TABLE IX
THE COMPARISON OF FTL WITH ORIGINAL RESULTS USING RF.

RF	*F1-score*		*AUC*		*MCC*	
	original	FTL	original	FTL	original	FTL
ant-1-4	0.229	**0.241**	0.529	**0.557**	0.026	**0.040**
camel-1-2	0.430	**0.495**	0.628	**0.651**	0.145	**0.273**
camel-1-6	0.336	0.308	0.658	0.623	0.206	0.166
ivy-1-1	0.729	0.707	0.648	**0.658**	0.343	0.299
ivy-2-0	0.260	**0.268**	0.637	**0.638**	0.197	**0.198**
jedit-3-2	0.597	0.584	0.743	**0.761**	0.420	0.398
jedit-4-0	0.517	0.500	0.713	**0.718**	0.374	0.355
jedit-4-1	0.514	**0.533**	0.704	**0.731**	0.352	**0.395**
jedit-4-2	0.220	**0.297**	0.661	**0.722**	0.155	**0.252**
log4j-1-0	0.507	**0.601**	0.775	0.746	0.364	**0.476**
log4j-1-1	0.580	**0.600**	0.752	**0.800**	0.431	**0.464**
log4j-1-2	0.959	0.956	0.648	**0.697**	0.265	0.230
lucene-2-0	0.553	**0.590**	0.656	**0.670**	0.175	**0.220**
lucene-2-2	0.661	0.618	0.582	0.576	0.172	0.109
lucene-2-4	0.737	0.730	0.718	0.710	0.329	0.305
poi-1-5	0.691	**0.693**	0.668	**0.678**	0.290	0.289
poi-2-0	0.344	0.216	0.713	**0.750**	0.275	0.157
poi-2-5	0.855	0.839	0.848	0.844	0.582	0.559
poi-3-0	0.835	0.831	0.838	**0.844**	0.548	0.522
redaktor	0.310	**0.462**	0.681	**0.700**	0.198	**0.390**
synapse-1-0	0.137	**0.240**	0.646	0.636	0.091	**0.180**
synapse-1-1	0.493	**0.534**	0.738	0.720	0.357	**0.362**
synapse-1-2	0.562	**0.565**	0.735	**0.737**	0.356	0.353
tomcat	0.351	0.221	0.744	0.699	0.301	0.178
velocity-1-4	0.897	**0.916**	0.797	**0.839**	0.545	**0.628**
velocity-1-6	0.511	0.504	0.678	0.668	0.254	**0.267**
xalan-2-4	0.296	**0.357**	0.681	**0.709**	0.208	**0.267**
xalan-2-5	0.654	0.632	0.714	0.709	0.346	0.309
xalan-2-6	0.705	0.696	0.777	**0.786**	0.472	0.463
xerces-1-3	0.445	0.437	0.747	0.744	0.371	0.356
xerces-1-4	**0.937**	**0.937**	0.915	0.912	0.757	0.756
Average	0.536	**0.552**	0.692	**0.717**	0.290	**0.330**
Improved	0.016		0.025		0.039	
W/T/L	15/1/15		19/0/12		14/0/17	

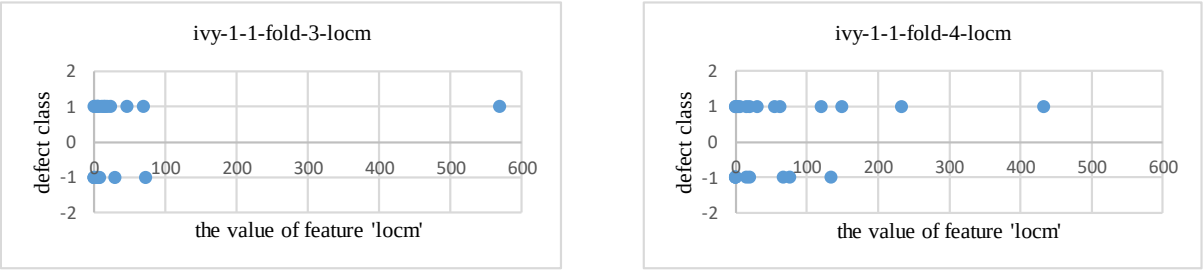

Fig. 8. The data distribution of 'lcom' of ivy-1-1.

TABLE X
THE COMPARISON OF FTL WITH ORIGINAL RESULTS USING NB.

