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<th><strong>Title</strong></th>
<th>Impacts from initialization techniques – An optimal computational resource allocation problem</th>
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Background & Purpose

• Initialization techniques are always considered as "computational-resource-free"
• Not true under computational expensive environment where single FE costs a lot
• Optimally allocate the limited computational resources becomes important

Optimal Computational Resource Allocation Problem (OCRAP):
Under given amount of computational resources \( R \), objective function of the base problem \( f \), initialization technique \( IniT \) and optimization algorithm \( OA \), to find an resource allocation scheme \( RA=IniR/(IniR+OptR) \) where \( IniR \) and \( OptR \) are the resources consumed by \( IniT \) and \( OA \) so that either the optimal solution \( (y=y^*) \) of the objective function \( (y=f(x)) \) is achieved with the least total resources \( IniR+OptR<R \) or the best suboptimal solution \( (y\neq y^*) \) is achieved when resources are used up \( (IniR+OptR=R) \).

Computational resource is defined as number of FE used under computational expensive environment. Due to the extreme long time required by FE, other calculations are negligible.

Problem Formulation:

• General version:
  \[
  \min_{IniT,OA,RA} [((IniR + OptR), |y - y^*|)] = F(RA) \\
  \text{s.t. } IniR + OptR \leq R \\
  IniR > 0 \\
  OptR > 0
  \]

• Simulation version:
  \[
  \min_{IniT,OA,RA} [((IniFE + OptFE), |y - y^*|)] = F(RA) \\
  \text{s.t. } IniFE + OptFE \leq \text{TotalFE} \\
  IniFE > 0 \\
  OptFE > 0
  \]

Simulation cases
Initialization techniques:
• Pseudo Random Number Generator (PRNG)
• Opposition-Based Learning (OBL) [1]
• Quasi-Opposition-Based Learning (QOBL) [2]
• Quadratic Interpolation (QI) [3]

Optimization algorithms:
• Differential Evolution (DE) [4]
• Chemical Reaction Optimization (CRO) [5]

Benchmark functions:
• CEC14 computational expensive problem set

Simulation results

• Notations & settings:
  • M1: without considering \( IniR \)
  • M2: \( IniR \) considered
  • \( M3 = \frac{r_{init}}{r_{rand}} \), the ratio between results from using \( IniT \) and using PRNG.
  M3<1 means \( IniT \) better
  M3>1 means PRNG better
  • \( D=10,30 & 100; \text{MaxFE}(R)=50*D; \text{No. of run}=50 \)
  • Comparison between \( IniR \) considered and not considered:

Some curves
• Using QI with DE to test different RA ratios
• Comparing QI, OBL under different RA

Conclusion
• Formulate and solve the optimal computational resource allocation problem
• Define the computational resource under the expensive environment
• Conduct simulations analyze performances from different initialization techniques

Reference