**Supplementary note 1**

*Complementary information about Nondominated Sorting Genetic Algorithm-II (NSGA-II)*

Nondominated Sorting Genetic Algorithm-II (NSGA-II) is a multi-objective optimization (MOO) method based on Genetic Algorithm (GA). The presence of MOO offers a set of optimal solutions (widely renowned as Pareto-optimal solutions), rather than a single optimal solution. Without any further information, any of these Pareto-optimal solutions cannot be better than the others ([1](#_ENREF_1)). Ordinary single objective GA turns to NSGA-II, a multi objective algorithm, through addition of two new operators including non-dominated sort and crowding distance. In single objective algorithms, since there is only one target function, criteria of superiority of results will unambiguously be defined. For instance, in case of minimizing issues, the best answer is minimum answer.

Multi objective problems are more complicated because, at least, there are two objective functions. In this case, the domination concept is defined as follow, X point dominates Y point if and only if Y point does not surpass X point in any fitness function, and X point at least exist in one fitness function. Sometimes, there are some points which are not superior rather than others. Therefore, pairwise comparison is not possible. The possible answers are obtained through ranking which determine defeat points. Eventually, the best points will be opted as the result or Pareto-optimal front. Occasionally, members of a dataset should compare with equal rank. This procedure should be carried out along with diversity conservation of answers concept, which means smoothly selection from any interval. Mathematical description of *i* point is defined as follow (Eqs. 1-3):

(1)

(2)

(3)

Whereas, showes *jth* value of *ith*fitness function, stands for maximum value and represents minimum value of *ith* fitness function. Also, displays ratio of *ith* perimeter to total area of fitness function *fi*. This quantity *di* serves as an estimate of the perimeter of the cuboid formed using the nearest neighbors as the vertices. Moreover, *D(i)* is crowding distance of *ith* point. Higher crowding distance covers greater area. Elimination of a higher crowding distance point will result in loss of diversity of solutions in a wide range of answers.

In NSGA-II, the offspring population (*Qt*) is generated using the parent population (*Pt*), and the ordinary genetic operators (crossover and mutation operators); afterwards, the two populations are merged in order to create *Rt* of size 2*N*. Then, a non-dominated sorting is applied to classify the entire population *Rt*. Once the non-dominated sorting is *c*, the new population is filled by solutions of different non-dominated fronts, one at a time. The filling starts with the best non-dominated front and continues with solutions of the second non-dominated front, tracked by the third non-dominated front, and so forth. Since the total population size of *Rt* is 2*N*, not all point are accommodated in *N* slots obtained in the new population ([2](#_ENREF_2)). For selecting new N solutions in Pt+1, first solution with rank 1 is selected, if the number of selected solutions were less than N, then solutions with rank 2 should also be added. If the number of solutions in aforementioned ranks have to be less than N, the procedure will be continued, but if the number of solutions due to rank 1 and 2 become greater than N, some solutions with rank 2 should be deleted using crowding distance. This is done to preserve the number of solutions to N size.

In MOO approaches, optimum result(s) will be obtained as a set. There are various ways to select an appropriate result. The most popular criterion is the min-max method ([3](#_ENREF_3)). In this approach, the best point of Pareto-optimal solutions will be achieved via following function (Eqa. 4):

(4)

Where, *Ω* is Pareto-optimal solutions, *m* is number(s) of objective and *zi(x)* is calculated as Eqa. 5:

(5)

In this study, In order to calculate ‘c’ and ‘σ’ coefficients, NSGA-II: A multi-objective optimization algorithm toolbox (<http://www.mathworks.com)> was employed.

**References**

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