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Editorial: Diffusion and Convection in Nature

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Abstract. We present the Topical Issue 'Diffusion and Convection in Nature'.

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1 Introduction

Diffusion and convection are the two facets of mass transport phenomena in fluids. While diffusion stems from the thermal motion of molecules at the microscopic scale, convection involves the collective motion of particles at the macroscopic scale. Both phenomena can be observed in many natural systems, even beyond the realm of fluid dynamics. Several studies have focused, e.g. on the diffusion of languages in human communities [1], as well as viruses like in the case of the latest pandemia of Covid-19 [2]. Collective motion can be observed in the values of stocks as well as in the mouvement of flocks of birds [3] which are just a couple of examples of self-organized flow observed in systems other than fluids. In this Topical Issue we exactly aimed at attracting contributions from authors that are working in more general fields of science with the goal of sharing common knowledge on modelling tools, as well as statistically analysis of experimental data, or even numerical tools for simulating the similar behaviour of different systems.

2 Topical Issue

The EPJE Topical Issue 'Diffusion and Convection in Nature' contains a total of 7 scientific papers classified in 2 groups, namely 'diffusion' and 'convection'. The publishe d papers are presented in a scattered order in the following.

2.1 Diffusion

Diffusion is a fundamental transport process that stems from the movement of molecuIs due to thermal agitation at the microscopic scale. It is driven by the presence of a gradient in one or more thermodynamic variables and its effect can be observed at any scale from the microscopic to the macroscopic. In recent years a lot of attention has been focused on the behaviour of non-equilibrium fluctuations and their long range nature in the presence of a macroscopic gradient [4] that is the link between the random walk of molecules to the large scale behaviour of diffusion in natural systems. In this Topical Issue we host contributions in different fields where diffusion plays an important role. In the paper by Armin Afrough [5] a magnetic resonance method is applied to investigate the diffusion of liquids in geological porous materials showing that the analysis can be more complicated than usually believed. In the paper by Nathalie Bergeon, Guillaume Reinhart, Fatima L. Mota, Nathalie Mangelinck-Noël and Henri Nguyen-Thi [6] microgravity experiments are compared to ground-based ones in order to remove buoyancy forces and detect only the diffusive effects that lead the solidifaction processes of metal alloys comparing experimental results to existing theories and numerical results. In the paper by Fabio Giavazzi, Antara Pal and Roberto Cerbino [7] a method is described to investigate at the same time the rotational and translational diffusive behaviour of colloidal particles by means of a simple microscope and a modification of the well known Differential Dynamic Microscopy method [8].

2.2 Convection

Convection is the macroscopic transport mechanism that is universally spread in nature. Convection is often driven by gravity force and initiated by the amplification of non-equilibrium fluctutations as recently shown in literature [9]. In the paper by Bingchuan Nie, Yutao Shao and Feng Xu [10] the authors enquire the impact of the boundary conditions when isothermal and isoflux conditions cohexist in different parts of the section of a wall with possible applications to the study of building envelopes and their

thermal performances. In the paper by Noureddine Latrache and Innocent Mutabazi [11] the transition to turbulence is investigated in Taylor-Couette flow of a viscoelastic polymer solution by varying the rotating speed of the inner cylinder of the apparatus. A similar apparatus is utilised in the paper by Mukesh Kumar Awasthi and G. A. Hoshoudy [12] where the impact of the heat and mass transfer on the instability are investigated. Finally in the paper by H. Thameem Basha and R. Sivaraj [13] the flow of blood containing nanoparticles is investigated through a porous tube for possible medical applications.

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References

1. M. Ye, L. Zino, Ž. Mlakar, J.W. Bolderdijk, H. Risselada, B.M. Fennis and M. Cao, Collective patterns of social diffusion are shaped by individual inertia and trend-seeking, Nat. Commun. **12**, 5698 (2021) https://doi.org/10.1038/s41467-021-25953-1
2. F. Croccolo and H.E. Roman, Spreading of infections on random graphs: A percolation-type model for COVID-19, Chaos, Solitons and Fractals **139**, 110077 (2020) https://doi.org/10.1016/j.chaos.2020.110077
3. B. Afsharizand, P.H. Chaghoei, A.A. Kordbacheh, A. Trufanov and G. Jafari, Market of Stocks during Crisis Looks Like a Flock of Birds, Entropy **22**, 1038 (2020) https://doi.org/10.3390/e22091038
4. F. Croccolo, J. M. Ortiz de Zárate and J. V. Sengers, Non-local fluctuation phenomena in liquids, Eur. Phys. J. E **39**, 125 (2016) https://doi.org/10.1140/epje/i2016-16125-3
5. Armin Afrough, Magnetic resonance free induction decay in geological porous materials, Eur. Phys. J. E **44**, 107 (2021) https://doi.org/10.1140/epje/s10189-021-00110-0
6. Nathalie Bergeon, Guillaume Reinhart, Fatima L. Mota, Nathalie Mangelinck-Noël and Henri Nguyen-Thi, Analysis of gravity effects during binary alloy directional solidification by comparison of microgravity and Earth experiments with in situ observation, Eur. Phys. J. E **44**, 98 (2021) https://doi.org/10.1140/epje/s10189-021-00102-0
7. Fabio Giavazzi, Antara Pal and Roberto Cerbino, Probing roto-translational diffusion of small anisotropic colloidal particles with a bright-field microscope, Eur. Phys. J. E **44**, 61 (2021) https://doi.org/10.1140/epje/s10189-021-00063-4
8. Roberto Cerbino and Veronique Trappe, Differential Dynamic Microscopy: Probing Wave Vector Dependent Dynamics with a Microscope, Phys. Rev. Lett. **100**, 188102 (2008) https://doi.org/10.1103/PhysRevLett.100.188102
9. Fabio Giavazzi and Alberto Vailati, Scaling of the spatial power spectrum of excitations at the onset of solutal convection in a nanofluid far from equilibrium, Phys. Rev. E **80**, 015303(R) (2009) https://doi.org/10.1103/PhysRevE.80.015303
10. Bingchuan Nie, Yutao Shao and Feng Xu, An experimental study of natural convection on a vertical surface with neighboring isothermal and isoflux heating, Eur. Phys. J. E **44**, 104 (2021) https://doi.org/10.1140/epje/s10189-021-00105-x
11. Noureddine Latrache and Innocent Mutabazi, Transition to turbulence via flame patterns in viscoelastic Taylor–Couette flow, Eur. Phys. J. E **44**, 63 (2021) https://doi.org/10.1140/epje/s10189-021-00067-0
12. Mukesh Kumar Awasthi and G. A. Hoshoudy, Study of heat and mass transport on the instability of a swirling viscoelastic liquid film, Eur. Phys. J. E **44**, 36 (2021) https://doi.org/10.1140/epje/s10189-021-00048-3
13. H. Thameem Basha and R. Sivaraj, Exploring the heat transfer and entropy generation of Ag/Fe3O4-blood nanofluid flow in a porous tube: a collocation solution, Eur. Phys. J. E **44**, 31 (2021) https://doi.org/10.1140/epje/s10189-021-00024-x