NB	*F1-score*		*AUC*		*MCC*	
	original	FTL	original	FTL	original	FTL
ant-1.4	0.404	0.352	0.600	**0.616**	0.129	0.122
camel-1.2	0.336	**0.533**	0.578	**0.622**	0.161	0.148
camel-1.6	0.308	**0.409**	0.684	**0.714**	0.207	**0.230**
ivy-1.1	0.582	**0.729**	0.713	**0.764**	0.317	**0.331**
ivy-2.0	0.322	0.317	0.742	**0.764**	0.233	**0.244**
jedit-3.2	0.531	**0.617**	0.774	**0.785**	0.396	**0.424**
jedit-4.0	0.464	**0.554**	0.756	**0.764**	0.348	**0.412**
jedit-4.1	0.538	**0.591**	0.780	**0.807**	0.443	0.438
jedit-4.2	0.383	**0.445**	0.834	**0.865**	0.303	**0.367**
log4j-1-0	0.639	0.621	0.816	**0.846**	0.556	0.514
log4j-1-1	0.717	0.699	0.837	**0.841**	0.601	0.561
log4j-1-2	0.645	**0.875**	0.705	0.620	0.180	0.098
lucene-2-0	0.541	**0.654**	0.751	0.730	0.303	0.302
lucene-2-2	0.496	**0.705**	0.627	0.612	0.222	0.177
lucene-2-4	0.532	**0.706**	0.723	0.703	0.309	0.232
poi-1-5	0.404	**0.753**	0.716	**0.738**	0.162	**0.331**
poi-2-0	0.231	**0.340**	0.697	**0.746**	0.146	**0.268**
poi-2-5	0.527	**0.816**	0.760	**0.785**	0.254	**0.457**
poi-3-0	0.451	**0.811**	0.800	**0.805**	0.250	**0.493**
redaktor	0.311	**0.410**	0.785	0.739	0.177	**0.297**
synapse-1-0	0.271	**0.506**	0.704	**0.830**	0.172	**0.447**
synapse-1-1	0.511	**0.520**	0.719	**0.740**	0.323	**0.324**
synapse-1-2	0.590	**0.603**	0.753	**0.759**	0.413	0.384
tomcat	0.332	**0.400**	0.793	**0.812**	0.262	**0.340**
velocity-1-4	0.898	0.893	0.761	**0.776**	0.565	0.556
velocity-1-6	0.390	**0.607**	0.709	**0.755**	0.222	**0.360**
xalan-2-4	0.372	**0.428**	0.749	**0.782**	0.265	**0.313**
xalan-2-5	0.385	**0.648**	0.614	**0.629**	0.140	**0.195**
xalan-2-6	0.593	**0.723**	0.784	**0.819**	0.435	**0.450**
xerces-1-3	0.463	**0.513**	0.756	**0.764**	0.372	**0.424**
xerces-1-4	0.729	**0.864**	0.841	**0.924**	0.437	**0.621**
Average	0.481	**0.601**	0.738	**0.757**	0.300	**0.350**
Improved	0.121		0.019		0.050	
W/T/L	26/0/5		26/0/5		20/0/11	

TABLE XI
THE COMPARISON OF FTL WITH FE METHODS USING RF.

F1-score	Random	Force-var	Force-PCA	PCA	FTL
Average	0.544	0.441	0.358	0.393	**0.552**
W/L	13/18	2/29	0/31	0/31	**16/15**
AUC	Random	Force-var	Force-PCA	PCA	FTL
Average	0.704	0.605	0.501	0.504	**0.717**
W/L	8/23	1/30	0/31	0/31	**22/9**
MCC	Random	Force-var	Force-PCA	PCA	FTL
Average	0.310	0.152	-0.011	0.000	**0.330**
W/L	8/23	1/30	0/31	0/31	**22/9**

TABLE XII
THE COMPARISON OF FTL WITH FE METHODS USING NB.

F1-score	Random	Force-var	Force-PCA	PCA	FTL
Average	0.455	0.348	0.472	0.469	**0.601**
W/L	2/29	1/30	4/27	3/28	**24/7**
AUC	Random	Force-var	Force-PCA	PCA	FTL
Average	0.715	0.655	0.492	0.530	**0.757**
W/L	5/26	1/30	0/31	0/31	**25/6**
MCC	Random	Force-var	Force-PCA	PCA	FTL
Average	0.261	0.186	-0.002	0.011	**0.350**
W/L	5/31	2/31	0/31	0/31	**24/7**

