energy Resources Eng. (\$2,000).</i>                | Stanford University |
| 2006 | Brigham Award<br><i>Awarded for outstanding service to the department (\$2,000).</i>  | Stanford University |
| 2005 | Centennial Teaching Award<br><i>University-wide award for outstanding teaching (\$2,000).</i>                                 | Stanford University |

## Service

### *Professional Community*

#### **Journal Editorial Boards**

2014 to present *Associate Editor*: SPE Journal.

2012 to present *Technical Editor*: Computational Geosciences, Fuel, and J. of Natural Gas Sci. and Eng.

#### **Conference Committees**

2017 and 2019 *Organizing Committee*: SPE Reservoir Simulation Conference.

2017 *Session Chair*: SPE Reservoir Simulation Conference.

2013 *Session Chair*: SIAM Mathematical and Computational Issues In The Geosciences.

2012 *Minisymposium Organizer*: SIAM Annual Meeting.

2012 *Session Chair*: SIAM Annual Meeting.

#### **Grant and Award Committees**

2017 American Chemical Society New Directions Grant

2015 SPE Junior Researcher Award

#### **Steering Committees**

2015 SPE Section Study Group on IOR in Unconventional Reservoirs.

### *University and College*

2016 - 2019 *Elected Member*: University Graduate Council.

2016 *Thesis Committee Member*: Mingzheng Yang (ME 2016).

2013 - 2014 *Faculty Advisor*: TU Toast Masters Student Club.

2012 *Faculty Search Committee*: Bovaird Endowed Professor of Energy Business.

### *McDougall School of Petroleum Engineering*

#### 2013 - current **Graduate Program Director**

- *Recruiting*: inquiries, application review, screening, and decisions.
- *Administration*: orientation, probation and dismissal, office-space, and qualifying exams.
- *Teaching Assistants*: hiring, termination, contracts, assignments, and assessment.
- *Awards*: Chapman, Woobank, and Parriott award nominations and review.
- *Advising*: Master of Engineering program.
- *Higher Learning Commission Graduate Program Assessment*.

#### 2014 - 2017 **Thesis and Dissertation Committees**

- *PhD*: Jiamin Jiang (2017); Bailian Chen (2017); Reza Mohammadnia (2017); Xin Liu (2016); Duc Le (2015); Abdulaziz Al-Qasim (2015); Diego Oliveira (2014)
- *M.S.*: Yuanshan Zhang (2017); Yuchen Zhang (2016); Guotong Ren (2016); Zhe Liu (2016); Tsebaot Mesfin Lemma (2016); Shahriyar Al-Khasli (2015); Yiteng Zhang (2015); Jiamin Jiang (2015); Yuhang Wang (2015); Anqi Bao (2015); Soham Sheth (2014); Ruslan Miftakhov (2014);

2015 **Faculty Search Committee**: MSPE Chair.

2015 **Faculty Search Committee**: Assistant Professor.

2012 **Departmental Graduate Seminar Organizer**

## Teaching

*Undergraduate (2012-2017 18 credit hours)*

Semester	Course Title	Enrolled	Review* (out of 5)
SP 2017	Integrated Reservoir Modeling	20	4.6
FA 2016	Reservoir Engineering I	44	4.5
SP 2016	Reservoir Engineering I	54	4.3
FA 2015	Reservoir Engineering I	82	4.0
SP 2015	Applied Mathematical Modeling in Petroleum Engineering	3	5.0
SP 2014	Applied Mathematical Modeling in Petroleum Engineering	11	5.0

*Graduate (2012-2017 36 credit hours)*

Semester	Course Title	Enrolled	Review* (out of 5)
SP 2017	Numerical Reservoir Simulation	5	4.8
FA 2016	Advanced Reservoir Engineering	20	4.7
SP 2016	Numerical Reservoir Simulation	9	4.9
FA 2015	Advanced Reservoir Engineering	24	4.3
SP 2015	Well Test Analysis	9	4.7
FA 2014	Numerical Reservoir Simulation	13	4.8
FA 2014	Advanced Reservoir Engineering	39	4.6
SP 2014	High Performance Computing with C++	9	4.3
FA 2013	Geostatistics	8	4.1
FA 2013	Advanced Reservoir Engineering	35	4.3
SP 2013	Iterative and Direct, Linear and Nonlinear Solvers	14	4.8
FA 2012	Advanced Reservoir Engineering	8	4.6

