Comparing Decomposition-based and Automatically Component-Wise Designed Multi-objective Evolutionary Algorithms

Supplementary Material

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle

IRIDIA, CoDE, Universit Libre de Bruxelles, Brussels, Belgium
{lteonaci,manuel.lopez-ibanez,stuetzle}@ulb.ac.be **

Abstract. A main focus of current research on evolutionary multi-objective optimization (EMO) is the study of the effectiveness of EMO algorithms for problems with many objectives. Among the several techniques that have led to the development of more effective algorithms, decomposition and component-wise design have presented particularly good results. But how do they compare? In this work, we conduct a systematic analysis that compares algorithms produced using the MOEA/D decomposition-based framework and the AutoMOEA component-wise design framework. In particular, we identify a version of MOEA/D that outperforms the best known MOEA/D algorithm for several scenarios and confirms the effectiveness of decomposition on problems with three objectives. However, when we consider problems with five objectives, we show that MOEA/D is unable to outperform SMS-EMOA, being often outperformed by it. Conversely, automatically designed AutoMOEAs display competitive performance on three-objective problems, and the best and most robust performance among all algorithms considered for problems with five objectives.

Table 1: Numerical parameters selected by irace for the different MOEA/D algorithms.

								DRA strategy			
MOEA/D	$N_{\text{divisions}}$	ρ	p_c	η_c	*bitwise*	p_v	η_v	δ	ϕ	t_{size}	ν
3-obj DTLZ	30	0.97	—	38	T	—	3	—	—	—	—
5-obj DTLZ	10	0.98	—	42	T	—	3	—	—	—	—
3-obj WFG	29	0.13	—	49	F	0.10	5	—	—	—	—
5-obj WFG	10	0.64	—	48	F	0.10	7	—	—	—	—

								DRA strategy			
MOEA/D$_{\text{DRA-SBX}}$	μ	ρ	p_c	η_c	*bitwise*	p_v	η_v	δ	ϕ	t_{size}	ν
3-obj DTLZ	500	0.93	1.00	50	T	—	4	0.64	0.90	8	6
5-obj DTLZ	500	0.97	0.86	46	T	—	2	0.44	0.44	19	5
3-obj WFG	100	0.32	0.44	38	F	0.08	10	0.44	0.58	12	10
5-obj WFG	500	0.45	0.89	50	F	0.09	8	0.81	0.65	13	6

								DRA strategy			
MOEA/D$_{\text{DRA-DE}}$	$N_{\text{divisions}}$	ρ	CR	F	*bitwise*	p_v	η_v	δ	ϕ	t_{size}	ν
3-obj DTLZ	500	0.22	0.12	1.00	T	—	40	0.00	0.79	9	3
5-obj DTLZ	500	0.92	0.21	1.00	T	—	13	0.32	0.35	16	5
3-obj WFG	200	0.38	0.16	0.98	T	—	42	0.10	0.44	18	10
5-obj WFG	500	0.63	0.15	0.99	T	—	48	0.81	0.31	6	10

