

Sophie Roman

32 years old

Civil union, 1 child

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Associate Professor

Keywords: fluid dynamics, microfluidics, microfabrication, imaging, metrology, multiphase flow, reactive transport, porous media.

WORK EXPERIENCES

From Sept. 2017 **Institut des Sciences de la Terre d'Orléans (ISTO, France)**, Associate Professor, Porous Media Group.



- Multiphase flows in Porous Media at the pore-scale
- Dissolution and precipitation phenomena at the pore-scale

Oct 2013-2017



Stanford University (CA, USA), Energy Resources Engineering Department, post-doctoral fellow (2 years), research scientist (2 years) working with Prof. Anthony Kovscek and Prof. Hamdi Tchelepi.

« *Experimental study of the dynamics of multiphase flows in micromodels* »

- Fabrication of 2D micromodels (photolithography, etching, glass bonding, PDMS molding).
- Control of the flow conditions in the micromodels and imaging of the flow.
- Development of micro-PIV (Particle Image Velocimetry) measurements in micromodels.
- Image processing and analysis (interface tracking, analysis of heterogeneous reaction processes).
- Comparison of experimental, theoretical and numerical modeling.

2013



Montpellier 2 University (France), Laboratoire Charles Coulomb, post-doctoral fellow (7 months), working with Dr. Vincent Jourdain and Prof. François Henn

« *Biosensor: confinement of ionic bio-channels inside a carbon nanotube for selective ion transport* »

- Design and fabrication of micro-devices for nanofluidics based on isolated carbon nanotubes,
- Characterization of the ion transport using voltage-clamp technique (electrophysiology).

2009-2012



Institut de Mécanique des Fluides de Toulouse (IMFT, France), PhD student, thesis defended in December 2012 under the supervision of Dr. Sylvie Lorthois and Dr. Frédéric Risso

« *Flow of concentrated suspensions of red blood cells in microchannels: experimental study* ».

- Development of a microfluidic device for the study of red blood cell flows in microchannels:
 - o design and microfabrication (photolithography and casting in silicone),
 - o implementation of the fluidic system for the control of flow conditions,
 - o imaging of the flow of red blood cells.
- Quantification of flow parameters:
 - o velocity fields: validation and optimization of the *dual-slit* technique and *in vitro* measurements,
 - o concentration fields: development of a photometric technique.
- Parametric *in vitro* study of the phase segregation effect (asymmetric distribution of red blood cells and plasma at microvascular bifurcations).

2009



Sanofi, Toulouse (France), Scientific Computing & Data Management department, internship (6 months)

« *Acquisition, processing and image analysis* ».

- Development of image processing tools for biological problems of neuronal migration and proliferation of neural stem cells.
- Identification of new factors that reflect neuronal reorganization.
- Development of an application for automated image acquisition.

EDUCATION

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| 2009-2012 | PhD of National Polytechnic Institute of Toulouse (France), specialized in <i>Fluid Dynamics</i> . |
| 2006-2009 | Master of Science in Bioscience Engineering , Institute of Biosciences of Paris (France), www.isbs.fr . Options: biomechanics/biomaterials and bio-imaging/computer science |
| 2004-2006 | Preparation in Physics, Chemistry, Mathematics, Biology and Geology for the entrance to French Engineering Schools: Lycée Ozenne (Toulouse, France) |

TEACHING & MENTORING

Teaching

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| 2017-current | University of Orléans , Universe Science Observatory (OSUC), 192 hours/year. Undergraduate and master level (lectures and practical work): hydrogeology, reactive transport, geochemistry of natural waters, transport laws and fluid mechanics, modeling of groundwater flows, field course in hydrogeology. |
| 2015 | Stanford University , School of Earth, Energy and Environmental Sciences. Lecture in the Flow through Porous Media Laboratory class (ENERGY 120A): experimental fluid mechanics in porous media. |
| 2009-2012 | Paul Sabatier University (Toulouse, France), Department of Physical Measurements, 64 hours/year Undergraduate level (practical works): Electricity, Optics, Solid mechanics. |