\* College average review: 4.3

*2012 - 2017 Research and Dissertation (112 credit hours)*

*2012 - 2017 Research and Thesis (32 credit hours)*

*2012 - 2017 Independent Study and MEN Project (7 credit hours)*

## Research

### Externally Funded Projects

#### Completed

2012	P.I.	SPE Young Faculty Research Initiation Award <i>Efficient full-resolution simulation of geological CO<sub>2</sub> sequestration in deep saline aquifers</i> PI: R.M. Younis.	\$40,000 (2 yr.)
2017	P.I.	Occidental Petroleum <i>CO<sub>2</sub> Proxy Model and Modular Deployable IOR Analytics Code</i> PI: R.M. Younis.	\$38,733 (1.5 mo.)

#### Ongoing

2015	P.I.	Future Reservoir Simulation Systems and Technology <i>Industry sponsored consortium with annual membership</i> PI: R.M. Younis. Membership Year 2018: \$300,000 (anticipated) Membership Year 2017: \$200,000 Membership Year 2016: \$150,000 Membership Year 2015: \$100,000	\$450,000 to date
2015	Co-P.I.	NSF NRT Grant <i>Workplace inspired approaches for improved graduate education</i> PI: M. Keller. Co-PI: B. Brummel, D. Curnkleton, and R.M. Younis.	\$484,522 (4 yr.)

#### Pending

2017	P.I.	Petrobras <i>Transient, compositional, non-isothermal multiphase wellbore simulator</i> PI: R.M. Younis. Co-PI: A.C. Reynolds.	\$291,475 (18 mo.)
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#### Unsuccessful Proposals

2017	P.I.	Linde <i>A Full-Physics, Wellhead-To-Reservoir Simulator for Cryogenic Fracturing and Proppant Delivery Using Low-Grade Gases</i> PI: R.M. Younis.	\$ 233,211 (2 yr.)
2017	P.I.	Koren Ron Systems Ltd. <i>Automatic Differentiation and Discretization C++ Libraries for Numerical Simulator Development</i> PI: R.M. Younis.	\$ 187,196 (18 mo.)
2016	P.I.	National Science Foundation <i>NSF CAREER: Adaptive Solvers To Enable Efficient and Robust Implicit Simulation of Complex Physics</i> PI: R.M. Younis.	\$420,845 (4 yr.)
8/2016	P.I.	DOE UCFER: Penn State University <i>Quantitative Characterization of Numerical Discretization Errors In Multiphase Gas-Solids Flow Simulations</i> PI: R.M. Younis.	\$132,574 (1 yr.)

<b>2015</b>	Co-PI.	National Science Foundation <i>Free Boundary Problems in Transport with Spatially Varying Coefficients</i> PI: R.D. Hazlett. Co-PIs: C. Costanda, and R.M. Younis	\$204,155 (3 yr.)
<b>2015</b>	PI.	National Science Foundation <i>Nonlinear Solution Methods For Implicit Simulation of Advection-Diffusion-Reaction</i> PI: R.M. Younis. Co-PIs: A.C. Reynolds	\$348,983 (3 yr.)
<b>2015</b>	Co. PI.	National Science Foundation <i>Multiscale Transport of Complex Fluids and Solids for Effective Flow-Induced Fracturing of Porus Media</i> PI: R.D. Hazlett. Co-PIs: R.M. Younis	\$328,063 (3 yr.)
<b>2015</b>	PI.	American Chemical Society <i>New Doctoral Investigator: The Fundamental Nature of Locality Within Newton Iterations for Implicit Reservoir Simulation Time Stepping</i> PI: R.M. Younis.	\$110,000 (2 yr.)
<b>2013</b>	PI.	American Chemical Society <i>New Doctoral Investigator: The Nature of Spatiotemporal Locality in Coupled Multiphase Flow and Transport Phenomena</i> PI: R.M. Younis.	\$110,000 (2 yr.)
<b>2012</b>	PI.	American Chemical Society <i>New Doctoral Investigator: Precisely, How Localized are Flow and Transport Phenomena?</i> PI: R.M. Younis.	\$110,000 (2 yr.)