** Available at https://iridia.ulb.ac.be/supp/IridiaSupp2015-002/

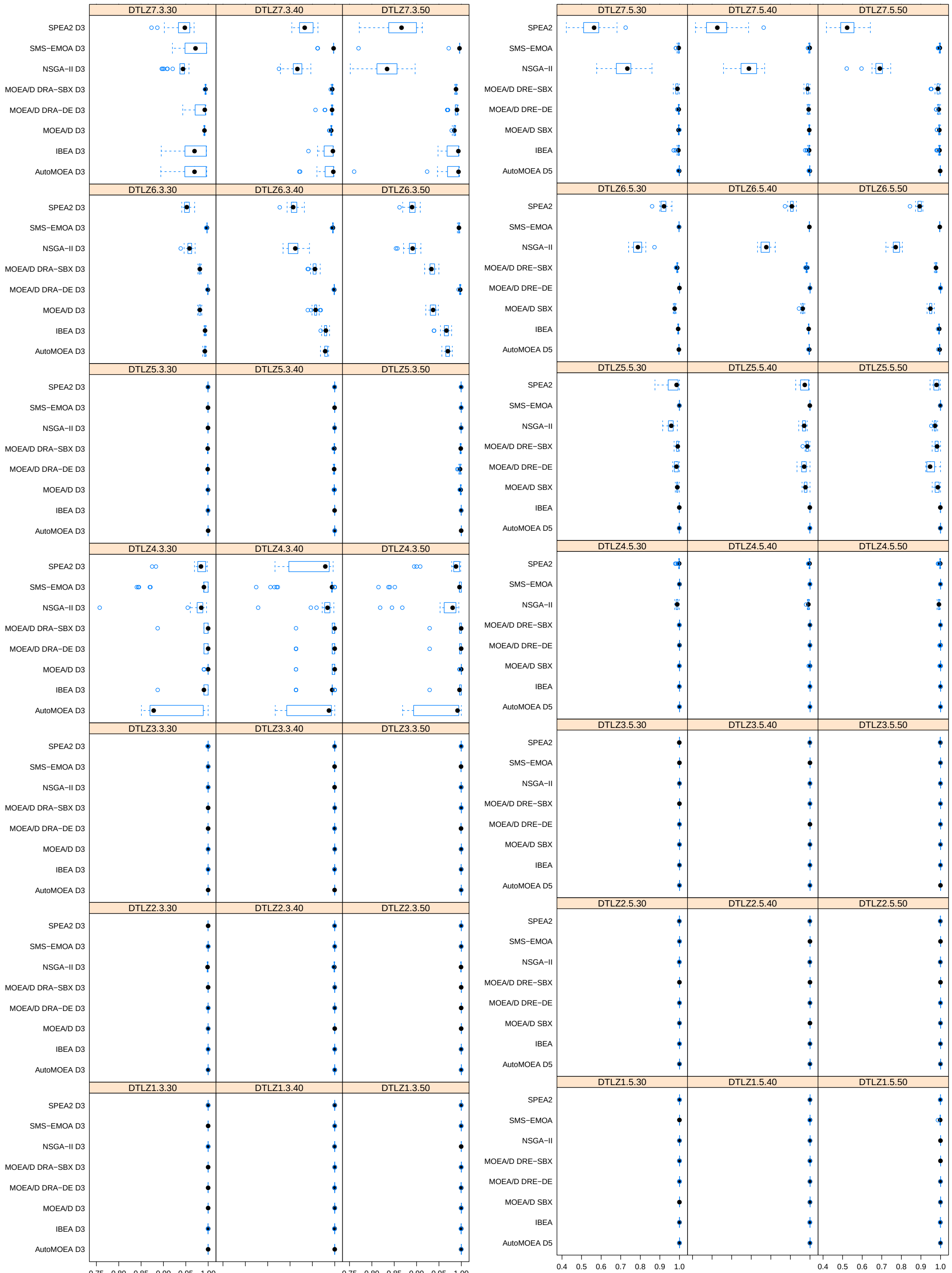

Fig. 1: Boxplots of the relative hypervolume for 3-objective (left) and 5-objective (right) DTLZ problems with $\{30, 40, 50\}$ variables.

