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Biomimetic Adaptations of Multi-objective Evolutionary Algorithms for the Optimization of Chemical Processes

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In this work, the biogenetic law of embryology is used in the framework of elitist non-dominated sorting genetic algorithm with jumping adaptation (NSGA-II-aJG) to develop a new algorithm, namely B-NSGA-II-aJG. This provides an intelligent strategy for industrial optimization for a specific class of problems involving frequent changes in the objective functions, decision variables, bounds, constraints, etc., with the system remaining unchanged. The strategy developed is applied to the optimization of an industrial phthalic anhydride catalytic tubular reactor, and to on-line optimal control.

In another adaptation, the altruistic behavior of honey bee-colonies is bio-mimicked in the framework of NSGA-II-aJG to give another algorithm, namely, Alt-NSGA-II-aJG. Multiple queens (unlike in honeycombs) are used to enhance the convergence rates of this algorithm, mimicking other species of hymenopterans, e.g., ants, wasps, etc. This is applied for industrial optimization problems.

Further, a common social behavior of following heroes is adapted in evolutionary framework to develop the new algorithm, namely, adapted social evolution (ASE). This adaptation is applied for both continuous and discrete search space problems. Interestingly, the developed algorithm works well for problems with multiple minima, combinatorial nature and industrial applications.