

TABLE I
CLASSICAL SYMBOLIC REGRESSION BENCHMARKS(SRB).

FileNumber	FileName	Objective Function	Data Set
F1	Keijzer-5	$\log(x)$	U[0,2,20]
F2	Nguyen-8	\sqrt{x}	U[0,2,20]
F3	Korns-1	$1.57 + 24.3x$	U[-1,1,20]
F4	Korns-6	$6.87 + 11\cos(7.23x^3)$	U[-0.5,0.5,20]
F5	Nguyen-4	$x^6 + x^5 + x^4 + x^3 + x^2 + x$	U[-1,1,20]
F6	Nguyen-3	$x^5 + x^4 + x^3 + x^2 + x$	U[-1,1,20]
F7	Koza-1,Nguyen-2	$x^4 + x^3 + x^2 + x$	U[-1,1,20]
F8	Nguyen-1	$x^3 + x^2 + x$	U[-1,1,20]
F9	Koza-3	$x^6 - 2x^4 + x^2$	U[-1,1,20]
F10	Koza-2	$x^5 - 2x^3 + x$	U[-1,1,20]
F11	Nguyen-5	$\cos(x)\sin(x^2) - 1$	U[-1.6,1.6,20]
F12	Nguyen-6	$\sin(x) + \sin(x + x^2)$	U[-1,1,20]
F13	Nguyen-11	x^y	U[2,4,400]
F14	Keijzer-11	$xy + \sin((x - 1)(y - 1))$	U[-1,1,400]
F15	Nguyen-12	$x^4 - x^3 + y^2/2 - y$	U[-1,1,400]
F16	Keijzer-13	$6\sin(x)\cos(y)$	U[-1,1,400]
F17	Keijzer-15	$x^3/5 + y^3/2 - y - x$	U[-1,1,400]
F18	Nguyen-9	$\sin(x) + \sin(y^2)$	U[-1,1,400]
F19	Nguyen-10	$2\sin(x)\cos(y)$	U[-1,1,400]
F20	Vladislavleva-1	$\exp(-(x - 1)^2/(1.2 + (y - 2.5)^2))$	U[-1,1,400]
F21	Keijzer-3	$30xz/((x - 10)y^y)$	x,z:[-1,1,1000] y:U[1,3,1000]
F22	Korns-2	$0.23 + 14.2(x + y)/(3z)$	x,y:U[-1,1,1000] z:U[1,3,1000]
F23	Vladislavleva-5	$30((x - 1)(z - 1))/(y^2(x - 10))$	U[0,2,1000]

TABLE II
PENN MACHINE LEARNING BENCHMARKS(PMLB).

FileNumber	FileName	Samples	Variables	Task
F72	210_cloud	108	5	regression
F73	519_vinnie	380	2	regression
F74	573_cpu_act	1000	21	regression
F75	1027_ESL	488	4	regression
F76	1028_SWD	1000	10	regression
F77	1029_LEV	1000	4	regression
F78	analcatdata_boxing1	120	3	classification
F79	car-evaluation	1000	21	classification
F80	wine_quality_white	1000	11	classification
F81	towerData	1000	25	regression

TABLE III
FEYNMAN SYMBOLIC REGRESSION BENCHMARKS(FSRB).

