Dr. Lyes Kahouadji

Curriculum Vitae, March 23, 2024.

13 Devonshire House, 50 Putney Hill
SW15 6DJ, London, United Kingdom
+44 (0) 7952 973 902
l.kahouadji@imperial.ac.uk
www.imperial.ac.uk/people/l.kahouadji
@LKahouadji

Current Position and Work Experience

Since 2023 ***Research Fellow in Computational Fluid Dynamics,*** Department of Chemical Engineering, Imperial College London.

2015-2023 ***Research Associate,*** Department of Chemical Engineering, Imperial College London. Working under the guidance of Prof. Omar K. Matar.

Developed expertise: *Massively parallel DNS of fully three-dimensional multiphase flows*

2016-2017 ***Scientific Adviser***, Procter & Gamble (P&G) in Brussels (Belgium).

Developed expertise: Modelling & simulation of complex industrial applications

2013-2014 ***Research Associate*** at LOMC-CNRS, Univ. of Le Havre, France. Project: "Heat transfer by Görtler vortices developed on a wall with finite conductivity".

2013 ***Research Associate*** at PMMH and LIMSI-CNRS. Project: "Parallel direct numerical simulation of three-dimensional Faraday waves".

2012-2013 ***Teaching Fellow*** in mathematics and thermodynamics at Ecole Polytechnique Féminine, and Ecole Centrale d'Electronique, France.

2011-2012 ***Teaching Fellow*** in mathematics at the University Paris-Descartes, France.

2010-2011 ***Teaching Fellow*** in mathematics at the University Paris-Dauphine, France.

2007-2010 ***Graduate Teaching Assistant*** in mathematics at the University Paris-Orsay, France.

Education

2007-2011 ***PhD in Computational Fluid Dynamics and Engineering***, University of Pierre & Marie Curie, Paris VI, France. Thesis title: "Linear stability analysis for free surface rotating flow". ***Honors*** : Très Honorable (Highest honors).

2005-2007 **Masters degree in Fluid Mechanics and Energetics**, University of Pierre & Marie Curie University, Paris VI, France, with emphasis of Multiphase flow, Instability and Turbulence.

2002-2005 **Licence in Mathematics (Bachelor of Science)**, University of Pierre & Marie Curie, Paris VI, France.

Major Areas of Research Expertise

Applied Mathematics; numerical analysis, Fluid-Structure Interaction, adaptive mesh refinement, Miscible and immiscible multiphase flows; heat and mass transfer, and phase change; interfacial flows driven by thermocapillarity and surfactant-driven effects; microfluidics; numerical methods for CFD; high performance computing; Newtonian and non-Newtonian fluids including viscoplastic materials.

Awards

Nov. 2023 APS-DFD Milton Van Dyke poster award. Gallery of Fluid Motion: *"Drop Medusa".*

Nov. 2022 APS-DFD Gallery of Fluid Motion poster award: *"Self Inducing Subharmonic Waves".*

Nov. 2019 APS-DFD Milton Van Dyke poster award. Gallery of Fluid Motion: *"Rico and the Jets".*

July 2019 UK Fluids Network video award: *"Fabulous, flowing, and folding fountain of chocolate".*

2017 EPSRC Knowledge Transfer Secondment Scheme (£12K).

Research publications: (30 published or accepted for publication)

[1] ***L. Kahouadji*** et al. *Stability threshold for the free surface flow driven by a rotating disk in a small aspect ratio cylindrical cavity.* ***Mec. Ind.*** **vol 11**, 339-344 (2010).

[2] ***L. Kahouadji*** et al. *Thermocapillary instabilities in a laterally heated liquid bridge with end wall rotation.* ***Phys. Fluids*****, vol 23**, 104104 (2011).

[3] ***Kahouadji*** and Martin Witkowski. *Free surface due to a flow driven by a rotating disk inside a vertical cylindrical tank: Axisymmetric configuration.* ***Phys. Fluids*****, 26**, 072105 (2014).

[4] ***L. Kahouadji***, N. Périnet, L. S. Tuckerman, S. Shin, J. Chergui and D. Juric. *Numerical simulation of super-square patterns in Faraday waves.* ***J. Fluid Mech.*** **vol 772**:R2 (2015).

[5] S. Shin et al. *A hybrid interface tracking-level set technique for multiphase flow with soluble surfactant.* ***J. Comput. Phys.*** **vol 359**, 409-435 (2018).

