Supplementary file 1

Description of Liver Fibrosis (LF) and Early-stage Cirrhosis (ESC)

In this study, all enrolled patients underwent pathologic examination procedure and results of the histopathological assessment served as the reference standard for staging liver fibrosis and early-stage cirrhosis. Liver fibrosis was assessed according to the METAVIR scores, ranging from F0 to F4. F0-F3 was liver fibrosis (LF) and F4 was early-stage cirrhosis (ESC). Our data were acquired from medical record system in our hospital, and the patients without diagnosis description of pathologic examination were excluded.

Details of RELIEFF

RELIEFF algorithm, also named ReliefF, is commonly used to reduce the dimensions of feature space in machine learning classification models. The basic principle of RELIEFF is as follows:

First, a sample ***R*** was randomly selected from training dataset ***D***, then k-nearest neighbor ***H*** was calculated from the same class as ***R***, the k-nearest neighbor M was calculated from the different class with ***R***, finally, the weight of each feature was upgraded. Details of the procedure are as follows:

1. Zero all feature weights.

2. *for i = 1 to numSampling do*

2.1 a sample ***R*** was randomly selected

2.2 k-nearest neighbor H_j ***(j=1, 2, …, k)*** and M_j ***(C)*** was calculated from same class and different class with ***R***, respectively

2.3 *for A = 1 to numFeatures do*

$$W(A) = W(A) - \sum_{j=1}^{k} \frac{diff(A, R, H_j)}{(numSampling \cdot k)} + \sum_{C \notin class(R)} \left[\frac{p(C)}{1 - p(class(R))} \sum_{j=1}^{k} diff\left(A, R, M_j(C)\right) \right] / (numSampling \cdot k) \quad (1)$$

Where, $diff(A, R_1, R_2)$ is difference of sample $\boldsymbol{R_1}$ and $\boldsymbol{R_2}$, $M_j(C)$ is j_{th} k-nearest neighbor. The formula of $diff(A, R_1, R_2)$ is as follows:

$$diff(A, R_1, R_2) = \begin{cases} \dfrac{|R_1[A] - R_2[A]|}{\max(A) - \min(A)} & if\ A\ is\ continuous \\ 0 & if\ A\ is\ discrete\ and\ R_1[A] = R_2[A] \\ 1 & if\ A\ is\ discrete\ and\ R_1[A]\ \neq R_1[A] \end{cases} \quad (2)$$

2.4 sort the weights, rank the features.

Results of univariate analysis and RELIEFF selection of models in Plan 1

Table S1. The results of univariate analysis of plan 1.

Features	*P* value		Features	*P* value		Features	*P* value	
	Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
0_GLDM_GLV	0.50531	0.63460	400_GLDM_GLV	0.22611	0.33819	800_GLDM_GLV	0.65700	0.00980
0_GLDM_HGLE	0.61031	0.40877	400_GLDM_HGLE	0.47195	0.00601	800_GLDM_HGLE	0.14241	0.97266
0_GLDM_DE	0.03562	0.23686	400_GLDM_DE	0.07906	0.92411	800_GLDM_DE	0.07814	0.57904
0_GLDM_DNU	0.25637	0.18261	400_GLDM_DNU	0.54878	0.05701	800_GLDM_DNU	0.44989	0.75529
0_GLDM_GLNU	0.45936	0.03421	400_GLDM_GLNU	0.85978	0.79258	800_GLDM_GLNU	0.06827	0.32981
0_GLDM_SDE	0.81234	0.31591	400_GLDM_SDE	0.52855	0.02938	800_GLDM_SDE	0.03577	0.60541
0_GLDM_SDHGLE	0.09013	0.06262	400_GLDM_SDHGLE	0.56373	0.29576	800_GLDM_SDHGLE	0.77721	0.20541
0_GLDM_DNUN	0.58390	0.15159	400_GLDM_DNUN	0.05518	0.87269	800_GLDM_DNUN	0.07413	0.98854
0_GLDM_LDE	0.28913	0.09393	400_GLDM_LDE	0.91876	0.64055	800_GLDM_LDE	0.70767	0.78440
0_GLDM_LDLGLE	0.04751	0.14693	400_GLDM_LDLGLE	0.75023	0.87807	800_GLDM_LDLGLE	0.66251	0.05143
0_GLDM_DV	0.33867	0.04661	400_GLDM_DV	0.01245	0.62090	800_GLDM_DV	0.56409	0.71450
0_GLDM_LDHGLE	0.10192	0.57963	400_GLDM_LDHGLE	0.03547	0.06894	800_GLDM_LDHGLE	0.83009	0.09078
0_GLDM_SDLGLE	0.30386	0.62728	400_GLDM_SDLGLE	0.90017	0.22959	800_GLDM_SDLGLE	0.01189	0.02526
0_GLDM_LGLE	0.04563	0.53010	400_GLDM_LGLE	0.75739	0.62681	800_GLDM_LGLE	0.16506	0.75199
0_GLCM_JointAverage	0.29864	0.16512	400_GLCM_JointAverage	0.05971	0.02655	800_GLCM_JointAverage	0.17050	0.07538
0_GLCM_SumAverage	0.37021	0.48334	400_GLCM_SumAverage	0.67138	0.91792	800_GLCM_SumAverage	0.49230	0.57376
0_GLCM_JointEntropy	0.09713	0.06230	400_GLCM_JointEntropy	0.57843	0.84248	800_GLCM_JointEntropy	0.05123	0.83888
0_GLCM_ClusterShade	0.56375	0.91979	400_GLCM_ClusterShade	0.09916	0.77762	800_GLCM_ClusterShade	0.13564	0.64972
0_GLCM_MaxProb	0.32169	0.86648	400_GLCM_MaxProb	0.81357	0.84299	800_GLCM_MaxProb	0.05571	0.07993
0_GLCM_Idmn	0.73033	0.00946	400_GLCM_Idmn	0.64082	0.01390	800_GLCM_Idmn	0.43000	0.14657

