June 2019

SPE Review London

The official e-magazine of the Society of Petroleum Engineers' London branch

Negotiating for a gender-balanced future

Women in Energy 13th Annual Conference

PLUS+

* Dynamic Rock Typing in Current Reservoir Simulators
* Letter from the Chair
* Student paper contest!

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ABOUT US

The Society of Petroleum Engineers (SPE) is a not-for-profit professional association whose members are engaged in energy resources, development and production. SPE serves more than 143,000 members in 141 countries worldwide. SPE is a key resource for technical knowledge related to the oil and gas exploration and production industry and provides services through its global events, publications, events, training courses and online resources at www.spe.org. SPE London section publishes SPE Review London, an online newsletter, 10 times a year, which is digitally sent to its 3000+ members. If you have read this issue and would like to join the SPE and receive your own copy of SPE Review London, as well as many other benefits – or you know a friend or colleague who would like to join – please visit www.spe.org for an application form.

CONTACTS

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SPE encourages open and objective discussion of technical and professional subjects pertinent to the interests of the Society in its publications. Society publications shall contain no judgmental remarks or opinions as to the technical competence, personal character, or motivations of any individual, company, or group. Any material which, in the publisher's opinion, does not meet the standards for objectivity, pertinence, and professional tone will be returned to the contributor with a request for revision before publication.

In this issue

Behind the Scenes: SPE Review Editorial Board

Jonathan Ovens

After graduating from Cambridge University with a Ph.D in Physics, Jonathan joined Shell in 1986. Reservoir Engineer – hydraulic fracturing, pressure transient analysis and reservoir simulation.
1997 - 2012: independent consultant: North Sea, North Africa and the Middle East. Experience: Exploration and Development planning to Reserves Evaluation.
2013: Senior Reservoir Engineer at JX Nippon E&P (UK) Ltd.
2009 and 2015 served with SPE Europec Technical Committee.
Member of the SPE London Board.

Josh Beinke

Graduated from University of Adelaide in 2008 with a Petroleum Engineering degree. Worked various roles with Chevron, Origin Energy and Santos, including as a Production Engineer on the Gorgon Field during First Gas. Following move to Europe in 2016, consulted on European and African assets (specialising in data room and field development advisory) before current position working in Amsterdam as a Production/Exploitation Engineer with Vermilion Energy.

Ffion Llwyd-Jones

Editor and business writer, with 15+ years experience in North America/ UK.
Editor for several trade and consumer magazines (print and/online).
Provides industry-related case studies, and detailed, research-driven B2B Designer reports and technical white papers.
Accomplished photographer, and videographer.
Educated in Canada, and in the UK, with BA (Hons) from The Open University.

Letter from the SPE London Chair

Dear SPE London members and colleagues, welcome to the June issue of SPE Review London.

June is the last month of the operational year for the SPE London board – the policy making and governing body of the Section.

It is also the last month for me to act as a Chair for the SPE London since my one-year term is coming to an end. It has been a great honour for me to be trusted to represent the Section and also a very valuable experience in leading a not-for-profit organisation such as SPE.

I am very thankful to all the members of our board, officers and volunteers who supported me throughout the year. Thanks to our joint efforts, we made it possible again to deliver on the SPE mission in the most professional manner.

As always, I would encourage our members to get involved with us as volunteers supporting the variety of our committees – please refer to our website to find out more on their activities and do not hesitate to get in touch: https://www.spe-london.org/committees