[6] ***L. Kahouadji*** et al. *Simulation of immiscible liquid-liquid flows in complex microchannel geometries using a front-tracking scheme.* ***Micro. Nano.*****, vol 22,** 126 (2018).

[7] A. W. Russell et al. *Mixing viscoplastic fluids in stirred vessels over multiple scales: A combined experimental and CFD approach.* ***Chem. Eng. Sci.*** **vol 208**, 115129 (2019).

[8] C. R. Constante-Amores, ***L. Kahouadji*** et al. *Dynamics of retracting surfactant-laden ligaments at intermediate Ohnesorge number.* ***Phys. Rev. Fluids*****, vol 5**, 084007 (2020).

[9] A. Batchvarov, ***L. Kahouadji*** et al. *Effect of surfactant on elongated bubble at high Reynolds number.* ***Phys. Rev. Fluids*****, vol 5**, 093605 (2020).

[10] C. R. Constante-Amores, ***L. Kahouadji*** et al. *Rico and the jets: Direct numerical simulations of turbulent liquid jets.* ***Phys. Rev. Fluids*****, vol 5**, 110501 (2020).

[11] A. Batchvarov, ***L. Kahouadji*** et al. *Three-dimensional dynamics of falling films in the presence of insoluble surfactants.* ***J. Fluid Mech.*** **vol 906**:A16 (2021).

[12] C. R. Constante-Amores, ***L. Kahouadji*** et al. *Dynamics of a surfactant-laden bubble bursting through an interface.* ***J. Fluid Mech.*** **vol 911**:A57 (2021).

[13] C. R. Constante-Amores, ***L. Kahouadji*** et al.. *Direct numerical simulations of transient turbulent jets: vortex-interface interactions.* ***J. Fluid Mech.*** **vol 922**:A6 (2021).

[14] C. R. Constante-Amores, A. Batchvarov, ***L. Kahouadji*** et al. *Role of surfactant-induced Marangoni stresses in drop-interface coalescence* ***J. Fluid Mech.*** **vol 925**:A15 (2021).

[15] A. Obeysekara et al. *Prediction of multiphase flows with sharp interfaces using anisotropic mesh optimisation.* ***Advances in Engineering Software*****, vol 5**,103044 (2021).

[16] J. P. Valdes, ***L. Kahouadji***, and O. K. Matar. *Current advances in liquid-liquid mixing in static mixers: A review.* ***Chem. Eng. Res.*** & ***Design*****, vol 177**, 694-731 (2022).

[17] ***L. Kahouadji*** et al. *A Numerical Investigation of Three-dimensional Falling Liquid Films.* ***Environ. Fluid Mech.*****, vol 2**, 367–382 (2022).

[18] ***C. E. Heaney*** et al. *An AI-based non-intrusive reduced-order model for extended domains applied to multiphase flow in pipes.* ***Phys. Fluids*****, vol 34**, 055111 (2022).

[19] ***L. Kahouadji*** et al. *The transition to aeration in two-phase mixing in stirred vessels.* ***Flow*****, vol 2**, E30 (2022).

[20] F. Liang, ***L. Kahouadji*** et al. *Numerical study of oil-water emulsion formation in stirred vessels: effect of impeller speed.* ***Flow*****, vol 2**, E34 (2022).

[21] J. Chen et al. *Computational fluid dynamics simulations of phase separation in dispersed oil-water pipe flows.* ***Chem. Eng. Sci.*** **vol 267**, 118310, (2023).

[22] C. R. Constante-Amores at al. *Direct numerical simulations of turbulent jets: vortex-surface-surfactant interactions.* ***J. Fluid Mech.*** **vol 955**:A42 (2023).

[23] C. R. Constante-Amores, ***L. Kahouadji*** at al. *Role of kidney stones in renal pelvis flow.* ***J. Biomechanical Eng.*****, vol 145**(5), 051007 (2023).

[24] J. P. Valdés, ***L. Kahouadji*** et al. *Direct numerical simulations of liquid-liquid dispersions in a SMX mixer under different inlet conditions.* ***Chem. Eng. J.*****, vol 462**, 142248 (2023).

[25] C. R. Constante-Amores, ***L. Kahouadji*** et al. *Impact of droplets onto surfactant-laden thin liquid films.* ***J. Fluid Mech.***, **vol 961**:A8 (2023).

[26] M. Kalli et al. *Effect of surfactants during drop formation in a microfluidic channel: a combined experimental and CFD approach.* ***J. Fluid Mech.***, **vol 961**:A15 (2023).