0_GLCM_JointEnergy	0.62930	0.99975	400_GLCM_JointEnergy	0.32151	0.39412	800_GLCM_JointEnergy	0.99052	0.26865
0_GLCM_Contrast	0.04638	0.33690	400_GLCM_Contrast	0.07841	0.29126	800_GLCM_Contrast	0.03014	0.18717
0_GLCM_DiffEntropy	0.32986	0.94329	400_GLCM_DiffEntropy	0.12560	0.48536	800_GLCM_DiffEntropy	0.76065	0.63872
0_GLCM_InveVariance	0.86599	0.70639	400_GLCM_InveVariance	0.75055	0.83725	800_GLCM_InveVariance	0.16036	0.01715
0_GLCM_DiffVariance	0.20818	0.12727	400_GLCM_DiffVariance	0.00586	0.52368	800_GLCM_DiffVariance	0.92889	0.52457
0_GLCM_Idn	0.05795	0.58501	400_GLCM_Idn	0.13364	0.15824	800_GLCM_Idn	0.07749	0.54343
0_GLCM_Idm	0.30915	0.64350	400_GLCM_Idm	0.13413	0.21595	800_GLCM_Idm	0.65015	0.93845
0_GLCM_Correlation	0.03475	0.07115	400_GLCM_Correlation	0.02079	0.01405	800_GLCM_Correlation	0.46580	0.13436
0_GLCM_Autocorrelation	0.11052	0.80015	400_GLCM_Autocorrelation	0.54154	0.84917	800_GLCM_Autocorrelation	0.28455	0.67640
0_GLCM_SumEntropy	0.46015	0.84730	400_GLCM_SumEntropy	0.04751	0.77326	800_GLCM_SumEntropy	0.05794	0.10012
0_GLCM_MCC	0.76351	0.26803	400_GLCM_MCC	0.34216	0.54628	800_GLCM_MCC	0.82766	0.44916
0_GLCM_SumSquares	0.04125	0.32298	400_GLCM_SumSquares	0.44486	0.08316	800_GLCM_SumSquares	0.79338	0.55468
0_GLCM_ClusProm	0.63175	0.04132	400_GLCM_ClusProm	0.75361	0.71526	800_GLCM_ClusProm	0.74394	0.01996
0_GLCM_Imc2	0.28822	0.86803	400_GLCM_Imc2	0.03574	0.30464	800_GLCM_Imc2	0.07426	0.44859
0_GLCM_Imc1	0.36080	0.89072	400_GLCM_Imc1	0.27139	0.27059	800_GLCM_Imc1	0.69064	0.36112
0_GLCM_DiffAverage	0.01257	0.69891	400_GLCM_DiffAverage	0.77513	0.27091	800_GLCM_DiffAverage	0.07512	0.77459
0_GLCM_Id	0.01479	0.02525	400_GLCM_Id	0.05941	0.54297	800_GLCM_Id	0.67473	0.25859
0_GLCM_ClusTendency	0.35494	0.82035	400_GLCM_ClusTendency	0.35210	0.24535	800_GLCM_ClusTendency	0.50792	0.23133
0_IH_InteRange	0.39409	0.90398	400_IH_InteRange	0.97873	0.06122	800_IH_InteRange	0.84592	0.49644
0_IH_Skewness	0.05364	0.21510	400_IH_Skewness	0.02639	0.02001	800_IH_Skewness	0.05711	0.78227
0_IH_Uniformity	0.89470	0.25371	400_IH_Uniformity	0.96071	0.44315	800_IH_Uniformity	0.78643	0.75337
0_IH_Median	0.73797	0.57317	400_IH_Median	0.09746	0.54924	800_IH_Median	0.04632	0.06248
0_IH_Energy	0.41869	0.00490	400_IH_Energy	0.71917	0.91685	800_IH_Energy	0.67440	0.70905
0_IH_RMAD	0.05968	0.14113	400_IH_RMAD	0.24885	0.08142	800_IH_RMAD	0.44084	0.31587
0_IH_MAD	0.23708	0.84908	400_IH_MAD	0.34617	0.11418	800_IH_MAD	0.04516	0.18088
0_IH_TotalEnergy	0.14646	0.72999	400_IH_TotalEnergy	0.18745	0.91434	800_IH_TotalEnergy	0.45221	0.89848