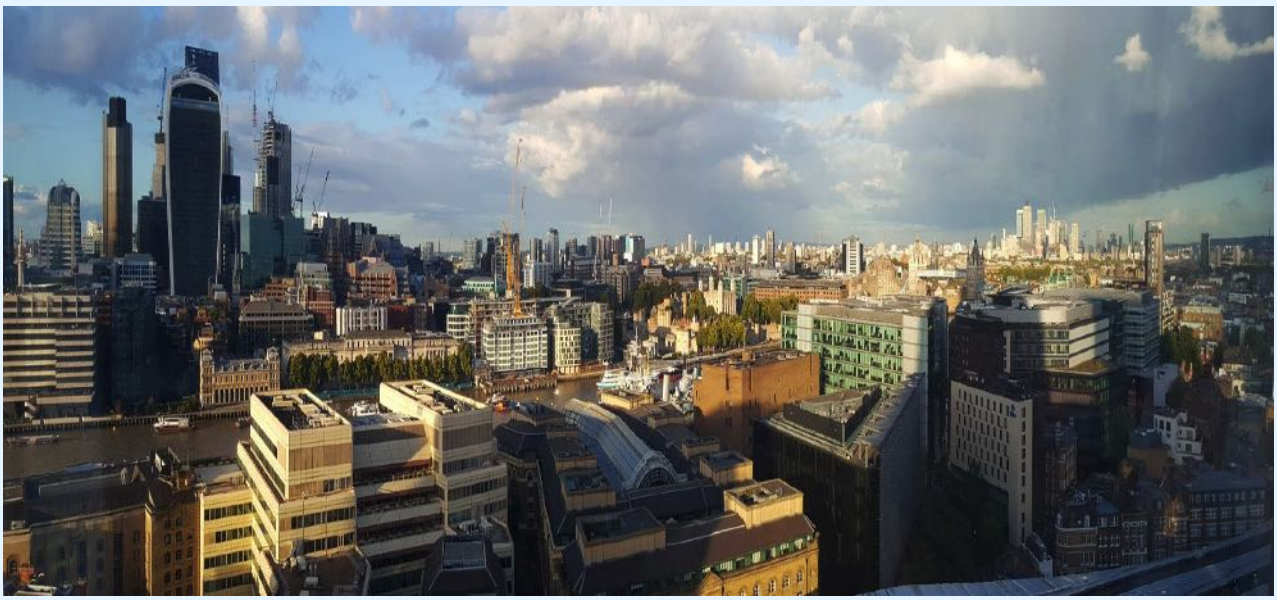
For those who would like to invest more time and actually help us to govern the Section, we have two open Board positions we are recruiting for – Secretary and Treasurer. Please let us know if you are interested, and we can then come back to you with the requirements of the roles: SPELondon@spemail.org.

Thank you all again for staying with us!

I wish you all the best summer and look forward to seeing you at one of our events as we resume in September!

Best regards,

Dr Olga Bradulina
SPE Chairperson



Negotiating for a Gender-Balanced Future

SPE Women in Energy 13th Annual Conference, 14 June 2019

Louise Kingham, OBE FEI, Chief Executive of the Energy Institute, inspires with her keynote speech.

Women in Energy (WiE) is an annual seminar organised by volunteers and hosted by the Society of Petroleum Engineers, London Section, where leaders of the industry get together to discuss how to achieve gender balance from a personal level to the corporate and industrial level. It is a full-day event including keynote speakers, workshops, panel discussions and opportunities for networking, which this year included more than 160 attendees of all levels of seniority in the energy sector, from students to CEOs.

Peter Duff, Head of Diversity & Inclusion BP informs the crowd of the status quo on gender balance in BP and the initiatives launched to force change.

Part of the SPE Women in Energy Committee and friends.

This year, the conference had a focus on negotiation skills, themed “Negotiating for a Gender Balanced Future”. Negotiation skills can’t be overestimated. Your role and how you are viewed in your organisation are almost constantly up for negotiation: salary, promotions, responsibilities, how you interact with your colleagues… Practice and preparation are key to presenting your best self in a balanced workplace, so this year’s conference was geared up to turn our attendees into master negotiators.

The day began with the keynote speech from Louise Kingham OBE FEI, Chief Executive of the Energy Institute, presenting statistics on the gender-balance status of the industry, and inspiring the audience to be braver, stronger, and more prepared to take action. Peter Duff, Head of Diversity & Inclusion (D&I) at BP followed with a view of gender statistics in BP, and how D&I initiatives in the company and across the sector are working to make the industry a better place to work for everyone.

The panel session, moderated Jane Whaley, Editor-

Negotiating for a Gender-Balanced Future... continued

Professor Steve Dunn, Head of Chemical & Petroleum Engineering LSBU welcomes the crowd.

SPE WiE 2019 panellists sharing their knowledge and experience.

