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DE's Selection Rule for Multiobjective Optimization

Jouni Lampinen

Lappeenranta 2001

Symbols and Abbreviations

X	Individual vector, member of the current population.
U	Trial vector.
i	Index referring to an individual vector into population.
G	Generation index, current generation.
f , f_k	Objective function to be minimized.
l	The number of objective functions.
k	Index pointing to an individual objective function.
g , g_j	Constraint function
m	The number of constraint functions
j	Index pointing to an individual constraint function

DE's original selection scheme

The population for the next generation, P_{G+1}, is selected from the current population, P_G, and the child population, according to the following rule:

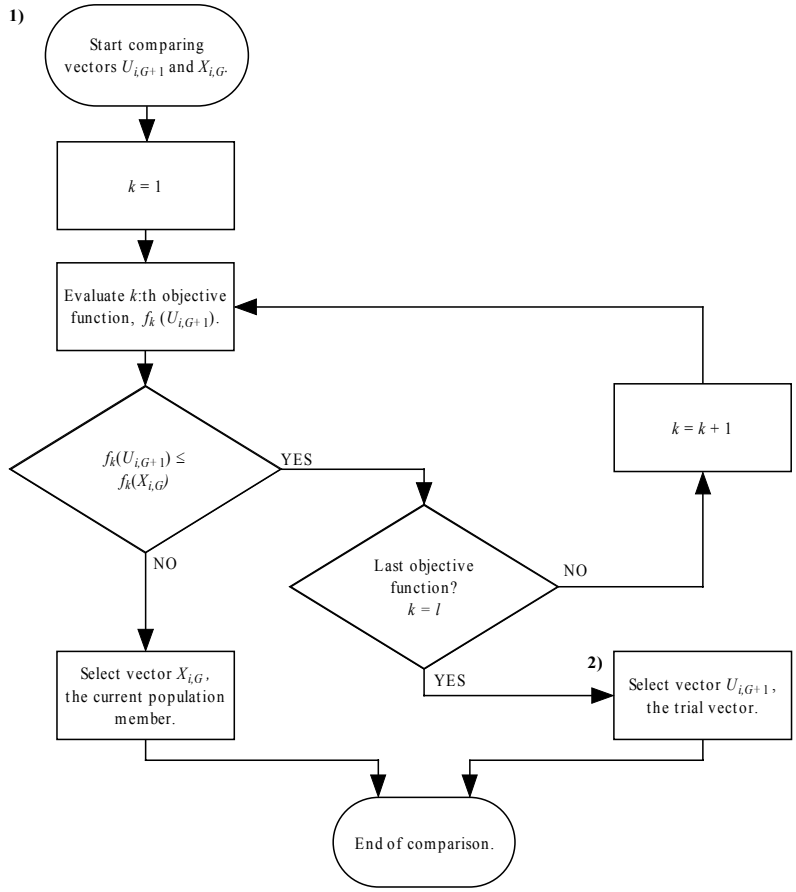
$$X_{i,G+1} = \begin{cases} U_{i,G+1} & \text{if } f(U_{i,G+1}) \le f(X_{i,G}) \\ X_{i,G} & \text{otherwise} \end{cases} .$$

Multiobjective selection scheme

Multiobjective selection scheme can be implemented on the basis of the Pareto optimization concept:

$$X_{i,G+1} = \begin{cases} U_{i,G+1} & \text{if } \forall k \in \{1,...,l\} : f_k(U_{i,G+1}) \le f_k(X_{i,G}) \\ X_{i,G} & \text{otherwise} \end{cases} ,$$

where a trial vector will be selected if it is weakly effective in comparison with the corresponding current population member.



1) Objective function values for $X_{i,G}$ are kept stored in the program variables in order to avoid unnecessary re-evaluation here.

2) Objective function values for the trial $U_{i,G+1}$ will be stored in the program variables.