Advisor

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| 2019-2022 | Principal advisor of Mahdi Mansouri, PhD student , « <i>A microfluidic study of the physical and chemical mechanisms induced by CO₂ injection in deep saline aquifers</i> ». |
| 2018 | Primary advisor of Aghiles Ferrah: master's student at the University of Lorraine, 6 month internship , « <i>Trapping of CO₂ in deep saline aquifers from a pore-scale perspective</i> ». |
| 2018 | Primary advisor of Alex Vella: master's student at OSUC, 2 month internship , « <i>Study of multiphase flow in micromodels using the Micro-Particle Image Velocimetry technique</i> ». |
| 2015 | Advisor of Pauline Louazel: master's student at ENSTA ParisTech, 3-month internship , « <i>Experimental Investigation of Interfacial Jumps in Micromodels</i> ». |

AWARDS

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| 2013 | Léopold Escande Prize 2013 : best thesis in Engineering, National Polytechnic Institute of Toulouse. 2012 Best Poster Prize , 37th Annual Meeting of the Biomechanics Society. |
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SKILLS

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| Languages: | French: native language. English: fluent. |
| Computing: | General: Linux, Windows, MS Office, LaTeX. Scientific software: COMSOL Multiphysics®, MATLAB®, ImageJ, OpenFOAM®. Programming languages: C/C++, JAVA. |
| Experimental: | Microfluidics: design of experiments, flow control systems. Microfabrication: mask design, lithography, PDMS molding, etching, Optical Microscopy, Scanning Electron Microscopy, Raman spectroscopy Velocimetry: Particle Image Velocimetry, Particle Tracking Velocimetry (PTV), Dual-Slit, Voltage-clamp technique (electrophysiology), Laboratory techniques in biology (cell culture, viability test, transfections, Western Blot assays). |

SELECTED PRESENTATIONS

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| 2016 | Invited seminar: Heriot-Watt University , Institute of Petroleum Engineering, invited by Julien Maes and Florian Doster, « <i>Image Analysis to Improve Data Acquisition During Micromodel Experiments</i> ». |
| 2016 | Talk, Pore-scale modeling workshop organized by TOTAL , Pau (France), « <i>Experimental microfluidics to improve mechanistic understanding of multiphase flow at the pore-scale</i> ». |
| 2014 | Invited seminar: ARTORG Center for Biomedical Engineering Research in Bern (Switzerland), invited by Dominik Obrist, « <i>Experimental Study of Red Blood Cell Flows in Microchannels</i> ». |

OTHERS

Reviewer for: Chemical Engineering Science, Scientific Report, Transport in Porous Media, Fuel, Advances in Water Resources.

PUBLICATIONS

Articles in preparation

[1] **Roman S.**, Soulaïne C., Kovscek A., Dissipative processes during immiscible two-phase flows, to be submitted in December 2018 in Journal of Colloid and Interface Science.

Articles published in journals with peer review

[1] Soulaïne C., **Roman S.**, Kovscek A., Tchelepi H., *Pore-scale modelling of multiphase reactive flow: application to mineral dissolution with production of CO₂*, Journal of Fluid Mechanics, 855: 616-645, 2018.

[2] **Roman S.**, Abu AlSaud M., Tokunaga T., Wan J., Tchelepi H., Kovscek A., *Measurements and simulation of liquid films during drainage displacements and snap-off in constricted capillary tubes*, Journal of Colloid and Interface Science, 507: 279-289, 2017

[3] Soulaïne C., **Roman S.**, Kovscek A., Tchelepi H., *Mineral dissolution and wormholing from a pore-scale perspective*, Journal of Fluid Mechanics, 827: 457-483, 2017.

