СЕКЦІЯ II
ІНТЕЛЕКТУАЛЬНІ КОМП'ЮТЕРНІ СИСТЕМИ

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GUIDED HYBRID GENETIC ALGORITHM FOR SOLVING GLOBAL OPTIMIZATION PROBLEMS

The paper develops and implements a new algorithm for solving global optimization problems by combining genetic algorithm and quasi-Newton methods, which reproduces guided local search, and combines two successful modifications of the hybrid approach, the first of which BOHGA establishes a qualitative balance between local and global search, the second – HGDN – prevents re-exploration of previously explored areas of search space. In addition, a modified bump function and an adaptive scheme for determining its parameter – the radius of the "deflated" region of the objective function in the vicinity of the already found local minimum - were proposed to speed up the algorithm.

The choice of local search method for inclusion in the hybrid should be made taking into account the benefits and costs of using each of the approaches. Genetic algorithm operators also partially perform the role of local search with relatively low computational cost compared to more accurate local search methods. Therefore, the limited use of a local search operator is rational. A specific scheme is proposed in BOHGA [1], which offers to perform a local search only when the best representative of the offspring population is also the best in the current parent population.

However, in the described scheme it is still possible to re-apply local search to individuals falling into the same area of attraction of the search space, so in order to prevent unnecessary computational costs in the modification of HGDN [2] was proposed "deflated" Newton scheme, which effectively identifies several local optimums in the immediate vicinity of the starting point, and changes the function accordingly. The key to success is that the found optimums are "removed", ie "deflation" is located where the optimum was. A further Newton's search does not converge to the same point, and finds other optimum or diverge, that demonstrates the absence of optimums near an individual.

The main problem solved was to combine the above-described modifications based on the idea of a guided local search algorithm [3], which is a meta-heuristic method that builds penalties during the search and uses them to help local search algorithms to get out of the local minimum. When the local search algorithm reaches the local minimum, this algorithm modifies the objective function in a certain way and the algorithm then works with this modified objective function, which is built to get out from the local optimum. A key issue in the guided local search method is how to modify the objective function, which is well handled by the approach proposed in HGDN.

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In practice, the question arises about the choice of the value of the radius of "deflation" of the previously found optimum. If you choose too small a value of the parameter, its positive effect on the algorithm will not be noticeable. On the contrary, choosing too large a value of this parameter, we assume that the local search algorithm qualitatively investigated this region, although this relatively small area itself can be very complex, which can lead to premature convergence of the algorithm. To overcome this uncertainty in the new algorithm, it is proposed to use an adaptive scheme for selecting the value of this parameter, which response to the frequency of falling into the area of attraction of the local optimum.

Conclusions

In general, the presented algorithm can be successfully applied to solve global optimization problems with different types of complexities, such as multimodality, non-separability, nonlinearity, non-differentiability, gully trap, the high dimension of search space, high computational complexity, and more.

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