Participants hard at work in the "Advocating for Change" workshop by Rebekah Bostan.

in-Chief of GEOEXPRO Magazine, included standout contributions from Peter Duff, Janine Esbrand, Founder of Lightbox Coaching, Andrea Cotton-Berry Global Head Strategic Operations US, EU &APAC, Precision Oncology, and Zvonimir Djerfi, President of Global Sales, BHGE.

The panellists discussed their most successful negotiation techniques and stories, and the audience contributed to a lively debate about issues of gender inclusion in the workplace. Most notable was the common theme that there is NO difference between men and women in negotiations; once you are well researched and confident, anyone can be successful.

The workshops included practical sessions on "Advocating for Change", "The Cleopatra Effect", "Positive Thinking", "The Way of the Productivity Ninja", "Leadership Working Across Cultures", "Negotiating Your Financial Future" and "Backward Goal Planning". Each of the workshop rooms was buzzing with energy, buoyed by the brilliance and passion of the delegates.

Running throughout the day was a constant hum of excitement: colleagues getting to chat outside work, old friends catching up and new friendships being forged. The strength of the SPE WiE event is always the people that attend and the opportunity to create a vibrant network of like-minded people across the industry. If the smiling, engaged faces were any indication, this year was no different and we look forward to making next year even better!

We are really grateful to our sponsors: BP, BHGE, Total, CNOOC & LSBU. This fantastic event wouldn't have happened without their generosity. If anyone is interested in sponsoring next year's SPE WiE event, please get in touch with the committee on spe.londonwie@gmail.com

New Concept of Dynamic Rock Typing and Necessity of Modifying Current Reservoir Simulators

Editor's note: Upscaling of relative permeability curves for use in Reservoir Simulation has been the subject of research for many years and, as a brief online search shows, continues to be an active topic of hot debate. The following paper, from Iran, suggests another method. Although this article is too short to provide an in-depth exposition of the method, this paper may prove useful in continuing the debate.

Dr. Abouzar Mirzaei-Paiaman is a Senior Reservoir-Production Engineer at National Iranian South Oil Company (NISOC). He has held positions in both industry and academia and published more than 40 papers in top journals of petroleum/chemical engineering and SPE conferences.

Dr. Mirzaei-Paiaman's research interests are reservoir simulation, pore- and core-scale physics of multiphase fluid flow in porous media, enhanced oil recovery, petrophysical characterization of porous media, and SCAL studies.

Contact:
mirzaei1986@gmail.com

Abouzar Mirzaei-Paiaman, Ph.D., discusses a new method of True Effective Mobility (TEM-function) that makes it possible to perform dynamic rock typing using relative permeability data and prepare independent initial relative permeability data input to reservoir simulators. As current commercial simulators have been developed on the basis of a conventional capillary pressure-based static rock typing scheme, they need to be modified with an aim to have the capability of accepting this new method. This will result in easier and more physics-based history matching processes and consequently more accurate predictions.

Problem statement: One of the duties of a reservoir engineer is to assign representative capillary pressure and relative permeability data to each grid cell of a simulation model. Simulators use primary drainage capillary pressure data to perform water saturation-height calculations in aim to distribute the original oil in place (OOIP), while relative permeability data are used to model fluids flow.

Due to the heterogeneous nature of reservoir rock, usually the outcome of special core analysis (SCAL) is a broad set of capillary pressure and relative permeability measurements. A reservoir engineer should then attempt to find a correlation between these saturation functions and routine rock properties so that they can be assigned to simulation cells. Usually such a correlation can be established in the case of primary drainage capillary pressure data only. This process is called petrophysical static rock typing and the outcomes are petrophysical static rock types (PSRTs).

Though there is no apparent correlation in the case of relative permeability data which makes it extremely difficult, if not impossible, to assign average relative permeability data to simulation cells because no distinct relative permeability groups appear. In such a situation, as an alternative solution, reservoir engineers inevitably perform averaging of relative permeability data corresponding to each PSRT by averaging equations, and assign such data to simulation cells in the manner that capillary pressure data have been assigned. Furthermore, usually the necessary condition of presence of adjacent capillary pressure data in a PSRT is even compromised at the cost of observing similar endpoint saturations among the corresponding relative permeability curves. This may jeopardize the reliability of OOIP calculations.