FileNumber	FileName	Objective Function	Data Set
F24	I.6.2a	f	$\exp(-\theta^2/2)/\sqrt{2\pi}$ U[1,3,20]
F25	I.6.2	f	$\exp(-(\theta/\sigma)^2/2)/(\sqrt{2\pi}\sigma)$ U[1,3,400]
F26	I.12.1	F	muN_n U[2,4,400]
F27	I.12.5	F	q_2Ef U[2,4,400]
F28	I.14.4	U	$1/2k_{spring}x^2$ U[2,4,400]
F29	I.25.13	$Volt$	q/C U[2,4,400]
F30	I.26.2	θ_1	$\arcsin(ns \sin(\theta_2))$ $n:U[0,1,400]$ $\theta_2:U[2,4,400]$
F31	I.29.4	k	ω/c U[2,4,400]
F32	I.34.27	E_n	$(h/(2\pi))\omega$ U[2,4,400]
F33	I.39.1	E_n	$3/2prV$ U[2,4,400]
F34	II.3.24	$flux$	$Pwr/(4\pi r^2)$ U[2,4,400]
F35	II.8.31	E_{den}	$\epsilon Ef^2/2$ U[2,4,400]
F36	II.11.28	θ	$1+n\alpha/(1-(n\alpha/3))$ U[0,1,400]
F37	II.27.18	E_{den}	ϵEf^2 U[2,4,400]
F38	II.38.14	mus	$Y/(2(1+\sigma))$ U[2,4,400]
F39	III.12.43	L	$n(h/(2\pi))$ U[2,4,400]
F40	II.37.1	E_n	$mom(1+chi)B$ U[2,4,1000]
F41	I.18.12	tau	$rF \sin(\theta)$ U[2,4,1000]
F42	I.6.2b	f	$\exp(-((\theta-\theta_1)/\sigma)^2/2)/(\sqrt{2\pi}\sigma)$ U[1,3,1000]
F43	I.10.7	m	$m_0/\sqrt{1-v^2/c^2}$ $m_0, c:U[3,5,1000]$ $v:U[1,2,1000]$
F44	I.12.4	Ef	$q_1r/(4\pi\epsilon r^3)$ U[2,4,1000]
F45	I.14.3	U	mgz U[2,4,1000]
F46	I.15.1	p	$m_0v/\sqrt{1-v^2/c^2}$ $m_0, c:U[3,5,1000]$ $v:U[1,2,1000]$
F47	I.16.6	v_1	$(u+v)/(1+uv/c^2)$ U[2,4,1000]
F48	I.27.6	foc	$1/(d_1+n/d_2)$ U[2,4,1000]
F49	I.30.3	Int	$\text{Int}_0 \sin(n\theta/2)^2/\sin(\theta/2)^2$ U[2,4,1000]
F50	I.30.5	θ	$\arcsin(\lambda/(nd))$ $\lambda :U[1,2,1000]$ $d, n:U[2,4,1000]$
F51	I.34.1	ω	$\omega_0/(1-v/c)$ $c, \omega_0 :U[3,5,1000]$ $v:U[1,2,1000]$
F52	I.34.14	ω	$(1+v/c)/\sqrt{1-v^2/c^2}\omega_0$ $c, \omega_0 :U[3,5,1000]$ $v:U[1,2,1000]$
F53	I.37.4	Int	$I_1 + I_2 + 2\sqrt{I_1 I_2} \cos(\delta)$ U[2,4,1000]
F54	I.39.11	E_n	$1/(\gamma-1)prV$ U[2,4,1000]
F55	I.43.31	D	$mob_k b_T$ U[2,4,1000]
F56	I.47.23	c	$\sqrt{\gamma pr/\rho}$ U[2,4,1000]
F57	II.4.23	$Volt$	$q/(4\pi\epsilon r)$ U[2,4,1000]
F58	II.8.7	E_n	$3/5q^2/(4\pi\epsilon d)$ U[2,4,1000]
F59	II.10.9	Ef	$\sigma_{den}/\epsilon/(1+chi)$ U[2,4,1000]
F60	II.13.23	rho_c	$\rho_{co}/\sqrt{1-v^2/c^2}$ $\rho_{co}, c:U[3,5,1000]$ $v:U[1,2,1000]$
F61	II.13.34	j	$\rho_{co} v/\sqrt{1-v^2/c^2}$ $\rho_{co}, c:U[3,5,1000]$ $v:U[1,2,1000]$
F62	II.27.16	$flux$	ϵEf^2 U[2,4,1000]
F63	II.34.2a	I	$qv/(2\pi r)$ U[2,4,1000]
F64	II.34.2	mom	$qvr/2$ U[2,4,1000]
F65	II.34.29a	mom	$qh/(4\pi m)$ U[2,4,1000]
F66	III.7.38	ω	$2momB/(h/(2\pi))$ U[2,4,1000]
F67	III.8.54	$prob$	$\sin(E_n t/(h/(2\pi)))^2$ U[1,2,1000]
F68	III.15.12	E_n	$2U(1-\cos(kd))$ U[2,4,1000]
F69	II.15.4	E_n	$-momB \cos(\theta)$ U[2,4,1000]
F70	II.15.5	E_n	$-pdEf \cos(\theta)$ U[2,4,1000]
F71	I.18.14	L	$mrvsin(\theta)$ U[2,4,4000]

