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

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

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

Metrics:
• Without \(IniR\) considered (traditional way)
• Considering \(IniR\)
• Solve the OCRAP

Simulation results
• Notations & settings:
  • M1: without considering \(IniR\)
  • M2: \(IniR\) considered
  • \(M3 = r_{init}/r_{rand}\), 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