In practice, relative permeability curves corresponding to a single PSRT usually exhibit a significant scatter, often overlapping the scatters made by the curves belonging to other groups, especially in carbonate and shaly formations. The resulting averaged relative permeability data is highly uncertain and poorly representative of the true dynamic behavior of the cells. Reservoir engineers may even have to discard some relative permeability data to form groups with less scatters. To the best of our knowledge, there is not any

New Concept of Dynamic Rock Typing ... continued

clear flow-based criterion for such eliminations and sometimes valuable data from important rock types may mistakenly be disregarded, adding to the uncertainties of both reservoir characterization and simulation.

The format that current reservoir simulators use to input relative permeability data is based on the above capillary pressure-based static rock typing approach. Such a format, however, causes difficulties in history matching process and also significant uncertainties in model predictions because the underlying rock typing has not been based on relative permeability data despite spending a considerable budget and time in acquiring experimentally-measured relative permeability data.

Criterion for Characterization of Dynamic Behaviors: We employed an extension of the Darcy's law for multiphase flows to develop a True Effective Mobility (TEM-function) method. TEM is a saturation-dependent function and is dependent on relative permeability, permeability, porosity, and fluid viscosity. Systems with similar fluid flow characteristics, which form the same petrophysical dynamic rock type (PDRT), exhibit identical TEMs. Systems with different dynamic properties form different PDRTs yield dissimilar TEMs, where the curves representing higher quality systems with better dynamic characteristics stand above the curves of poorer ones.

Scaling Relative Permeability Data: TEM-function for analysis of relative permeability data is analogous to the J-function for scaling capillary pressure data. Thus, within each given PDRT, the relative permeability data of a particular sample can be extended to other samples.

TEM versus Relative Permeability: The dynamic behavior of systems may not necessarily be fully captured by relative permeability information and, if used, it can even result in misleading interpretations. Simulation engineers should instead seek a relationship between TEM (not relative permeability) data and properties of grid cells. This explains the main reason for historical unsuccessful attempts to establish a clear correlation between relative permeability data and cells' properties.

Dynamic Rock Typing for Different Fluids: As a traditional practice, averaging has always been performed using a pair of relative permeabilities as a unit property (e.g., water and oil, or oil and gas). However, this assumption might not always be true and factors such as wettability and pore-scale heterogeneity can raise different dynamics with respect to each fluid phase. Hence, different dynamic rock typing schemes should be applied to the flow of each fluid. In other words, rock typing is a phase-specific process and the outcome for one phase cannot be reliably extrapolated for other fluids.

Averaging Relative Permeability Data: The choice of averaging scheme can affect the uncertainty level of initial relative permeability data which is going to be inputted to simulators. There are two common averaging equations for this purpose and we showed that both are unreliable. Following the logic behind the TEM-function, we developed a new and reliable equation which uses permeability, porosity, and fluid viscosity as weighting factors when averaging relative permeability data.

Dynamic Rock Typing Using TEM-Function: PDRTs can be identified using the TEM-function followed by averaging relative permeability data in each identified rock group. For each group, the numeral lower and upper boundaries of a routine property which is specific to that group needs to be determined. Averaged data is then inputted to a simulator. Later in the simulation model, the simulator should have a capability to compute the property for each grid cell using its characteristics and assign a specific PDRT to it. This dynamic rock typing scheme is independent of PSRTs and primary drainage capillary pressure data. Alternatively, for a given PDRT, one may input the average TEM data to a simulator. The simulator should determine cells' quasi-relative permeability (a new form of relative permeability which is introduced by us) using the input average TEM data.

New Concept of Dynamic Rock Typing ... continued

Field Case and Comparative Study: SCAL data from a carbonate reservoir in one of the Iranian fields was used to show an example calculation. The average water and oil relative permeability data determined by use of the conventional approach for the identified PSRTs using three averaging schemes are shown in **Figures 1** and **2**.

