Table 54: Results of experimen

Cluster eval.	# clusters	Optim. a
Silhouette	2	PSO GAPSO LOGAPS

Table 56: Results of experimen

Cluster eval.	# clusters	Optim. a
Silhouette	4	PSO GAPSO LOGAPS

Table 58: Results of experimen

Cluster eval.	# clusters	Optim. a
Silhouette	4	PSO GAPSO LOGAPS

Table 60: Results of experimen

Cluster eval.	# clusters	Optim. a
Silhouette	6	PSO GAPSO LOGAPS

Table 62: Results of experimen

Cluster eval.	# clusters	Optim. a
Xie Beni	2	PSO GAPSO LOGAPS

Table 64: Results of experimen

Cluster eval.	# clusters	Optim. a
Xie Beni	2	PSO GAPSO LOGAPS

Table 66: Results of experimen

Cluster eval.	# clusters	Optim. a
Xie Beni	4	PSO GAPSO LOGAPS

Table 68: Results of experimen

Cluster eval.	# clusters	Optim. a
Xie Beni	6	PSO GAPSO LOGAPS

Table 70: Results of experimen

Cluster eval.	# clusters	Optim. a
Xie Beni	6	PSO GAPSO LOGAPS

Table 1: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	50	PSO	1.523837	0.341445	100	1.49618	1.4
		GAPSO	2.485251	0.442263			
		LOGAPSO	0.785528	0.775738			

Table 2: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	50	PSO	4.863639	1.060118	100	1.49618	1
		GAPSO	3.229788	0.837676			
		LOGAPSO	6.926435	7.743545			

Table 3: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	50	PSO	7.576002	1.489379	100	1	1.49618
		GAPSO	6.660279	1.293801			
		LOGAPSO	2.711762	0.367091			

Table 4: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	100	PSO	10.181829	4.857209	100	1.49618	1.
		GAPSO	10.785233	3.670596			
		LOGAPSO	3.347304	0.336459			

Table 5: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	100	PSO	9.923349	3.279843	100	1.49618	1
		GAPSO	10.793539	1.206775			
		LOGAPSO	4.540176	0.883645			

Table 6: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	100	PSO	16.281685	0.538781	100	1	1.49618
		GAPSO	17.143684	0.568807			
		LOGAPSO	9.014371	5.882949			

Table 7: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	200	PSO	18.742101	0.898119	100	1.49618	1.
		GAPSO	19.234347	0.741240			
		LOGAPSO	17.293138	4.727316			

Table 8: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	200	PSO	15.555375	0.749348	100	1.49618	1
		GAPSO	16.453669	1.045910			
		LOGAPSO	13.382653	4.845540			

Table 9: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Ackley	200	PSO	18.473616	0.283943	100	1	1.49618
		GAPSO	18.478619	0.451928			
		LOGAPSO	18.799011	0.267174			

Table 10: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Fuku Sugeno	2	PSO	-133.822794	5.585608	100	1.49618	1.4961
		GAPSO	-131.376948	14.490870			
		LOGAPSO	-137.748238	2.804973			

Table 11: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	2	PSO	-131.826658	6.300066	100	1.49618	1	0.
		GAPSO	-134.515013	5.701793				
		LOGAPSO	-139.710656	0.056465				

Table 12: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	2	PSO	-135.745516	6.141988	100	1	1.49618	0.
		GAPSO	-136.148794	5.824246				
		LOGAPSO	-139.710656	0.056465				

Table 13: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Fuku Sugeno	4	PSO	-159.161550	3.391232	100	1.49618	1.49618
		GAPSO	-155.746994	6.769352			
		LOGAPSO	-160.246477	2.404263			

Table 14: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	4	PSO	-159.362141	2.500361	100	1.49618	1	0.
		GAPSO	-160.599179	3.378386				
		LOGAPSO	-161.061210	1.692394				

Table 15: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	4	PSO	-156.635255	4.279142	100	1	1.49618	0.
		GAPSO	-155.616094	5.353597				
		LOGAPSO	-158.016655	2.808601				

Table 16: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Fuku Sugeno	6	PSO	-123.085820	6.816223	100	1.49618	1.49618
		GAPSO	-123.043487	4.985750			
		LOGAPSO	-125.016680	4.182138			

Table 17: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	6	PSO	-124.676490	5.084901	100	1.49618	1	0.
		GAPSO	-124.622912	5.771525				
		LOGAPSO	-122.294269	5.095494				

Table 18: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	6	PSO	-119.011632	5.154652	100	1	1.49618	0.
		GAPSO	-120.757291	9.881012				
		LOGAPSO	-126.436266	2.608925				

Table 19: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Silhouette	2	PSO	0.515634	0.0	100	1.49618	1.49618
		GAPSO	0.515634	0.0			
		LOGAPSO	0.515634	0.0			

Table 20: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Silhouette	2	PSO	0.515634	0.0	100	1.49618	1	0.
		GAPSO	0.515634	0.0				
		LOGAPSO	0.515634	0.0				

Table 21: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Silhouette	2	PSO	0.515634	0.0	100	1	1.49618	0.
		GAPSO	0.515634	0.0				
		LOGAPSO	0.515634	0.0				

Table 22: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Silhouette	4	PSO	0.515634	0.0	100	1.49618	1.49618
		GAPSO	0.515634	0.0			
		LOGAPSO	0.515634	0.0			

Table 23: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Silhouette	4	PSO	0.515634	0.0	100	1.49618	1	0.
		GAPSO	0.515634	0.0				
		LOGAPSO	0.515634	0.0				

Table 24: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Silhouette	4	PSO	0.515634	0.0	100	1	1.49618	0.
		GAPSO	0.515634	0.0				
		LOGAPSO	0.515634	0.0				

