

Purpose	Dataset / Problems	Variable(s) Tested	Fixed Settings	Candidate budget details (per BO batch)	Notes
Compare hybrid EGBO variants using different evolutionary generators	10 benchmark problems (ZDT1–4, DTLZ1, DTLZ3, DTLZ2-5obj, MW3, MW5, MW7)	Evolutionary algorithm (U-NSGA-III, SMS-EMOA, AGE-MOEA-II) vs qLogNEHVI baseline	18 initial samples; batch size = 8; 12 batches; 10 repeats; shared seeds; GP surrogate (Matérn 5/2); qLogNEHVI acquisition; EA pool = 256	qLogNEHVI: 8 candidates; single EA generator: 64 candidates; merged pool: 72; selected/evaluated: 8	Core benchmarking experiment
Assess whether combining multiple evolutionary generators improves performance	Subset of 8 benchmark problems	Generator combinations (U-NSGA-III + SMS-EMOA, AGE-MOEA-II + U-NSGA-III, all three)	Same as Study 1; equal total EA sample contribution per batch	2-generator hybrid: (8 + 64 + 64 = 136) pool; 3-generator hybrid: (8 + 64 + 64 + 64 = 200) pool; selected/evaluated: 8	Tests diminishing returns of added complexity
Evaluate sensitivity of methods to experimental noise	ZDT2, ZDT3, DTLZ2 (5 obj), MW5	Gaussian noise level (0%, 1%, 5%, 10%, 20%)	Same as Study 1; EGBO (U-NSGA-III) vs qLogNEHVI	EGBO: 72-pool (8 BO + 64 EA) then select 8; baseline qLogNEHVI: 8 then select 8	Noise scaled relative to objective range
Assess feasibility discovery and scalability	MW3, MW5, MW7; MW5 with a range of constraint tightness	Constraint difficulty; feature dimensionality	Same as Study 1; EGBO (U-NSGA-III) vs qLogNEHVI	EGBO candidate budget as above; qLogNEHVI baseline uses BO-only candidate set	MW5 constraint boundaries modified; dimensionality increased artificially
Assess feasibility discovery and scalability	MW5 high-dimensional variants (50D, 100D)	Constraint difficulty; feature dimensionality	Same as Study 1; EGBO (U-NSGA-III) vs qLogNEHVI	EGBO candidate budget as above; qLogNEHVI baseline uses BO-only candidate set	MW5 constraint boundaries modified; dimensionality increased artificially
Evaluate performance on experimental datasets	Suzuki; SDL5; ADA coatings; GDSC CRC5	Optimisation strategy (qLogNEHVI, EGBO, Novelty Aware EGBO)	18 initial samples; batch size = 4; 12 batches; 10 repeats; shared seeds; post-hoc selection without replacement	qLogNEHVI: 8 candidates; single EA generator: 64 candidates; merged pool: 72; selected/evaluated: 8	Post-hoc analysis on existing experimental data

Table S1: Details of simulations performed including variables tested and settings fixed.