The constraint functions can be handled with the following selection rule:

$$X_{i,G+1} = \begin{cases} U_{i,G+1} & \text{if } \begin{cases} \left(\left(\forall j \in \{1,...,m\} : g_j(U_{i,G+1}) \le 0 \wedge g_j(X_{i,G}) \le 0\right) \wedge \left(\forall k \in \{1,...,l\} : f_k(U_{i,G+1}) \le f_k(X_{i,G})\right)\right) \\ \vee \\ \left(\left(\forall j \in \{1,...,m\} : g_j(U_{i,G+1}) \le 0\right) \wedge \left(\exists j \in \{1,...,m\} : g_j(X_{i,G}) > 0\right)\right) \\ \vee \\ \left(\left(\exists j \in \{1,...,m\} : g_j(U_{i,G+1}) > 0\right) \wedge \left(\forall j \in \{1,...,m\} : \max\left(g_j(U_{i,G+1}), 0\right) \le \max\left(g_j(X_{i,G}), 0\right)\right)\right) \end{cases} \\ X_{i,G} & \text{otherwise} \end{cases}$$

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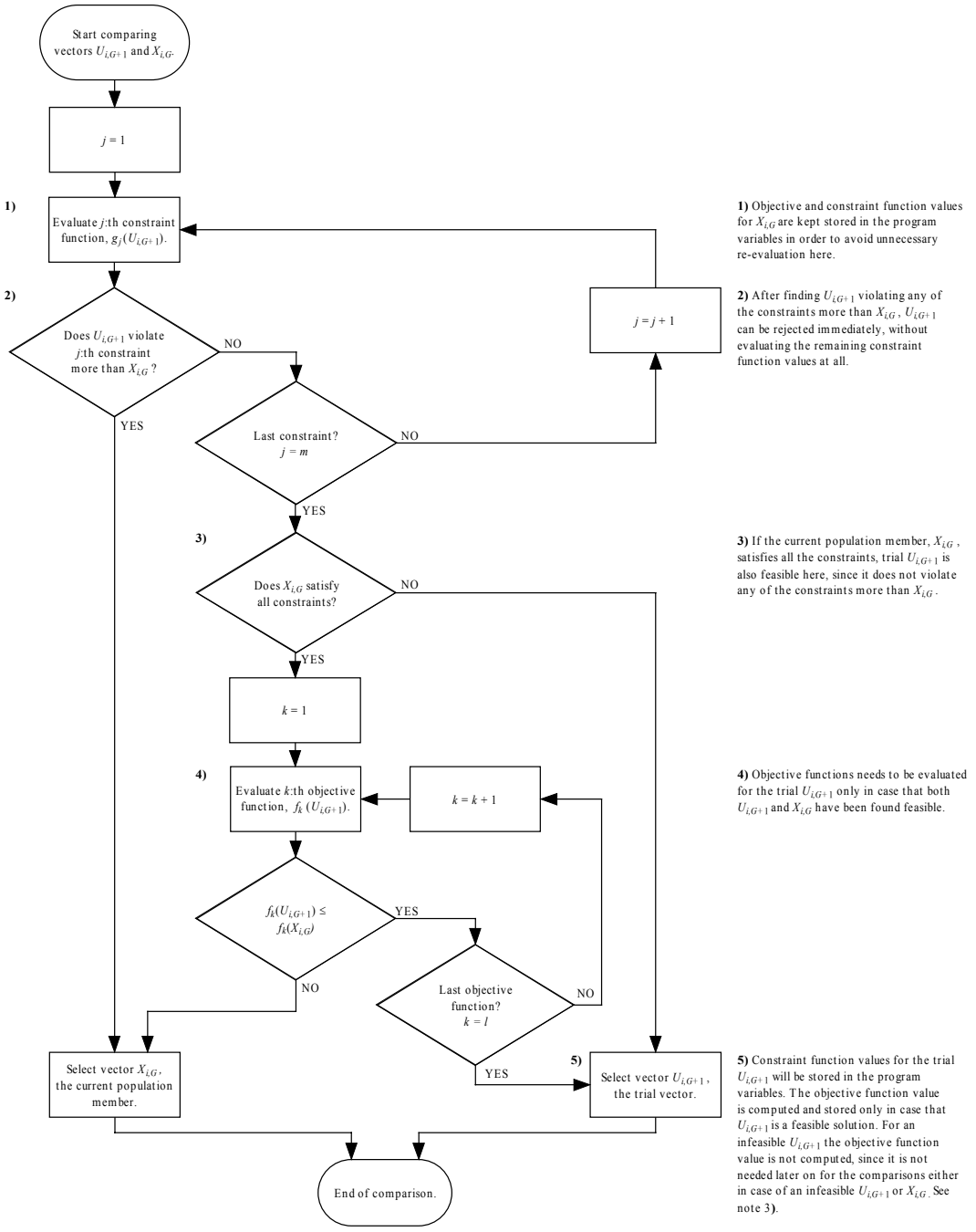

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