### Research Advising

#### Graduated

Jiamin Jiang	Ph.D. Accurate and efficient discretization schemes for implicit simulation	<b>2017</b>
Yuanshan Zhang	M.S. Alternate pressure management strategies in uncon. res.	<b>2017</b>
Yuchen Zhang	M.S. Data-driven pressure management in unconventional oil res.	<b>2016</b>
Guotong Ren	M.S. Fully-coupled geomechanics and flow in fractured res.	<b>2016</b>
Zhe Liu	M.S. Clustering-based robust optimization in naturally frac. res.	<b>2016</b>
Shahriyar AlKhasli	M.S. Suff. cond. for the convergence of damped Newton methods	<b>2015</b>
Jiamin Jiang	M.S. Hybrid continuum-discrete fracture models	<b>2015</b>
Ruslan Miftakhov	M.S. Modified Continuation-Newton with step-length adaptation	<b>2014</b>
Soham Sheth	M.S. Localized Newton methods for implicit flow and transport	<b>2014</b>

#### Current Ph.D.

Soham Sheth	Localized linear solvers for fully implicit simulation (2017)
Giorgiy Lutidze	Damped Newton methods for FIM simulation (2018)
Guotong Ren	Fully-coupled geomechanics, flow, and fracture propagation (2019)
Emilio Sousa	Co-advised with A.C. Reynolds: data assimilation (2019)

#### Current M.S.

Yuxuan Jing	Lithotripsy at the reservoir scale (2018)
Ryan Erickson	Computational geometry and automatic discretization (2018)
Yukun Yan	Optimal pressure management strategies in condensate res. (2018)

**Undergraduate Summer Research:** Sergio Saraiva (2014); Ryan Erickson (2015); Rachna Kumar (2016)

## Publications

Citations: 391, h-index: 12, i10-index: 13 (Google Scholar)

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Scopus Author ID: 16318156100