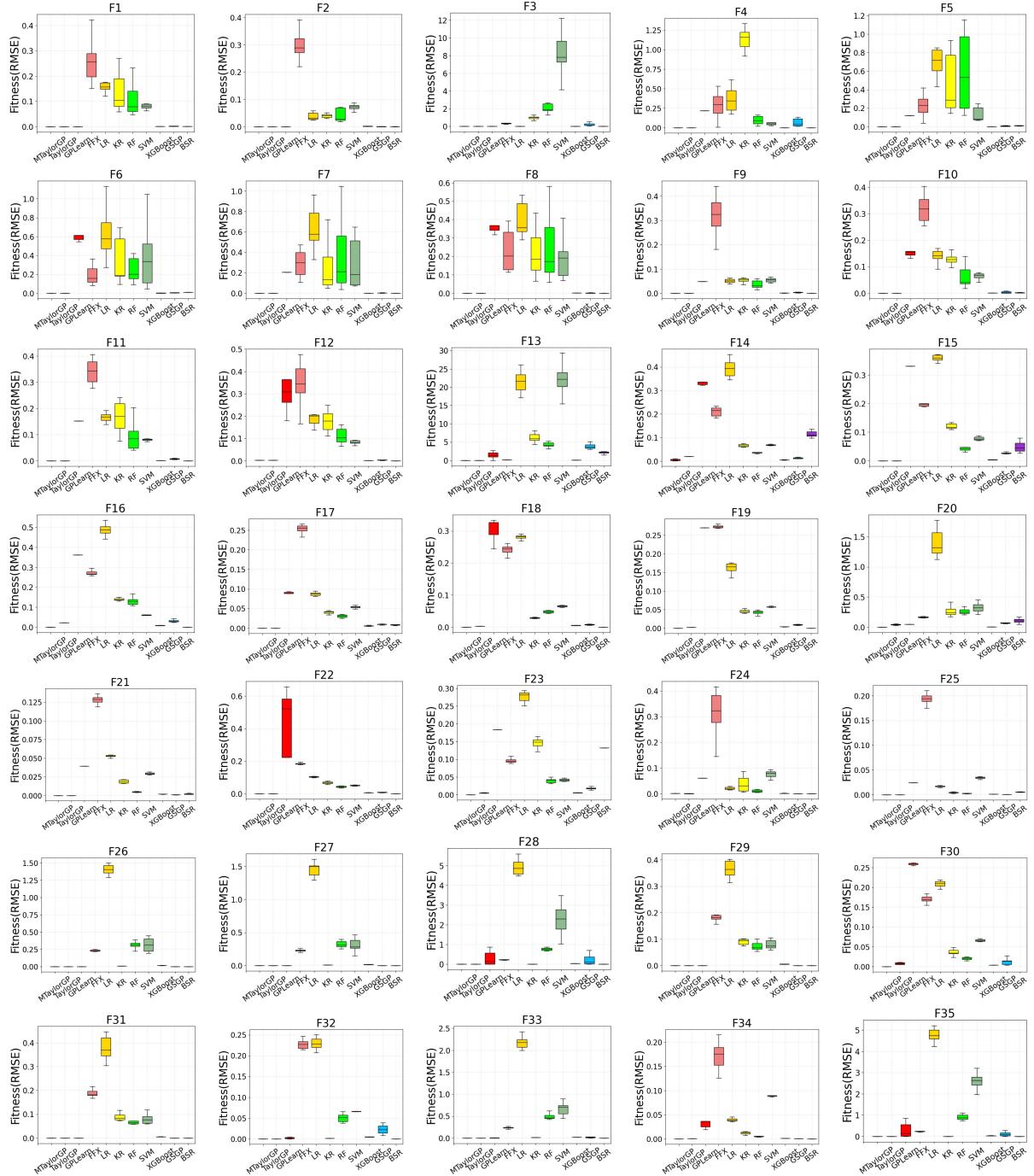


Fig. 1. Fitness comparison. The RMSE results on the benchmarks F1-F35.

