# Particle-based Method for Investigation of the Physical Processes in the Complex Industrial Tasks

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## ABSTRACT

Particle-based methods are widely used in many industrial applications. The main task of this research is improved of modelling accuracy and understanding of the physical process which arises in complex industrial tasks using Euler-Lagrange approach. There were two cases under the study.

The first one was aimed to study the dynamics of self-organized turbulent structures. The assessments of their size are important from the point of view of maximizing the power generated by wind turbines in wind farm, for analysing the optimal location of wind turbines. At the same time, it is necessary to study in details the process of air's ejection, the process of displacement of two media, in which one medium, being under pressure, affects the other and carries it in the required direction. The phenomenon of ejection plays a positive role and allows restoring the velocity's deficit in the wake of the wind turbine, therefore, affecting the wind capacity of the wind farm [1]. A first qualitative insight into the entrainment process in wind farm is obtained through particle tracking, where passive particles are released into the flow for every 200th time step. The particles are advected according to the local velocity at each time step. It was defined that there was a high degree of mixing and the initial colour partitioning was broken after turbines 1–2 for both seeding positions. There were also areas, where the particles have essentially been flushed away by the turbulent fluctuations. The distribution of particles changes significantly over time as they are advected through the farm. The distribution of particles from each seeding height is counted within 'imaginary' cylindrical tubes between the turbines.

The second case is focusing on Euler-Lagrange approach application for the understanding of the physical processes occurring the water droplets injection into a supersonic jet. The water injection into the jet flow to reduce acoustic disturbances is of current interest method in the aerospace industry. The supersonic flow from the launch vehicle nozzles is a powerful source of acoustic energy, which is emitted by the turbulent layer during the jet high-speed particles and air mixing. To provide thermal protection of the noise reflector at the launch pad, and to reduce noise levels and shock-wave pressure during the space vehicle lift-off special cooling systems of the propellant jets is used. As the test case, the water injection for cooling the propellant flow from the nozzle was selected [2]. The water droplets, coming out of the special sockets, are simulated by packages (parcels) of particles of a certain mass and size according to the specified flow rate. Parcels moving in the flow, breakup at high speeds, heating and evaporation are investigated.

The simulations were run on ISPRAS UNICFD cluster. The work is supported by the Russian Foundation of Basic Research - RFBR (Grant No. 17-07-01391).

## REFERENCES

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