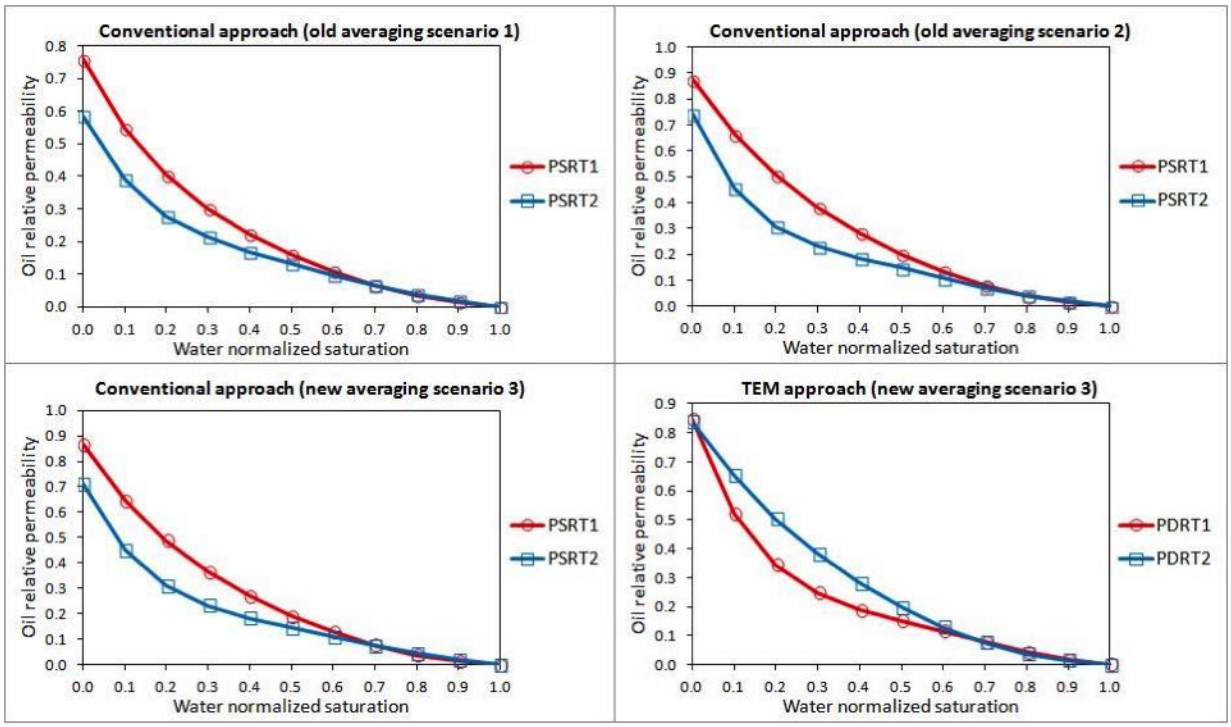


Figure 1: Average oil relative permeability data by different schemes.