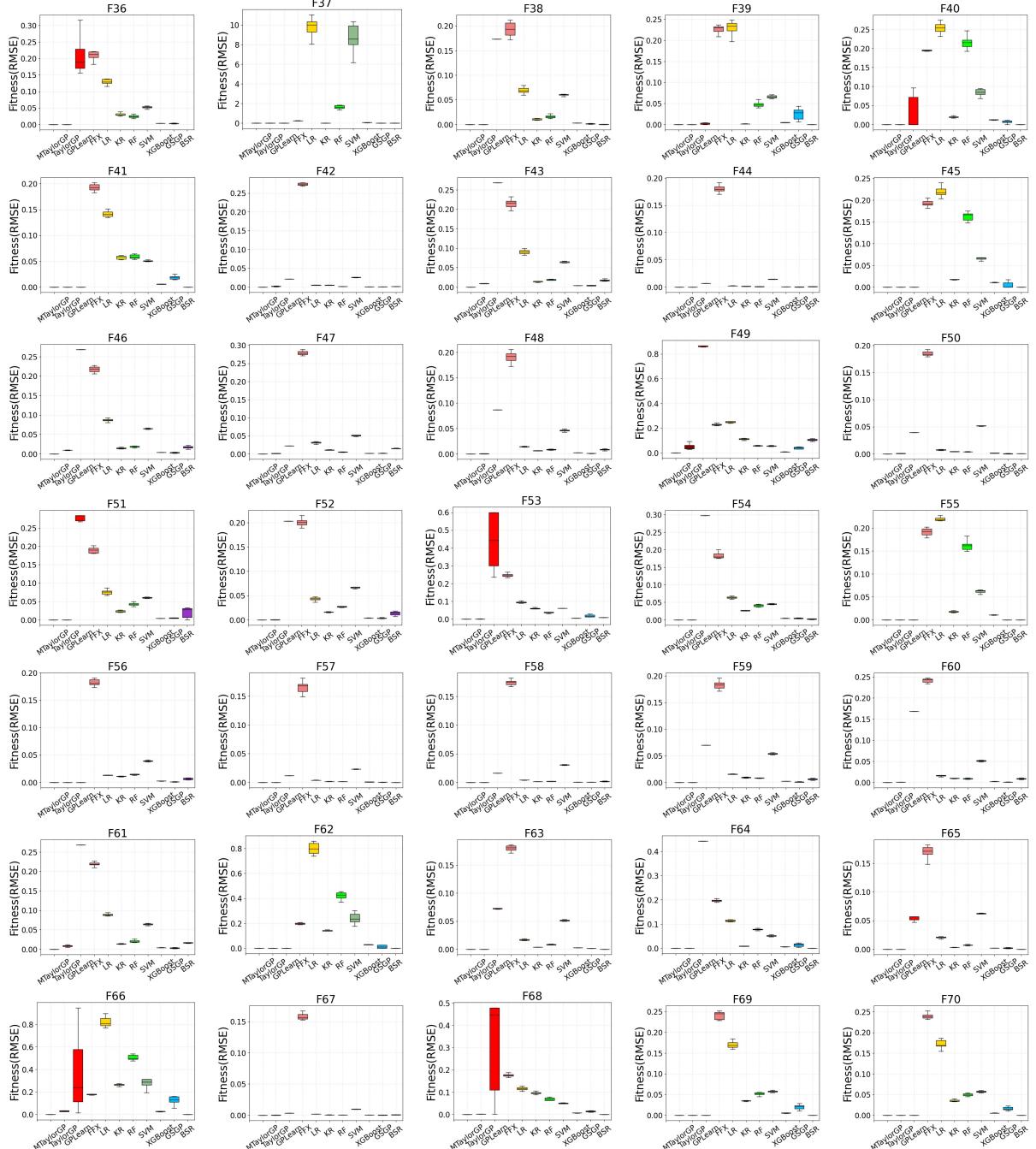


Fig. 2. Fitness comparison. The RMSE results on the benchmarks F36-F70.

