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Parallel Evolutionary Multi-Objective Optimization on Large, Heterogeneous Clusters: An Applications Perspective

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Real-world operational use of parallel multi-objective evolutionary algorithms requires successful searches in constrained wall-clock periods, limited trial-and-error algorithmic analysis, and scalable use of heterogeneous computing hardware. This study provides a cross-disciplinary collaborative effort to assess and adapt parallel multi-objective evolutionary algorithms for operational use in satellite constellation design using large dedicated clusters with heterogeneous processor speeds/architectures. A statistical, metric-based evaluation framework is used to demonstrate how time-continuation, asynchronous evolution, dynamic population sizing, and epsilon dominance archiving can be used to enhance both simple master–slave parallelization strategies and more complex multiple-population schemes. Results for a benchmark constellation design coverage problem show that simple master–slave schemes that exploit time-continuation are often sufficient and potentially superior to complex multiple-population schemes.

Nomenclature

A	epsilon dominance archive
a	semimajor axis
e	eccentricity
$\boldsymbol{f}$	objective function vector
I	inclination
k	objective functions index
M	mean anomaly
m	inequality constraints
N	population size
P^*	Pareto optimal set
PF^*	Pareto front

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