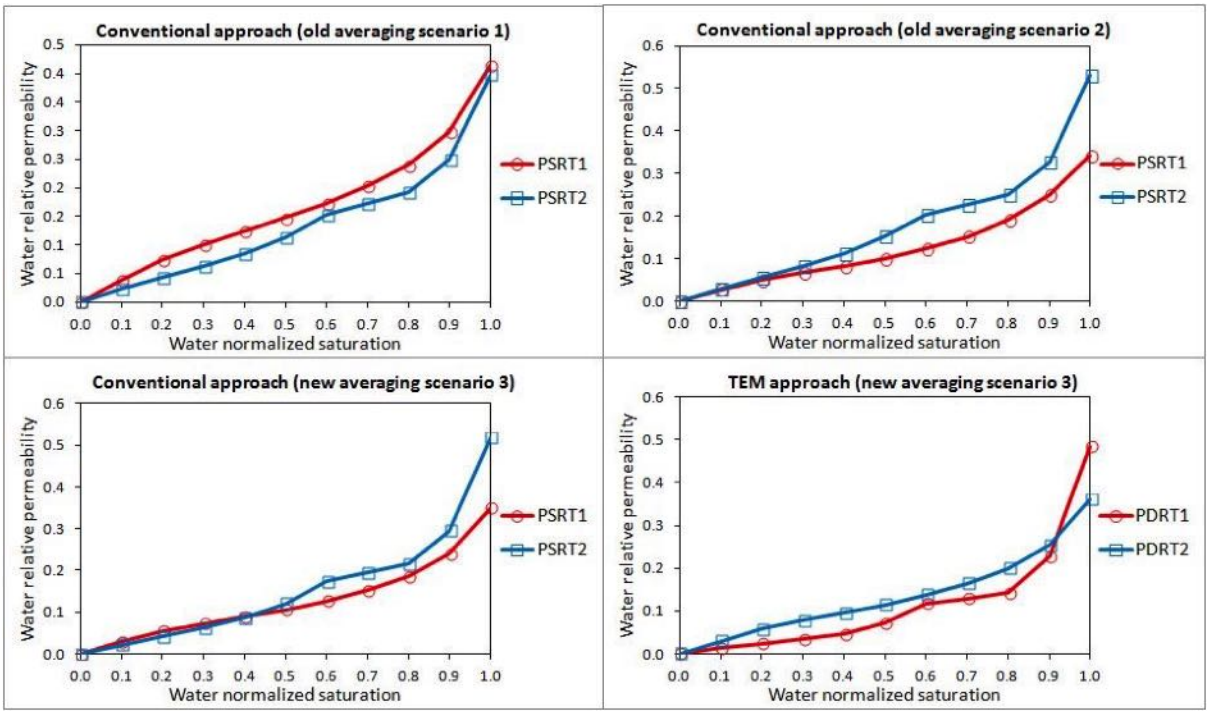


Figure 2: Average water relative permeability data by different schemes.

New Concept of Dynamic Rock Typing ... continued

Averaging scenarios 1 and 2 are two common equations used by reservoir engineers. Averaging scenario 3 is the new one presented by our team. The average water and oil relative permeability data determined through TEM approach for the identified PDRTs using the new averaging equation are also included in these two figures.

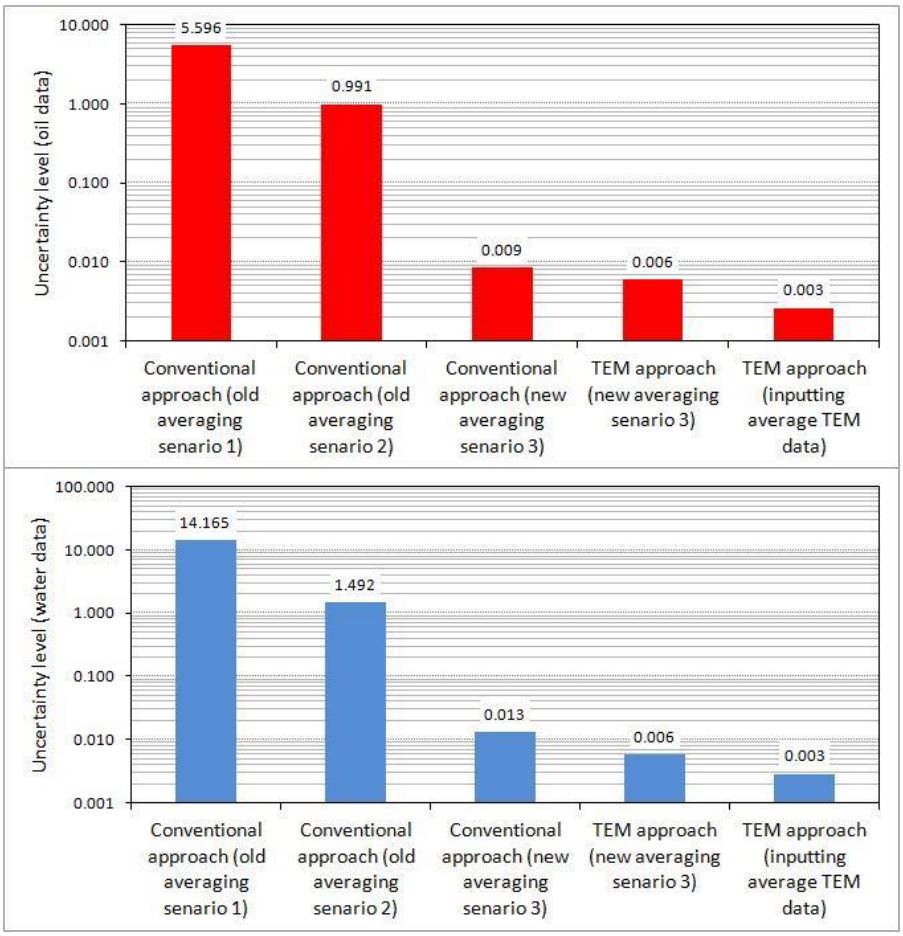


Figure 3: Uncertainty level associated with each type of average relative permeability or average TEM data. Oil data (top plot), water data (bottom plot).