[4] Yun W., Ross C. M., **Roman S.**, Kovscek A. R., *Creation of a dual-porosity micromodel with improved realism in both pore structure and flow behavior for the study of immiscible flow in complex porous media*, Lab on a Chip, 8, 2017.

[5] **Roman S.**, Soulaïne C., Abu AlSaud M., Kovscek A., Tchelepi H., *Particle Velocimetry Analysis of Immiscible Two-Phase Flow in Micromodels*, Advances in Water Resources, 95: 199-211, 2016.

[6] **Roman S.**, Merlo A., Duru P., Risso F., Lorthois S., *Going beyond 20 micrometer-sized channels for studying red blood cell phase separation in microfluidic bifurcations*, Biomicrofluidics, 10:3, 2016.

[7] Yazda K., **Roman S.**, Tahir S., Henn F. and Jourdain V., *Fabrication of Microfluidic Devices for the study of Ion transport through Single-Walled Carbon Nanotubes*, MRS Advances, 1(28): 2085–2090, 2016.

[8] Soulaïne C., Gjetvåg F., Garing C., **Roman S.**, Russian A., Gouze P., Tchelepi H., *The Impact of Sub-Resolution Porosity of X-ray Microtomography Images on the Permeability*, Transport in Porous Media, 113: 227, 2016.

[9] **Roman S.**, Lorthois S., Duru P., Risso F., *Velocimetry of red blood cells in microvessels by the dual slit method: effect of velocity gradients*, Microvascular Research, 84: 249-261, 2012.

[10] Moravec F., **Roman S.**, *Numerical computing of elastic homogenized coefficients for periodic fibrous tissue*, Applied and Computational Mechanics 3: 141-152, 2009.

Conference proceedings published in journals with peer review

[1] **Roman S.**, Lorthois S., Duru P., Risso F., *Flow of concentrated red blood cell suspensions at micro-bifurcations: an in vitro experimental study*, Computer Methods in Biomechanics and Biomedical Engineering: in press.

[2] **Roman S.**, Lorthois S., Duru P., Risso F., *An optimized technique for red blood cells velocity measurement in microvessels*, Journal of Biomechanics, 45: 1-35, 2012.

[3] Campagnolo L., **Roman S.**, Perchoux J., Lorthois S., *A new optical feedback interferometer for measuring red blood cell velocity distributions in individual capillaries: a feasibility study in microchannels*, Computer Methods in Biomechanics and Biomedical Engineering: 15-S1: 104-105, 2012.

[4] Nakib A., **Roman S.**, Oulhadj H., Siarry P., *Fast brain MRI segmentation based on two-dimensional survival exponential entropy and particle swarm optimization*, Conference proceedings: Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 5563–5566, 2007.

Oral communication (selection)

Experimental Investigation of Dissipative Processes during Two-Phase Flows, S. Roman, M. Abu Al Saud, T. Tokunaga, J. Wan, H. Tchelepi, A. Kavscek, 9th International Conference on Porous Media (Interpore) 2017, Rotterdam (The Netherlands)

Image Analysis to Improve Data Acquisition During Micromodel Experiments, S. Roman, C. Soullaine, P. Louazel, A. Kavscek, Computational Methods in Water Resources 2016, Toronto (Canada)

Particle Image Velocimetry Analysis in Micromodels to Investigate Two-phase Flow Mechanisms, S. Roman, C. Soullaine and A. Kavscek, 2014 AGU Fall meeting, Sa Francisco (USA)

Investigation and Visualization of Flow Through Porous Media at the Pore Scale, poster, S. Roman, C. Soullaine, H.Tchelepi, A. Kavscek, American Physical Society, 67th Annual Meeting, Division of Fluid Dynamics, November 2014, San Francisco (USA)

An optimized technique for red blood cells velocity measurements in microvessels, S.Roman, S. Lorthois, P.Duru and F. Risso 18th Congress of the European Society of Biomechanics, July 2012, Lisbon (Portugal)