

Colloquium Final Report

N. 621 – Transport and fluxes in dispersed turbulent flows

Dates and location: **30/06/2020 - 02/07/2021, Reykjavik, Iceland**

Chairperson **Luca Brandt**

Co-Chairperson **Francesco Picano, Pedro Costa**

Conference fees

What other funding was obtained? -

What were the participants offered? -

Number of members of Euromech (reduced registration fee) **0**

Number of non-members of Euromech (full registration fee) **0**

Scientific Report

The aim of the Colloquium was to present the latest advancements in the understanding of turbulent dispersed multiphase flow in the presence of moving interfaces (i.e., particles, bubbles, or droplets), and to address the current progress and future challenges in the understanding of these flows through advanced numerical and experimental techniques.

Indeed, the rapid development of high-fidelity numerical algorithms, together with the improved computational power has enabled very detailed interface-resolved simulations. These have been used not only to improve our fundamental understanding of multiphase flows, but as a starting point for the development or improvement of low-dimensional upscaled models, within so-called Euler-Euler and Euler-Lagrange frameworks. On the experiments front, there are interesting advances based on index-matched techniques, non-optical approaches to measuring multiphase flows, and other impressive multiphase turbulence optical measurement setups, some of which we had the privilege to witness in the Colloquium. The exchange of knowledge and ideas around these aspects constituted the main goal of the Colloquium which was, in our opinion, achieved with great success.

There were about 90 participants, and about 30 talks, with three keynote lectures, by Mikaël Bourgoïn, Maïke Baltussen, and Grétar Tryggvason. In addition, a final collective discussion on the perspectives in the field was organized during the last day, coordinated by Alfredo Soldati and Arezoo Ardekani. The full program, list of participants, together with the list of abstracts has been archived in [1].

PRESIDENT

Professor Marc Geers
m.g.d.geers@tue.nl

VICE PRESIDENT

Professor GertJan van Heijst
g.j.f.v.heijst@tue.nl

SECRETARY GENERAL

Professor Jacques Magnaudet
jacques.magnaudet@ifmft.fr

MANAGEMENT ADVISOR

Sara Guttilla
sara.guttilla@euromech.org

TREASURER

Stefanie Reese
euromech@ifam.rwth-aachen.de

Given the online nature of the Colloquium, it was decided to have it scheduled for two half days (days 1 and 3), and a full day (day 2). The talks were roughly grouped by topic, with some exceptions made to accommodate the different time zones.

Day 1 focused on particle-laden turbulent flows. In line with the Colloquium goals, the dominant contributions of numerical nature were balanced by a keynote lecture that used advanced experiments. Different types of carrier flows laden with a dispersed phase have been addressed, starting with the experiments of Lagrangian particle diffusion in turbulent jets during the keynote by Mikaël Bourgoïn, to wall-bounded turbulence studied with both particle-resolved and particle-modeled simulations. Two subsequent contributions considered the simulation and modeling of a dense wake flow, and the turbulence-driven particle capture in the surface of droplets. The last talks of the day considered advanced modeling approaches for gas-particle and gas-liquid flows, with heat transfer, and ended with a contribution of turbulent spray combustion in a rocket combustor.

Day 2 focused on turbulent two-fluid flows, such as droplet- and bubbly-laden flows. Despite this common theme, there was a vibrant variety of problems that were addressed, in a clear demonstration of the growth of the field. Another common theme in these contributions was the prominent use of interface-resolved simulations to describe these flows with high fidelity, in a clear reflection of the maturity of numerical methods and computing time availability. Topics like phase change, effects of surfactants, non-Newtonian suspending fluids, heat, and mass transfer (with a comprehensive contribution in the keynote by Maïke Baltussen) have been addressed here. There was only one talk of experimental nature in this day. However, their outstanding detail and depth sparked interesting discussions on both the limitations of simulations, and their usefulness to unveil certain quantities which are hard to measure.

Day 3, with some exceptions, focused on non-spherical particles and fibers, with two experimental talks. In addition, the keynote lecture of Grétar Tryggvason posed important questions about the nature of direct numerical simulations of multiphase turbulence and the fact that – contrary to the definition of DNS – they are typically not independent of the numerical method. Other outstanding issues such as three-phase flow modeling, machine learning, and interface-coarsening for large-eddy simulations of multiphase flows were also discussed.

Finally, at the end of Day 3, a plenary discussion was held. Here outstanding issues such as the portfolio of numerical approaches to tackle the same problem, the reproducibility and accessibility of resources, and the challenges in experiments were discussed. Finally, contributions of experimental nature were deemed to be crucial here, and the smaller number of contributions of this nature (only four out of 28), posed some concerns. Quoting a comment raised in the discussion, “While we can ensure that we are solving our equations right, we need experiments to make sure we are solving the right equations!”. The smaller number of experimental contributions was deemed to reflect the prevalence of the numerical studies due to easier accessibility and lower cost, and to the major challenges which still revolve around measuring multiphase turbulence.

In our view, the Colloquium was a great success. The quality of the contributions was excellent, and while the online nature of the Colloquium did not allow for the close interactions that are typical and expected in normal times, we were able to reach a much wider audience by having it held online. An important, outstanding conclusion is that the field needs more manpower focused on devising high-quality experimental campaigns, in an epoch where numerical studies seem to be

dominating the field.

[1] P. Costa, F. Picano, & L. Brandt. (2021). EUROMECH Colloquium 621 "Transport and Fluxes in Dispersed Turbulent Flows", Reykjavik, Iceland (Online Congress). <https://doi.org/10.5281/zenodo.5076018>

Please send this report in electronic form to the Secretary General of EUROMECH, within one month after your Colloquium.