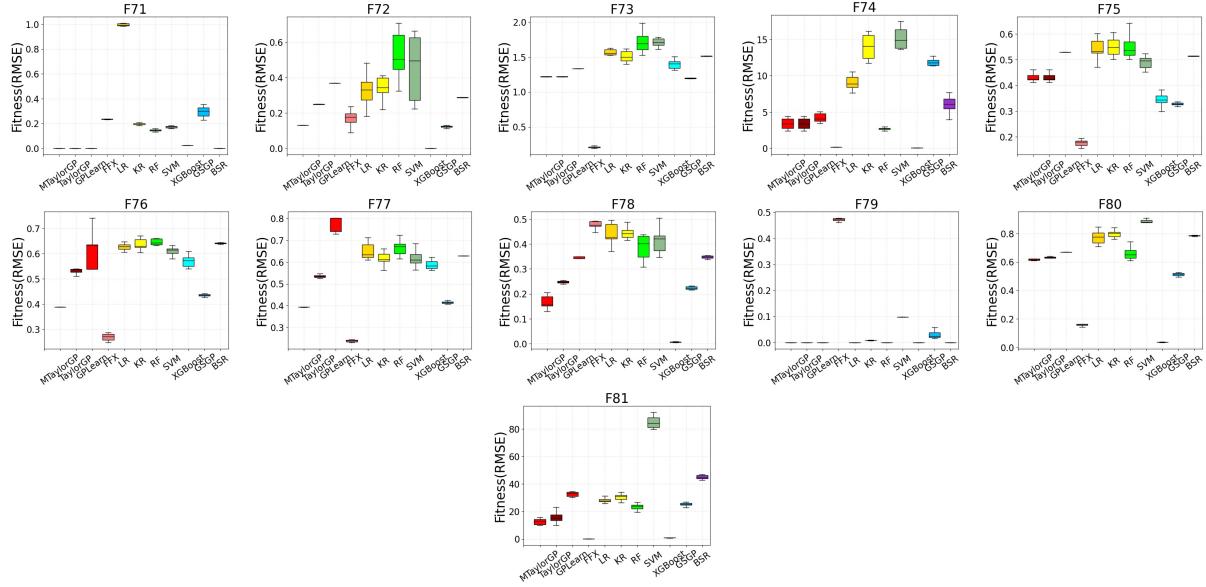


Fig. 3. Fitness comparison. The RMSE results on the benchmarks F71-F81.