The uncertainty levels associated with each case are shown in **Figure 3**. When the conventional PSRT approach is taken, the choice of the averaging equation highly affects the uncertainty that is introduced in the average relative permeability data. Considering the conventional approach, it is interesting to note that the new averaging equation generates a significantly more accurate result than two familiar equations commonly used by petroleum engineers.

Furthermore, the input average relative permeability data using the new technique based on either average TEM or average relative permeability is significantly more accurate than the conventional PSRT approach. Comparing the uncertainty levels of average TEM or average relative permeability and proceeding with more accurate average parameters resulting from the new approach would result in an additional increase in the confidence level associated with cells' relative permeability data.

Need to Modify Current Reservoir Simulators: Algorithms used in current simulators should be modified to grant them the capability to utilize PDRTs independent of PSRTs. In other words, saturation regions corresponding to PSRTs and PDRTs may not overlap. As such, the number of dynamic rock types could be less, equal, or more than the static groups. This is essential to reach easier and more physics-based history matching and more reliable predictions, especially in carbonates.

References

Mirzaei-Paiaman, A., Saboorian-Jooybari, H., Chen, Z., and Ostadhassan, M. 2019. New technique of True Effective Mobility (TEM-Function) in dynamic rock typing: Reduction of uncertainties in relative permeability data for reservoir simulation. Journal of Petroleum Science and Engineering, 179, 210-227.

Mirzaei-Paiaman, A., Ostadhassan, M., Rezaee, R., Saboorian-Jooybari, H., and Chen, Z. 2018. A New Approach in Petrophysical Rock Typing. Journal of Petroleum Science and Engineering, 166, 445–464.

Mirzaei-Paiaman, A., Sabbagh, F., Ostadhassan, M., Shafiei, A., Rezaee, R., Saboorian-Jooybari, H., and Chen, Z. 2019. A Further Verification of FZI* and PSRTI: Newly Developed Petrophysical Rock Typing Indices. Journal of Petroleum Science and Engineering, 175, 693-705.

SPE YPs - UK Student Paper Contest

Abstract Submission deadline: 1 September 2019

The SPE London Section is holding the 1st Annual UK paper contest between Young Professional and Student Chapters.

This new event is aiming to bring together students, researchers and young professionals to share their research experiences providing technological solutions for the oil and gas industry.

The competition is open to young professionals and all students studying an oil and gas BEng, MEng/MSc or PhD program in the UK.

To take part, candidates need to send an abstract of about 350 words that summarize the topic of research, stating the contribution to knowledge, main findings and conclusions by September 1st. The contest will be conducted considering four divisions: Young Professional, PhD, MSc/MEng and BEng students.

The abstracts finalists for each division must present their paper to an industry-academic panel at the special evening event planned for this purpose, during which the winners for each division will be selected and awarded.

The winners of this competition will be better prepared for the regional paper contests and gain more experience with technical presentation and networking.

Please note: the presentation evening will take place in London, and students will have to physically present their paper. While the SPE YP committee does not reimburse travel costs, the student's respective SPE Chapter may grant financial assistance, although this would need to be arranged with the chapter directly.

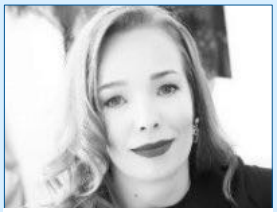
If you are interested in taking part, please send your abstract to **spe.chapters.london@gmail.com** by midnight on Sunday 1 September 2019, with a clear indication of the division in which you are participating, name and university or company affiliation.

Note: The dissertations do not need to be completed, as only the abstracts are required.

Further details will be released about the presentation evening closer to the date.
It will take place on Wednesday 25 September at London Southbank University, London.

Meet the SPE London Board

SPE is a non-profit professional society with 164,000members in 143 countries. The SPE London Section, with an average 2,000 members and seven associated student chapters, is an active section with an aim to connect, engage and promote the exchange of knowledge within the London energy community of technical and commercial professionals. The SPE London Board is the policy-making and governing body, consisting of volunteers who devote time to overseeing many of SPE London's administrative and operating responsibilites.