0_IH_Maximum	0.59794	0.04745	400_IH_Maximum	0.13866	0.45345	800_IH_Maximum	0.83306	0.71918
0_IH_RMS	0.05697	0.86921	400_IH_RMS	0.30411	0.03983	800_IH_RMS	0.01452	0.50407
0_IH_89Percentile	0.83302	0.30096	400_IH_89Percentile	0.31025	0.26036	800_IH_89Percentile	0.64633	0.98692
0_IH_Minimum	0.99223	0.41445	400_IH_Minimum	0.84910	0.17785	800_IH_Minimum	0.40504	0.04917
0_IH_Entropy	0.03417	0.48082	400_IH_Entropy	0.05662	0.19331	800_IH_Entropy	0.84440	0.36560
0_IH_Range	0.51268	0.80939	400_IH_Range	0.25818	0.31104	800_IH_Range	0.14574	0.87921
0_IH_Variance	0.68503	0.33468	400_IH_Variance	0.44610	0.98505	800_IH_Variance	0.42759	0.66609
0_IH_9Percentile	0.18938	0.30025	400_IH_9Percentile	0.63974	0.44388	800_IH_9Percentile	0.99156	0.05770
0_IH_Kurtosis	0.02549	0.26405	400_IH_Kurtosis	0.87383	0.85672	800_IH_Kurtosis	0.03548	0.02536
0_IH_Mean	0.50967	0.01467	400_IH_Mean	0.48217	0.06520	800_IH_Mean	0.64556	0.59806
0_GLRLM_SRLGLE	0.25034	0.75624	400_GLRLM_SRLGLE	0.79409	0.26432	800_GLRLM_SRLGLE	0.11542	0.55994
0_GLRLM_GLV	0.32856	0.68076	400_GLRLM_GLV	0.89679	0.95134	800_GLRLM_GLV	0.37985	0.64899
0_GLRLM_LGLRE	0.93898	0.30633	400_GLRLM_LGLRE	0.88986	0.74314	800_GLRLM_LGLRE	0.31864	0.81293
0_GLRLM_GLNUN	0.01247	0.69573	400_GLRLM_GLNUN	0.63606	0.54092	800_GLRLM_GLNUN	0.04715	0.14216
0_GLRLM_RunVariance	0.80236	0.16631	400_GLRLM_RunVariance	0.23250	0.05227	800_GLRLM_RunVariance	0.35290	0.37616
0_GLRLM_GLN	0.03459	0.09148	400_GLRLM_GLN	0.00413	0.27360	800_GLRLM_GLN	0.88598	0.04226
0_GLRLM_LRE	0.81383	0.59212	400_GLRLM_LRE	0.38581	0.17298	800_GLRLM_LRE	0.64163	0.85005
0_GLRLM_SRHGLE	0.17068	0.67490	400_GLRLM_SRHGLE	0.36931	0.79068	800_GLRLM_SRHGLE	0.70647	0.32311
0_GLRLM_RLNU	0.56521	0.89637	400_GLRLM_RLNU	0.03798	0.59353	800_GLRLM_RLNU	0.84941	0.01722
0_GLRLM_SRE	0.94242	0.31223	400_GLRLM_SRE	0.21529	0.00922	800_GLRLM_SRE	0.88002	0.54631
0_GLRLM_LRHGLE	0.55939	0.80053	400_GLRLM_LRHGLE	0.89658	0.39827	800_GLRLM_LRHGLE	0.62751	0.01412
0_GLRLM_RunPercentage	0.07683	0.05656	400_GLRLM_RunPercentage	0.26143	0.60386	800_GLRLM_RunPercentage	0.02449	0.13405
0_GLRLM_LRLGLE	0.21679	0.91736	400_GLRLM_LRLGLE	0.69924	0.88671	800_GLRLM_LRLGLE	0.49013	0.27199
0_GLRLM_RunEntropy	0.05413	0.99924	400_GLRLM_RunEntropy	0.04771	0.55323	800_GLRLM_RunEntropy	0.51779	0.40002
0_GLRLM_HGLRE	0.76459	0.08503	400_GLRLM_HGLRE	0.88519	0.39413	800_GLRLM_HGLRE	0.12995	0.02229
0_GLRLM_RLNUN	0.39449	0.12602	400_GLRLM_RLNUN	0.08544	0.02440	800_GLRLM_RLNUN	0.96480	0.03023