[27] F. Liang, ***L. Kahouadji*** et al. *Numerical simulation of surfactant-laden emulsion formation in a stirred vessel.* ***Chem. Eng. J.*****, vol 472**, 144807 (2023).

[28] J. P. Valdes, ***L. Kahouadji*** et al. *On the dispersion dynamics of liquid-liquid surfactant-laden flows in a SMX static mixer.* ***Chem. Eng. J.*****, vol 475**, 146058 (2023).

[29] D. Panda, ***L. Kahouadji*** et al. *Axisymmetric and azimuthal waves on a vibrated sessile drop.* ***Phys. Rev. Fluids*****, vol 8**, 110510 (2023).

[30] P. Pico, ***L. Kahouadji*** et al. *Drop encapsulation and bubble bursting in surfactant-laden flows in square capillary channels.* ***Phys. Rev. Fluids*****, vol 9**, 034001 (2024).

[31] F. Liang et al. *Liquid-liquid dispersion performance prediction and uncertainty quantification using recurrent neural networks.* **Accepted** for ***Ind. Eng. Chem. Research.***

Submitted

[32] S. Cheng et al. *Multi-domain encoder-decoder neural networks for latent data assimilation in dynamical systems.* **Submitted** to ***J. Comp. Phys.***

[33] A. M. S. H. Abdal, ***L. Kahouadji*** et al. *On the interaction between a rising bubble and a settling particle.* **Submitted** to ***J. Fluid Mech.***

[34] F. Horvath-Gerber et al. *In the heart of a micro-mixer: Characterisation of liquid-liquid flow hydrodynamics using LED-induced fluorescence.* **Submitted** to ***Chem. Eng. J.***

[35] N. Basha et al. *Machine Learning and Physics-Driven Modelling and Simulation of Multiphase Systems.* **Submitted** to ***Int. J. Multiphase Flow***

In preparation

[36] D. Panda, ***L. Kahouadji*** et al. *Shaking, Walking, Climbing, and Shooting: Complex Dynamics in Drops on Vibrated Substrates.* In preparation for ***J. Fluid Mech.***

[37] D. Panda, ***L. Kahouadji*** et al. *Nonlinear natural oscillations of surfactant-laden drops - role of Marangoni stresses.* In preparation for ***J. Fluid Mech.***

[38] D. Panda, ***L. Kahouadji*** et al. *Numerical simulations for surfactant-covered Faraday waves: role of Marangoni stresses in pattern formation.* In Preparation for ***J. Fluid Mech.***

[39] D. Panda, ***L. Kahouadji*** et al. *Drop Medusa.* In preparation for ***Phys. Rev. Fluids.***

[40] A. M. S. H. Abdal, ***L. Kahouadji*** et al. *Three-dimensional Simulations of Product Changeover: Miscible and Immiscible Approach.* In preparation for ***Chem. Eng. Sci.***

[41] A. M. S. H. Abdal, ***L. Kahouadji*** et al. *Pairwise interaction of in line spheroids settling in a linearly stratified fluid.* In preparation for ***Acta Mechanica***.

[42] P. Pico, ***L. Kahouadji*** et al. *Surfactant-laden bubble bursting: dynamics of capillary waves and Worthington jet at large Bo.* In preparation for ***Phys. Rev. Fluids.***

Reviewed proceedings in Conferences

[1] S. Shin, J. Chergui, D. Juric, A. Farhaoui, ***L. Kahouadji***, L. S. Tuckerman and N. Périnet : Parallel Direct Numerical Simulation of Three-Dimensional Two-Phase Flows, 8th International Conference on Multiphase Flow, Jeju, Korea, May 26th-31st May 2013.

[2] ***L. Kahouadji***, J. Peixinho and I. Mutabazi: Heat transfer by Görtler vortices developed on a wall with finite conductivity. 17e Rencontre du Non Linéaire, Paris, 18-20 Mars 2014.

[3] D. Juric, J. Chergui, S. Shin, ***L. Kahouadji***, R. V. Craster and O. K. Matar: Innovative computing for industrially-relevant multiphase flows. 12^{th} International Conference on CFD in Oil & Gas, Metallurgical and Process Industries SINTEF, Trondheim, Norway. May 30^{th} - June 1^{st} 2017.

Responsibilities

- Chair of the Postdoc Committee at the Department of Chemical Engineering.
- Member of the Departmental Research Committee.
- Member of the Departmental Equality, Diversity and Culture Committee (EDCC).
- Member of the Departmental Social Committee.
- Manager of Chem. Eng. Football Club.