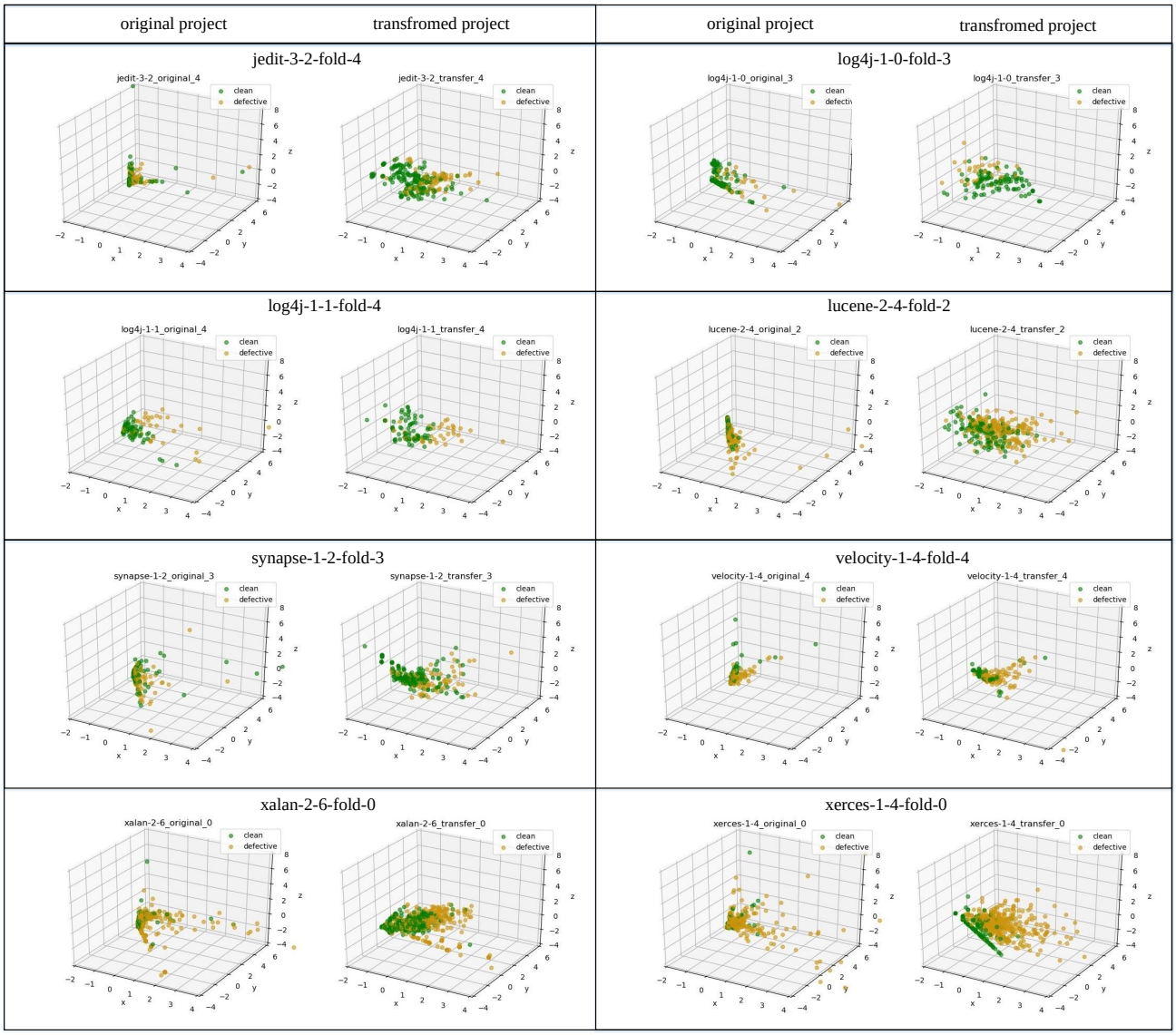

Fig. 9. The data distribution changing of PROMISE projects.

TABLE XIII
THE COMPARISON OF FTL WITH THE ORIGINAL CLASSIFIER AND FE METHODS USING AUC.

AUC/NB	original	Random	Force-var	Force-PCA	PCA	FTL
CM1	0.684	0.686	0.679	0.668	0.423	**0.732**
JM1	0.654	0.627	0.642	0.419	0.500	**0.698**
KC1	0.794	0.794	**0.796**	0.469	0.499	0.784
KC3	0.692	**0.724**	0.531	0.565	0.642	0.683
MC1	**0.920**	**0.920**	0.520	0.500	0.500	0.907
MC2	**0.747**	0.745	0.639	0.506	0.602	0.706
MW1	**0.776**	0.759	0.384	0.531	0.580	0.767
PC1	0.731	**0.737**	0.716	0.642	0.661	0.730
PC2	0.751	0.746	0.753	0.609	0.476	**0.800**
PC3	0.753	0.733	0.588	0.673	0.779	**0.806**
PC4	0.830	0.812	0.521	0.376	0.434	**0.837**
PC5	0.944	**0.951**	0.945	0.500	0.500	0.942
avg	0.773	0.769	0.643	0.538	0.550	**0.783**
W/T/L	3/12	4/12	1/12	0/12	0/12	5/12

TABLE XIV
THE COMPARISON OF FTL WITH THE ORIGINAL CLASSIFIER AND FE METHODS USING MCC.

MCC/NB	original	Random	Force-var	Force-PCA	PCA	FTL
CM1	0.217	0.137	0.221	-0.016	0.024	**0.273**
JM1	0.192	0.175	0.087	0.090	0.000	**0.248**
KC1	0.282	0.200	0.185	-0.078	0.000	**0.327**
KC3	0.288	**0.297**	0.136	0.000	0.037	0.209
MC1	0.188	**0.200**	0.108	0.000	0.000	0.187
MC2	0.254	0.348	0.336	0.000	0.000	**0.398**
MW1	**0.326**	0.205	0.067	0.025	0.094	0.289
PC1	**0.268**	0.141	0.171	0.025	0.000	0.266
PC2	**0.040**	0.024	-0.053	-0.005	0.000	0.023
PC3	0.059	0.090	-0.099	0.027	0.075	**0.314**
PC4	**0.387**	0.199	-0.131	0.061	-0.010	0.375
PC5	0.417	**0.427**	0.366	0.000	0.000	0.425
avg	0.243	0.204	0.116	0.011	0.018	**0.278**
W/T/L	4/12	3/12	0/12	0/12	0/12	5/12