Table 25: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Silhouette	6	PSO	0.515634	0.0	100	1.49618	1	0.
		GAPSO	0.515634	0.0				
		LOGAPSO	0.515634	0.0				

Table 26: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Silhouette	6	PSO	0.515634	0.0	100	1	1.49618	0.
		GAPSO	0.515634	0.0				
		LOGAPSO	0.515634	0.0				

Table 27: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Xie Beni	2	PSO	0.045159	0.002880	100	1.49618	1	0.
		GAPSO	0.043091	0.000488				
		LOGAPSO	0.043211	0.001056				

Table 28: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Xie Beni	2	PSO	0.043594	0.001609	100	1	1.49618	0.
		GAPSO	0.046769	0.002363				
		LOGAPSO	0.045493	0.002251				

Table 29: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Xie Beni	4	PSO	0.053982	0.011925	100	1.49618	1.49618
		GAPSO	0.052249	0.003867			
		LOGAPSO	0.053921	0.004797			

Table 30: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Xie Beni	4	PSO	0.053259	0.004937	100	1.49618	1	0.
		GAPSO	0.051434	0.005082				
		LOGAPSO	0.046747	0.002596				

Table 31: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Xie Beni	4	PSO	0.049083	0.003201	100	1	1.49618	0.
		GAPSO	0.051060	0.005905				
		LOGAPSO	0.051349	0.002314				

Table 32: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Xie Beni	6	PSO	0.048678	0.001874	100	1.49618	1.49618
		GAPSO	0.048045	0.002540			
		LOGAPSO	0.045676	0.002487			

Table 33: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Xie Beni	6	PSO	0.047362	0.003871	100	1.49618	1	0.
		GAPSO	0.051614	0.003719				
		LOGAPSO	0.047464	0.001943				

Table 34: Results of experiments using the diabetes dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Xie Beni	6	PSO	0.054825	0.012615	100	1	1.49618	0.
		GAPSO	0.048865	0.003369				
		LOGAPSO	0.053616	0.002371				

Table 35: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	50	PSO	0.004316	0.004837	100	1.49618	1
		GAPSO	1.133544	0.090156			
		LOGAPSO	228.521358	395.806154			

Table 36: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	50	PSO	0.051477	0.045850	100	1.49618	1
		GAPSO	0.005573	0.005632			
		LOGAPSO	0.003080	0.005335			

Table 37: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	50	PSO	0.068343	0.048570	100	1	1.49618
		GAPSO	0.018993	0.028603			
		LOGAPSO	0.008617	0.008617			

Table 38: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	100	PSO	2.101640	0.244514	100	1.49618	1.
		GAPSO	45.323100	27.502393			
		LOGAPSO	0.934814	0.100529			

Table 39: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	100	PSO	0.456211	0.297491	100	1.49618	1
		GAPSO	1.857904	0.700323			
		LOGAPSO	0.012597	0.008830			

Table 40: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	100	PSO	2.237203	1.689570	100	1	1.49618
		GAPSO	8.444162	5.831066			
		LOGAPSO	0.015717	0.010002			

Table 41: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ
Griewank	200	PSO	284.939137	54.450180	100	1.49618	1
		GAPSO	664.081139	106.814945			
		LOGAPSO	57.427771	8.079970			

Table 42: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	200	PSO	46.587754	20.518972	100	1.49618	1
		GAPSO	86.741473	16.467071			
		LOGAPSO	0.698894	0.107694			

Table 43: Results of experiments with benchmark functions

Benchmark function	# dims	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Griewank	200	PSO	125.520839	52.232086	100	1	1.49618
		GAPSO	229.086522	18.313773			
		LOGAPSO	0.666744	0.050441			

Table 44: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Fuku Sugeno	2	PSO	-71.614468	45.809989	100	1.49618	1.4961
		GAPSO	-80.613337	60.271911			
		LOGAPSO	-92.030733	29.094905			

Table 45: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	2	PSO	-164.193658	0.502329	100	1.49618	1	0.
		GAPSO	-164.433202	0.450694				
		LOGAPSO	-154.075985	9.283281				

Table 46: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	2	PSO	-129.911653	36.329327	100	1	1.49618	0
		GAPSO	-121.943591	25.352746				
		LOGAPSO	-95.705821	49.641044				

Table 47: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Fuku Sugeno	4	PSO	-271.979344	33.446588	100	1.49618	1.4961
		GAPSO	-221.980260	62.351117			
		LOGAPSO	-308.340229	66.569315			

Table 48: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	4	PSO	-369.855869	67.740479	100	1.49618	1	0
		GAPSO	-338.448054	42.332961				
		LOGAPSO	-455.208472	38.720287				

Table 49: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	4	PSO	-315.387614	95.098457	100	1	1.49618	0
		GAPSO	-258.651281	53.057233				
		LOGAPSO	-278.716748	77.378554				

Table 50: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2
Fuku Sugeno	6	PSO	-312.954482	41.934021	100	1.49618	1.496
		GAPSO	-243.526117	61.070155			
		LOGAPSO	-371.999956	105.649588			

Table 51: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	6	PSO	-376.585155	95.965692	100	1.49618	1	0
		GAPSO	-428.476931	61.454993				
		LOGAPSO	-407.679005	33.043936				

Table 52: Results of experiments using the ionosphere dataset

Cluster eval.	# clusters	Optim. algorithm	Avg. fitness	Std. dev.	Pop. size	ϕ_1	ϕ_2	w
Fuku Sugeno	6	PSO	-386.593765	63.461000	100	1	1.49618	0
		GAPSO	-357.502698	80.337570				
		LOGAPSO	-359.644518	23.303957				