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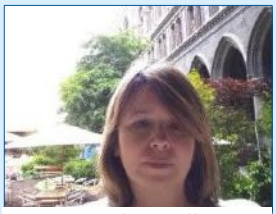

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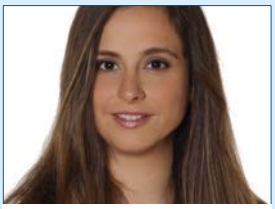

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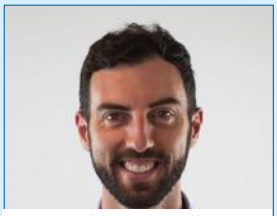

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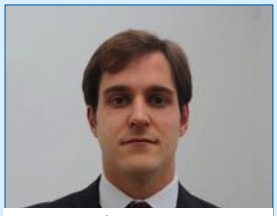

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What's happening?

SPE local and international events and on-demand webinars

06 September **SPE Offshore Europe Conference and Exhibition** Aberdeen, UK

Connecting the Global Upstream Offshore Oil & Gas Community

SPE Offshore Europe is recognised by offshore E&P professionals as Europe's leading E&P event. Attending will ensure you are up to date with the most significant technologies and can connect with a global network of 36,000+ attendees.

21-25 October **SPE Forum: Understanding the Reservoir Beyond the Wellbore** Phoenix, Arizona, USA

Predicting the properties of reservoirs beyond the wellbore has been the cornerstone of reservoir characterization. The outcome provides the framework for efficient management and optimization of hydrocarbon reservoirs. Proper reservoir characterization affects all reservoir types and all stages during the life of a field. Far-field characterization encompasses seismic, electromagnetic, and other geophysical surveys. This characterization can be facilitated in various configurations such as cross-well or surface-to-wellbore, accomplished while drilling, in open and cased wells, and while producing hydrocarbons. However, there is a trade-off between resolution and the distance of investigation from wells. This forum will uncover methods that could improve reservoir understanding with the aid of characterization between wellbores. It will expand the discussion from measurements to predictive modeling and include possibly disruptive innovations.

29 October **SPE Upstream Finance and Investments Conference** London, UK

This October, leaders and experts from the petroleum and finance industries across the globe will unite in London to share valuable insights, high-level discussion and debate on issues within oil and gas and finance and investments. Upstream Finance and Investments Conference will focus on how to position the oil and gas industry in a volatile price environment while achieving supply-demand balance, promoting technological growth and providing prudent investment on exploration.

05-06 November **SPE Workshop: Production Optimisation in Gas and Oil Assets** The Hague, The Netherlands

The Production Optimisation in Gas and Oil Assets workshop is a high-quality event where experts, operators, and service companies share their latest developments, successes, and failures on late-life production topics. This workshop aims to improve and accelerate the development of activities to optimise late-life production in gas and oil wells and assets.

28 November **Full Day Seminar: Introduction to Oil and Gas, Exploration & Production** London, UK

The 'Introduction to E&P' seminar provides an introduction to the full life cycle of oil and gas fields. It covers the basics of exploration, geoscience, drilling, operations, reservoir management and commercial terms. The speakers will also discuss key issues faced by the industry. Engineers and Managers often suggest this seminar to non-technical staff, so they can better understand the content of reports and budgets. This seminar is about communicating complex ideas to a non-technical audience. Presentations will be at a basic level and attendees will get an overall view across all upstream disciplines. The seminar is also for people working indirectly with oil and gas companies, or providing support services.

Recorded: 1.5.2019 **Using Machine Learning to Optimize Completion Design** Online webinar

As the industry moves to more complex multi-pad, multi-well completion designs, intelligent completion optimization will require more sophisticated algorithms to improve the decision-making process.

Recorded: 15.5.2019 **The Future Role of Oil** Online webinar

0.15 credits offered.

Presented by Dr. Iskander Diyashev, SPE Distinguished Lecturer.

Recorded: 5.1.2019 **Does the Oil and Gas Industry Have the Right Organizational Culture for Digital Transformation?** Online webinar

Interview with Helen Gilman.