### Refereed Articles and Proceedings

- [1] Ioannis K Argyros et al. "Extending the Mesh Independence For Solving Nonlinear Equations Using Restricted Domains". In: *International Journal of Applied and Computational Mathematics* (2017), pp. 1–12.
- [2] Jiamin Jiang and Rami M Younis. "An efficient fully-implicit multislope MUSCL method for multiphase flow with gravity in discrete fractured media". In: *Advances in Water Resources* 104 (2017), pp. 210–222.
- [3] Jiamin Jiang and Rami M Younis. "Efficient C1-continuous Phase-Potential Upwind (C1-PPU) Schemes for Coupled Multiphase Flow and Transport with Gravity". In: *Advances in Water Resources* (2017).
- [4] Guotong Ren et al. "A Bayesian model selection analysis of equilibrium and nonequilibrium models for multiphase flow in porous media". In: *International Journal of Multiphase Flow* 89 (2017), pp. 313–320.
- [5] Soham M Sheth, Rami M Younis, et al. "Localized Linear Systems in Sequential Implicit Simulation of Two-Phase Flow and Transport". In: *SPE Journal* (2017).
- [6] Jiamin Jiang and Rami Younis. "Hybrid Coupled Discrete-Fracture/Matrix and Multicontinuum Models for Unconventional-Reservoir Simulation". In: *SPE Journal* 21.03 (2016), pp. 1009–1027.
- [7] Jiamin Jiang and Rami M. Younis. "Compositional modeling of enhanced hydrocarbons recovery for fractured shale gas-condensate reservoirs with the effects of capillary pressure and multicomponent mechanisms". In: *Journal of Natural Gas Science and Engineering* 34 (2016), pp. 1262–1275.
- [8] G Ren, J Jiang, and RM Younis. "Fully Coupled Geomechanics and Reservoir Simulation for Naturally and Hydraulically Fractured Reservoirs". In: *50th US Rock Mechanics/Geomechanics Symposium*. 2016.
- [9] Guotong Ren, Jiamin Jiang, and Rami M. Younis. "A Fully Coupled XFEM-EDFM Model for Multiphase Flow and Geomechanics in Fractured Tight Gas Reservoirs". In: *Procedia Computer Science* 80 (2016). International Conference on Computational Science 2016, {ICCS} 2016, 6-8 June 2016, San Diego, California, {USA}, pp. 1404 –1415. ISSN: 1877-0509. DOI: <http://dx.doi.org/10.1016/j.procs.2016.05.449>. URL: <http://www.sciencedirect.com/science/article/pii/S1877050916309334>.
- [10] Soham M. Sheth and Rami M. Younis. "Localized Computation of Newton Updates in Fully-implicit Two-phase Flow Simulation". In: *Procedia Computer Science* 80 (2016), pp. 1392–1403. ISSN: 1877-0509.
- [11] Jiamin Jiang and Rami M Younis. "A multimechanistic multicontinuum model for simulating shale gas reservoir with complex fractured system". In: *Fuel* 161 (2015), pp. 333–344.
- [12] Jiamin Jiang and Rami M Younis. "Numerical study of complex fracture geometries for unconventional gas reservoirs using a discrete fracture-matrix model". In: *Journal of Natural Gas Science and Engineering* 26 (2015), pp. 1174–1186.
- [13] R.M. Younis. "A Sharp Analytical Bound on the Spatiotemporal Locality in General Two-phase Flow and Transport Phenomena". In: *Procedia Computer Science* 18 (2013), pp. 473 –480. ISSN: 1877-0509.
- [14] Rami M. Younis and Hamdi A. Tchelepi. "Lazy K-Way Linear Combination Kernels for Efficient Runtime Sparse Jacobian Matrix Evaluations in C++". In: *Recent Advances in Algorithmic Differentiation*. Ed. by Shaun Forth et al. Vol. 87. Lecture Notes in Computational Science and Engineering. Berlin, Heidelberg: Springer Berlin Heidelberg, 2012, pp. 333–342. ISBN: 978-3-642-30023-3.
- [15] Rami Younis, Hamdi A Tchelepi, and Khalid Aziz. "Adaptively Localized Continuation-Newton Method–Nonlinear Solvers That Converge All the Time". In: *SPE Journal* 15.02 (2010), pp. 526–544.

