Meta-optimization of the particle swarm method for EOS parametrization

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The wide-range multiphase equations of state (EOS) that describe the thermodynamic properties of matter in rather detail usually have a great number of free parameters whose determination is a difficult problem. Such problems are usually solved with the heuristic optimization methods that may also have their internal parameters. Moreover, these parameters often strongly influence optimization efficiency and depend on many factors such as the particular form of the objective function, the particular implementation of the method, etc. In practice, parametric studies are often taken to determine the coefficients and those giving best results on average are chosen [1]. But such an adjustment of heuristic algorithms may require much more work and time than their implementation and still not virtually ensure their effective performance when the functional is changed. In this paper it is proposed that this shortcoming be removed through a modification of the particle swarm method (PSM) where the inertial, social, and cognitive components are adapted in the course of EOS parametrization. The adaptation is done with another stochastic algorithm, where the sought parameters are weights and the objective function is the rate of PSM convergence. The real genetic algorithm and the particle swarm method were used as meta-optimizers. The paper presents two variants of their use: for the determination of the best PSM parameters prior to EOS parametrization, and for adaptation of PSM parameters directly during the solution of the main problem.

[1] Mikhaylov V N and Elkin V M 2025 *Zababakhin Scientific Talks XVII International Conference, Snezhinsk, May 19-23*