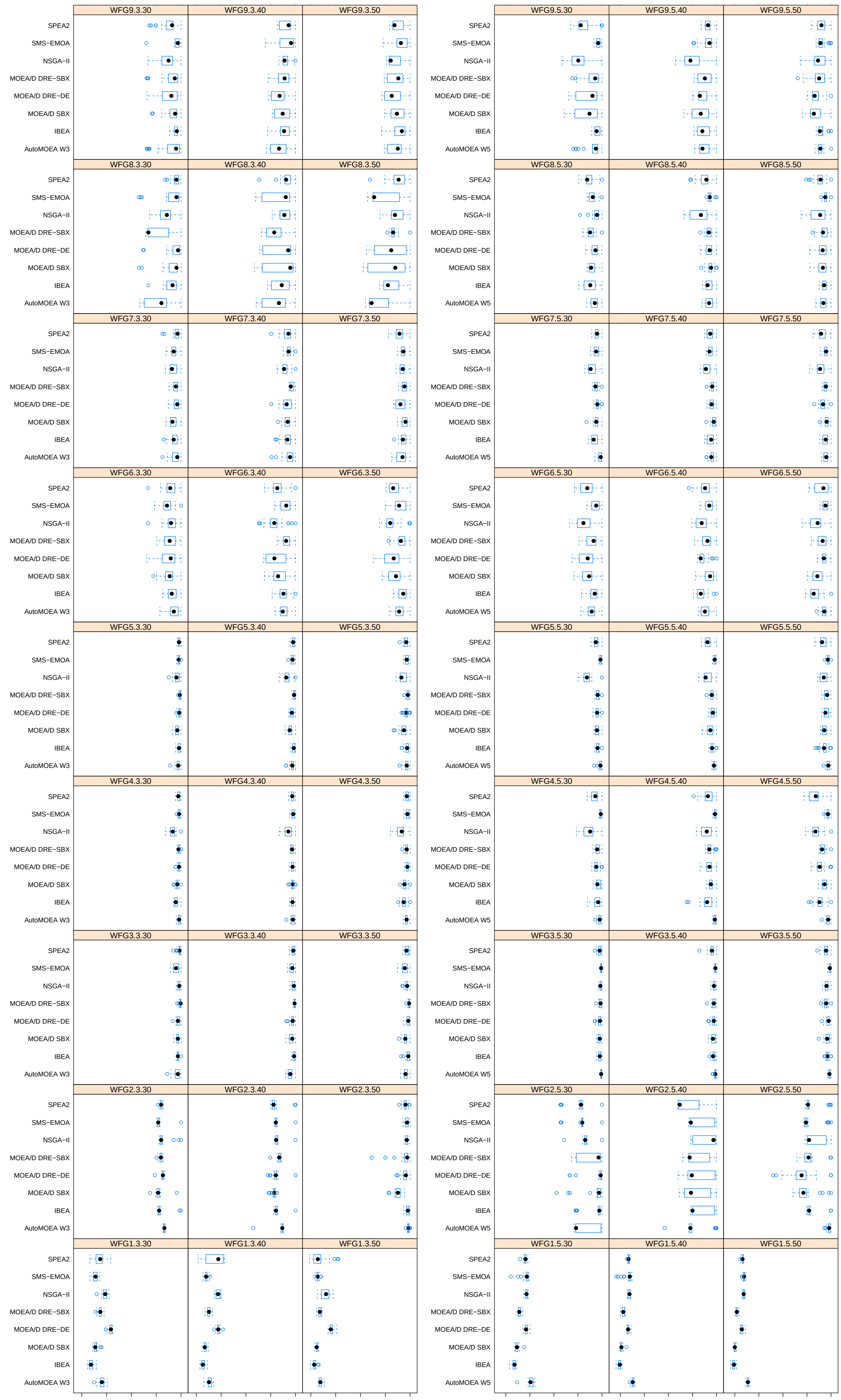

Fig. 2: Boxplots of the relative hypervolume for 3-objective (left) and 5-objective (right) WFG problems with $\{30, 40, 50\}$ variables.

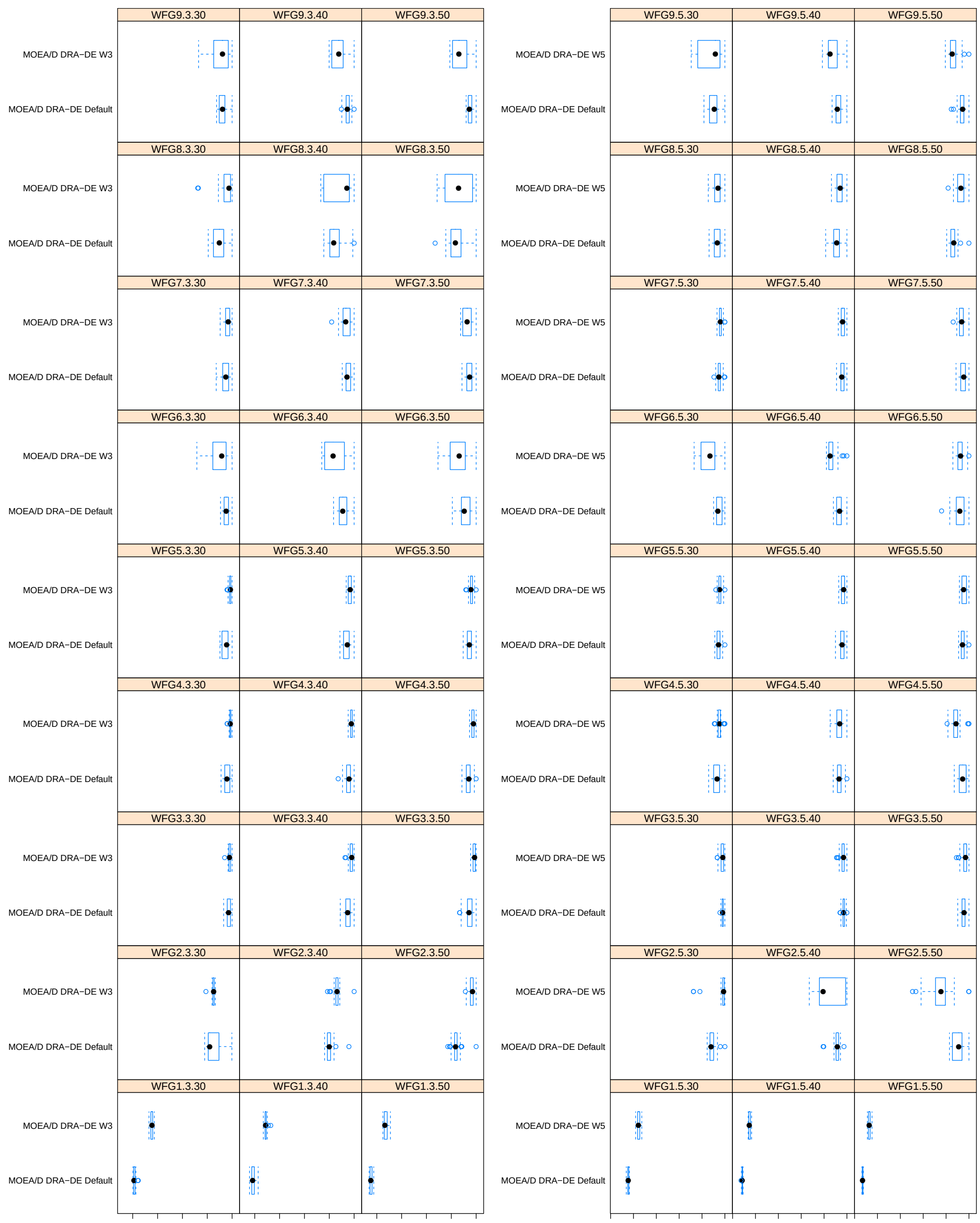

Fig. 3: Boxplots of the relative hypervolume contrasting the original and the tuned parameter settings used by MOEA/$D_{\text{DRA-DE}}$ for 3-objective (left) and 5-objective (right) WFG problems with $\{30, 40, 50\}$ variables.