*Unrefereed Proceedings*

- [16] Jiamin Jiang and Rami Younis. "An Efficient Fully-implicit MFD-MUSCL Method based on a Novel Multislope Limiting Procedure". In: *SPE Reservoir Simulation Conference*. Society of Petroleum Engineers. 2017.
- [17] Jiamin Jiang and Rami Younis. "C<sub>1</sub>-continuous PPU Schemes for Efficient Simulation of Fully-coupled Multiphase Flow with Gravity". In: *SPE Reservoir Simulation Conference*. Society of Petroleum Engineers. 2017.
- [18] Giorgiy Lutidze and Rami Younis. "Nonlinear Safeguarding Strategies for Fully Implicit Timestepping and Complex Processes". In: *SPE Reservoir Simulation Conference*. Society of Petroleum Engineers. 2017.
- [19] Guotong Ren and Rami Younis. "Fully-Coupled XFEM-EDFM Hybrid Model for Geomechanics and Flow in Fractured Reservoirs". In: *SPE Reservoir Simulation Conference*. Society of Petroleum Engineers. 2017.
- [20] Soham Sheth and Rami Younis. "Localized Solvers for General Full-Resolution Implicit Reservoir Simulation". In: *SPE Reservoir Simulation Conference*. Society of Petroleum Engineers. 2017.
- [21] Jiamin Jiang and Rami M Younis. "Compositional Modeling of Enhanced Hydrocarbons Recovery for Fractured Shale Gas-Condensate Reservoirs with the Effects of Capillary Pressure and Multi-component Mechanisms". In: *SPE Improved Oil Recovery Conference*. Society of Petroleum Engineers. 2016.
- [22] JM Jiang and RM Younis. "An Efficient Fully-implicit High-resolution MFD-MUSCL Method for Two-phase Flow with Gravity in Discrete Fractured Media". In: *ECMOR XIV-15th European Conference on the Mathematics of Oil Recovery*. 2016.
- [23] JM Jiang and RM Younis. "C<sub>1</sub>-PPU Schemes for Efficient Simulation of Coupled Flow and Transport with Gravity". In: *ECMOR XIV-15th European Conference on the Mathematics of Oil Recovery*. 2016.
- [24] G Lutidze and RM Younis. "Damping of Newton Iterations Using Automatic Error-control Step-length Selection". In: *ECMOR XIV-15th European Conference on the Mathematics of Oil Recovery*. 2016.
- [25] GT Ren, JM Jiang, and RM Younis. "XFEM-EDFM-MINC for Coupled Geomechanics and Flow in Fractured Reservoirs". In: *ECMOR XIV-15th European Conference on the Mathematics of Oil Recovery*. 2016.
- [26] SM Sheth and RM Younis. "Localized Computation of Newton Updates for General Fully-implicit Reservoir Simulation". In: *ECMOR XIV-15th European Conference on the Mathematics of Oil Recovery*. 2016.
- [27] Jiamin Jiang, Rami M Younis, et al. "A generic physics-based numerical platform with hybrid fracture modelling techniques for simulating unconventional gas reservoirs". In: *SPE Reservoir Simulation Symposium*. Society of Petroleum Engineers. 2015.
- [28] Jiamin Jiang et al. "Rate Transient Effects of Various Complex Fracture Network Topologies in Unconventional Gas Reservoirs: A Numerical Simulation Study". In: *Unconventional Resources Technology Conference (URTEC)*. 2015.
- [29] Duc H Le, Rami Younis, Albert C Reynolds, et al. "A History Matching Procedure for Non-Gaussian Facies Based on ES-MDA". In: *SPE Reservoir Simulation Symposium*. Society of Petroleum Engineers. 2015.
- [30] Soham M Sheth, Rami M Younis, et al. "Localized linear systems for sequential implicit simulation of flow and transport". In: *SPE Reservoir Simulation Symposium*. Society of Petroleum Engineers. 2015.
- [31] L Zhe et al. "A Diagnostic Framework for Bashed Wells in Unconventional Reservoirs: A Numerical Simulation and Model Selection Theory Approach". In: *SPE/CSUR Unconventional Resources Conference*. Society of Petroleum Engineers. 2015.
- [32] J Jiang and RM Younis. "A Multi-continuum Compositional Model for CO<sub>2</sub>-EGR Process in Stimulated Fractured Shale Gas Reservoirs". In: *ECMOR XIV-14th European Conference on the Mathematics of Oil Recovery*. 2014.

