

MULTIOBJECTIVE OPTIMIZATION OF INVERSE PROBLEMS

Cláudia Martins da Silva, Evaristo C. Biscaia Jr.
Department of Chemical Engineering, PEQ/COPPE
Federal University of Rio de Janeiro, UFRJ - Rio de Janeiro, RJ, Brazil
cmartins@peq.coppe.ufrj.br, evaristo@peq.coppe.ufrj.br

A multiobjective optimization approach has been applied to deal with inverse problems in Engineering. An improved genetic algorithm has been proposed to optimize mathematical model parameters. The parameter estimation procedure is based on the minimization of the total sum of every observed error. As opposing requirements are entailed to be satisfied simultaneously, the parameter estimation constitutes a multiobjective optimization problem. The algorithm makes use of an extended ranking procedure in order to treat multifunctional problems. A novel class of operators, consisting of a Pareto-set filter, an elitism operator and a niche operator, is introduced to enhance the algorithm performance. A new concept of fitness function based on each rank population size and rank level is provided to determine the reproduction ratio. The computational code developed operates in a continuous variable space, which is computationally fast and stable in converging to the Pareto optimal set.

In this contribution, a drying process has been analyzed. An algebraic-differential three-phase model has been adopted to describe the behavior of the system. In order to estimate the coefficients of heat and mass transfer between the solid and interstitial gas phases, minimization of the sum of the least squares of temperature and equilibrium moisture content have been conducted. The mathematical model is employed to generate the dependent variable values under the same conditions of the experiments. The minimization of every discrepancy between the measured and the predicted variables guides the search for the best-fit parameters. Experimental data obtained from a lab scale fluidized bed dryer operating in batch mode have been used to evaluate the estimated parameters. A bioorganic particulate material has been selected as the solid phase. The validated model consistently fitted the experimental data. The simulated results demonstrated the efficiency of the algorithm to perform parameter estimation, offering a consistent strategy to solve inverse problems.