Supervision and mentoring (PhD students)

Since 2020 • (1) Juan P. Valdés (Static mixer CFD), (2) Fuyue Liang (Liquid-Liquid mixing in a stirred vessel CFD), (3) Paula Pico (Microfluidics Multiphase Flows CFD), (4) Abdullah M. Abdal (FSI Stratified flows CFD), and (5) Debashis Panda (Faraday waves CFD).

2016-2020 • Dr Cristian R. Constante-Amores (Postdoc at University of Oxford and Wisconsin-Madison.)
"***Three-dimensional computational fluid dynamics simulations of complex multi-phase flows with surfactants***". (BP-funded project).

2017-2020 • Dr Assen Batchvarov (Now works as product Manager at Quaisr Ltd).
"***Three-dimensional computational fluid dynamics simulations of interfacial flows with surfactants***". (EPSRC-MEMPHIS and PREMIERE funded project).

2018-2019 • Dr Andrew Russell (Now works as technologist at Infinium).
"***Non-Newtonian fluid selection for achieving flow similarity in stirred vessels***". (Syngenta-funded project)

Teaching Experience (***1308 hours***: Lecturing, Tutoring, Lab. sessions, Supervising and Others.)

- ***2022-2024: Mathematics (2^{nd} year UG):*** Partial differentiation, chain rule, stationary points, vector calculus, scalar & vector line integrals, area & surface integrals, and integral theorems. **(2 × 12 hours)**

- ***2020-2022: Fluid Mechanics course (3^{rd} year UG):*** Streamfunctions, vorticity, potential, Stokes flow, Two-phase flows, Non-Newtonian fluids, and Turbulence. **(3 × 12 hours)**

- ***2018-2020: Teaching Fluid Mechanics using a Virtual Reality Environment:*** Flow past a sphere, Poiseuille flow, bubbly flow, non-Newtonian fluids, and Turbulent flows. **(3 × 20 hours)**

- ***2012-2013: Teaching Thermodynamics at Ecole Centrale d'Electronique:*** Introduction, definitions, states variable, temperature, ideal gas law, real gases, van der Waals gas, work, heat, heat capacity, at constant volume and pressure; First Law of Thermodynamics; (enthalpy, Joule's expansion and Joule Thompson expansion); Second Law of Thermodynamics ; reversible and irreversible processes, entropy diagrams, heat engines, classical Carnot heat engine, Ericson cycle, thermal efficiency); phase transition, phase diagram, and heat engine with phase transition. **(20 hours)**.

- ***2012-2013: Teaching analysis and scientific computing at Ecole Polytechnique Féminine***: Lab. section using Matlab. **(64 hours)**.

- ***2011-2012: Teaching mathematics at University Paris-Descartes***: Numerical simulation using Scilab, arithmetic, graph theory, linear algebra and analysis. **(192 hours)**.

- ***2011-2012: Teaching numerical analysis and scientific computing at University of Paris-Dauphine***: Direct and iterative methods for solving linear systems; integrations, eigenvalues and eigenvectors calculations; solving nonlinear equations; polynomial interpolation and quadrature formulae. **(88 hours)**.

- ***2007-2010: Teaching mathematics at University of Paris-Sud***: Determinants, solving linear systems (Gauss method) vector space; linear dependance or independence; basis, dimension, rank, linear map, set theory, binomial coefficient, logic, functions. **(3 × 64 hours)**.

- ***2007 2008: Lab. section for Master degree at ENS-Cachan and University of Pierre & Marie Curie, Paris 6***: Flow inside a wind-tunnel (NACA 23012); flow inside a tube using LDV (Laser Doppler Velocimetry); Blasius boundary layer flow using hot wire anemometer. **(12 hours)**.

- ***Since 2015*** I have supervised 10 UG students (20 hours each) and 14 Msc students (30 hours each) for a total of **(620 hours)**.

Other Professional Skills (Fluent in 4 languages)

French and Berber (native), English and Arabic (fluent), Spanish (notion)

Referees

Professor ***Omar K. Matar***, E-mail: o.matar@imperial.ac.uk
Professor ***Richard V. Craster***, E-mail: r.craster@imperial.ac.uk
Professor ***Panagiota Angeli***, E-mail: p.angeli@ucl.ac.uk
Professor ***Mark J. H. Simmons***, E-mail: m.j.simmons@bham.ac.uk
PhD ***Damir Juric***, E-mail: damir.juric@limsi.fr
PhD ***Laurette Tuckerman***, E-mail: laurette@pmmh.espci.fr