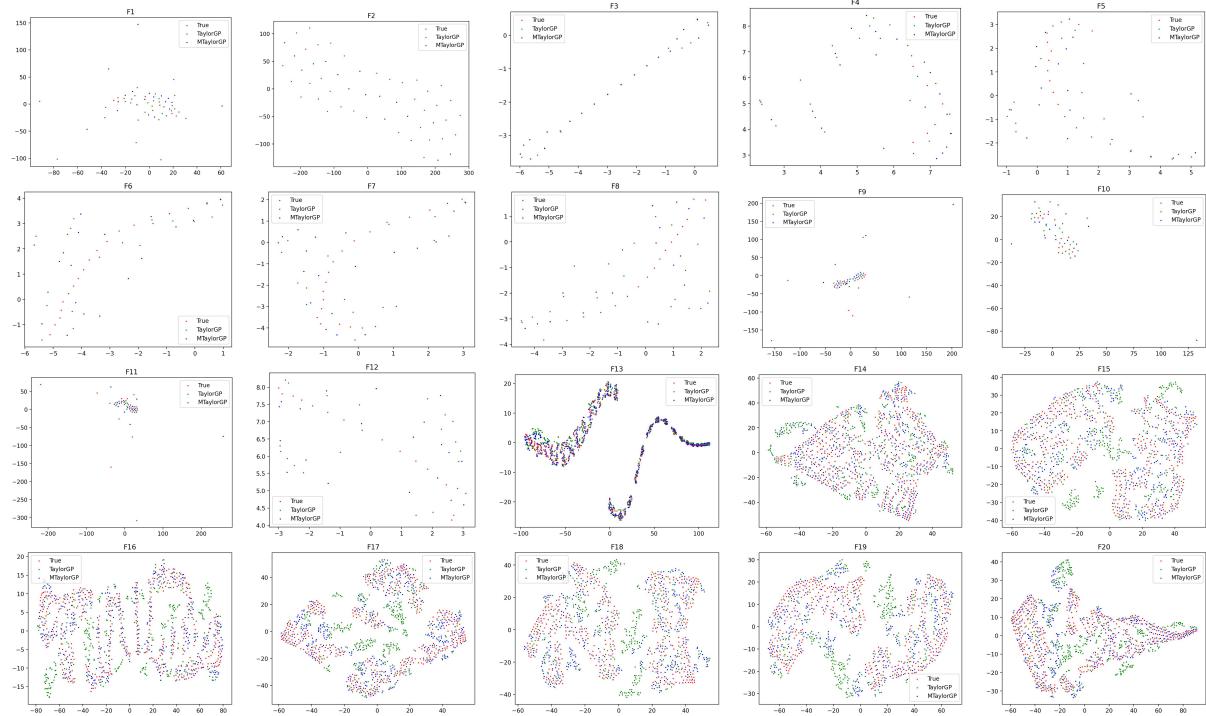


Fig. 4. t-SNE comparison. The comparison of visual effects of dimension reduction on the benchmarks F1-F20.

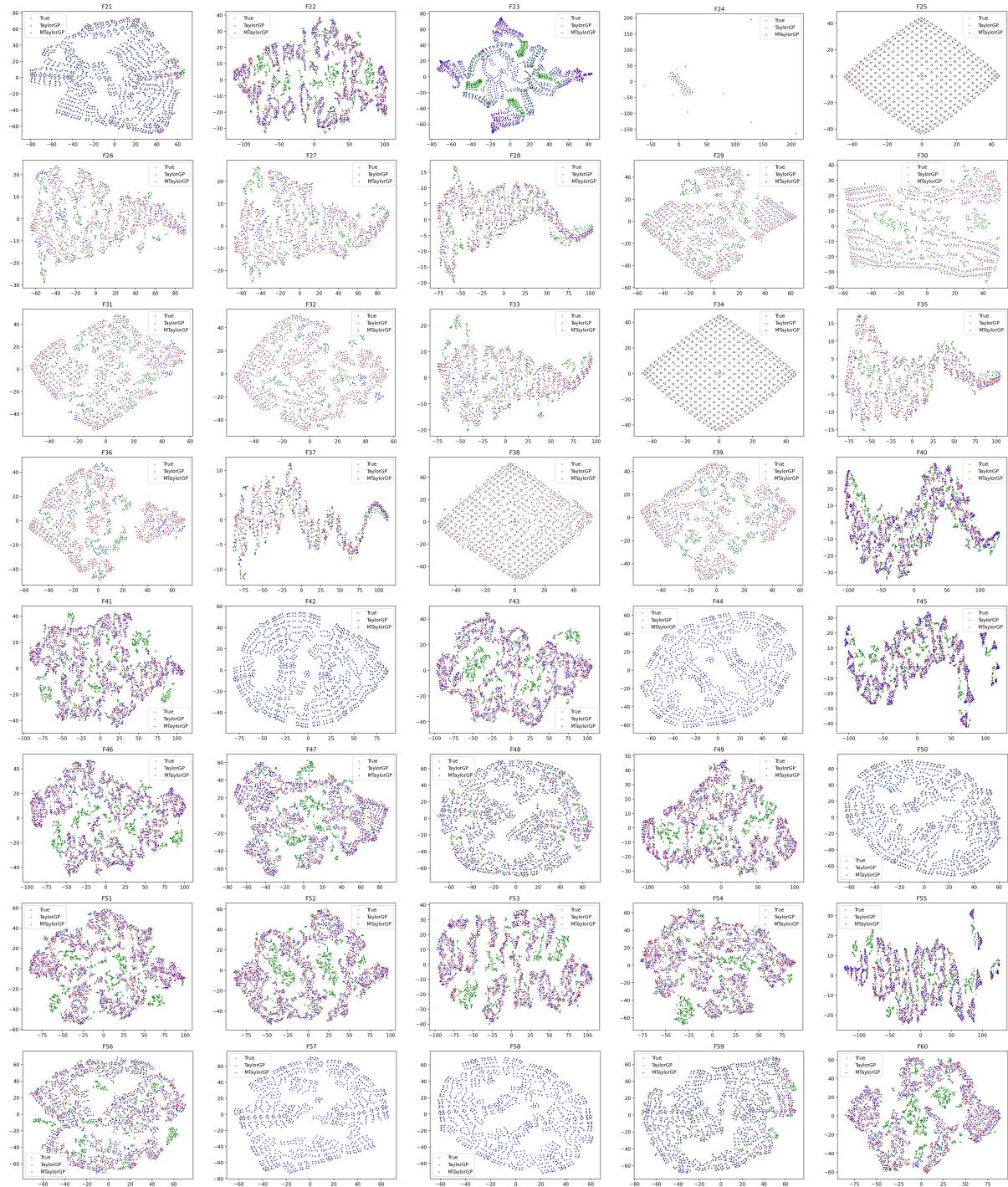


Fig. 5. t-SNE comparison. The comparison of visual effects of dimension reduction on the benchmarks F21-F60.