- [33] Jiamin Jiang, Yuanyuan Shao, Rami M Younis, et al. "Development of a multi-continuum multi-component model for enhanced gas recovery and CO<sub>2</sub> storage in fractured shale gas reservoirs". In: *SPE improved oil recovery symposium*. Society of Petroleum Engineers. 2014.
- [34] S Sheth and RM Younis. "Asynchronous multirate newton-a class of nonlinear solver that adaptively localizes computation". In: *ECMOR XIV-14th European Conference on the Mathematics of Oil Recovery*. 2014.
- [35] RM Younis and HA Tchelepi. "How Fast Is Your Newton-Like Nonlinear Solver?" In: *ECMOR XIII-13th European Conference on the Mathematics of Oil Recovery*. 2012.
- [36] Denis Viktorovich Voskov, Hamdi A Tchelepi, Rami Younis, et al. "General nonlinear solution strategies for multiphase multicomponent eos based simulation". In: *SPE Reservoir Simulation Symposium*. Society of Petroleum Engineers. 2009.
- [37] RM Younis, Hamdi Tchelepi, and Khalid Aziz. "Adaptively-localized-continuation-Newton; Reservoir Simulation Nonlinear Solvers that Converge All the Time". In: *ECMOR XI-11th European Conference on the Mathematics of Oil Recovery*. 2008.
- [38] Rami Younis, Khalid Aziz, et al. "Parallel automatically differentiable data-types for next-generation simulator development". In: *SPE Reservoir Simulation Symposium*. Society of Petroleum Engineers. 2007.
- [39] Rami Younis, Margot Gerritsen, et al. "Multiscale Process Coupling by Adaptive Fractional-Stepping; An In-Situ Combustion Model". In: *SPE/DOE Symposium on Improved Oil Recovery*. Society of Petroleum Engineers. 2006.
- [40] J Nilsson, M Gerritsen, R Younis, et al. "A novel adaptive anisotropic grid framework for efficient reservoir simulation". In: *SPE reservoir simulation symposium*. Society of Petroleum Engineers. 2005.
- [41] Jonas Nilsson, Margot Geertrui Gerritsen, Rami Younis, et al. "An adaptive, high-resolution simulation for steam-injection processes". In: *SPE Western Regional Meeting*. Society of Petroleum Engineers. 2005.
- [42] Margot Gerritsen et al. "Experimental investigation and high resolution simulator of in-situ combustion processes; 1. Simulator design and improved combustion with metallic additives". In: *SPE International Thermal Operations and Heavy Oil Symposium and Western Regional Meeting*. Society of Petroleum Engineers. 2004.
- [43] Jonas Nilsson, Margot Gerritsen, and Rami Younis. "Parallel Anisotropic Cartesian Grid Adaptation for In-Situ Combustion Simulations". In: *ECMOR IX-9th European Conference on the Mathematics of Oil Recovery*. 2004.
- [44] Rami M Younis and Jef Caers. "A Method For Static-Based Up-gridding". In: *ECMOR VIII-8th European Conference on the Mathematics of Oil Recovery*. 2002.

### *Presentations and Invited Talks*

1. Modeling and Computation for Flow and Transport in Porous Media, The 3rd International Conference on Engineering and Computational Mathematics, Hong Kong, 1-2 June, 2017.
2. Multiphysics, Multiscale, and Coupled Problems in Subsurface Physics, Institute for Pure and Applied Mathematics, University of California Los Angeles, 3-7 April, 2017.
3. Graduate Seminars: Texas A & M (9/2016); University of Kansas (2014); Colorado School of Mines (2013); and University of Wyoming (2013).
4. Poster presentation, Foundation Computer Modeling Group Summit, Calgary, Canada 2016.
5. On the locality within Newton iterations for implicit timestepping in reservoir simulation. Society of Petroleum Engineers Large Scale Computing and Big Data Challenges in Reservoir Simulation Conference and Exhibition, Istanbul, Turkey, 15-17 September, 2014.
6. Precisely, How Fast Is Your Fully Implicit Newton-Like Solver? CP<sub>3</sub> Iterative Solution Methods, 2013 SIAM Conference on Mathematical and Computational Issues in the Geosciences, Padua, Italy, 2013.



7. Automatic Differentiation and Reservoir Simulation Jacobian Evaluation? In *Proc.*, 13th European Workshop on Automatic Differentiation, INRIA Sophia-Antipolis, France, 2013.
8. Towards An Analytical Characterisation Of Locality In Travelling Wave Problems. Society of Industrial Applied Mathematics Annual Meeting, Minneapolis, Minnesota, 2012.
9. SPE Student Summit, Houston, TX 2013.

Last updated: August 20, 2017