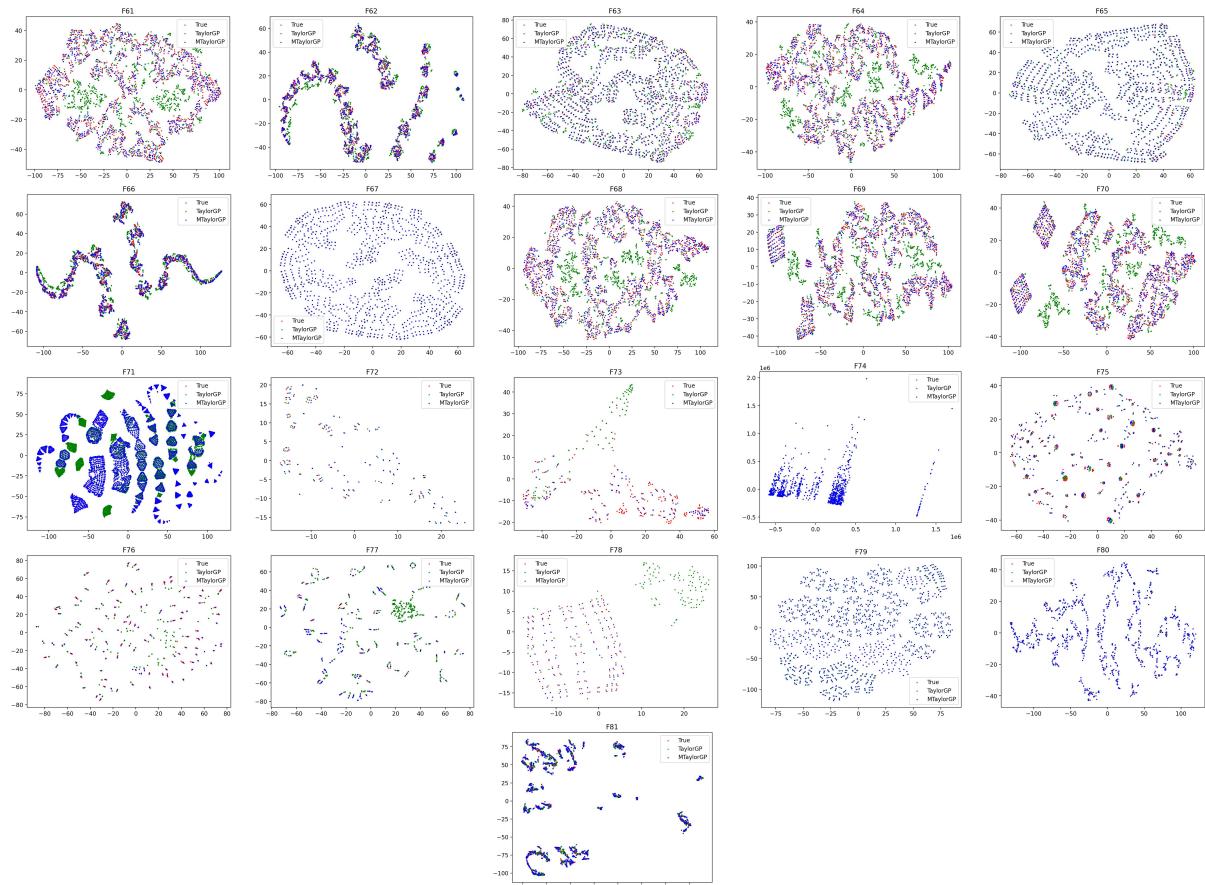


Fig. 6. t-SNE comparison. The comparison of visual effects of dimension reduction on the benchmarks F61-F81.