0_GLSZM_GLV	0.10328	0.86899	400_GLSZM_GLV	0.97767	0.17810	800_GLSZM_GLV	0.43686	0.15602
0_GLSZM_ZoneVariance	0.49643	0.47409	400_GLSZM_ZoneVariance	0.22303	0.68565	800_GLSZM_ZoneVariance	0.25329	0.78798
0_GLSZM_GLNUN	0.01249	0.68317	400_GLSZM_GLNUN	0.41035	0.73162	800_GLSZM_GLNUN	0.73873	0.73193
0_GLSZM_SZNUM	0.96957	0.59859	400_GLSZM_SZNUM	0.02565	0.04961	800_GLSZM_SZNUM	0.04413	0.29657
0_GLSZM_SZNU	0.34509	0.00850	400_GLSZM_SZNU	0.49578	0.45755	800_GLSZM_SZNU	0.86452	0.31156
0_GLSZM_GLNU	0.66075	0.86231	400_GLSZM_GLNU	0.92362	0.34536	800_GLSZM_GLNU	0.13520	0.52532
0_GLSZM_LAE	0.02544	0.65237	400_GLSZM_LAE	0.96129	0.84843	800_GLSZM_LAE	0.50610	0.08944
0_GLSZM_SAHGLE	0.45157	0.08279	400_GLSZM_SAHGLE	0.45093	0.86104	800_GLSZM_SAHGLE	0.73284	0.68720
0_GLSZM_ZonePercentage	0.98808	0.60788	400_GLSZM_ZonePercentage	0.45054	0.36166	800_GLSZM_ZonePercentage	0.12636	0.73644
0_GLSZM_LALGLE	0.44699	0.06174	400_GLSZM_LALGLE	0.23853	0.09665	800_GLSZM_LALGLE	0.07695	0.19048
0_GLSZM_LAHGLE	0.53865	0.56455	400_GLSZM_LAHGLE	0.62979	0.56075	800_GLSZM_LAHGLE	0.32210	0.79012
0_GLSZM_HGLZE	0.78487	0.04227	400_GLSZM_HGLZE	0.06618	0.72915	800_GLSZM_HGLZE	0.54345	0.51431
0_GLSZM_SAE	0.05887	0.36661	400_GLSZM_SAE	0.88313	0.23071	800_GLSZM_SAE	0.03367	0.10857
0_GLSZM_LGLZE	0.38337	0.66392	400_GLSZM_LGLZE	0.56567	0.00970	800_GLSZM_LGLZE	0.26278	0.17167
0_GLSZM_ZoneEntropy	0.41738	0.41516	400_GLSZM_ZoneEntropy	0.02759	0.09802	800_GLSZM_ZoneEntropy	0.27806	0.10055
0_GLSZM_SALGLE	0.63775	0.79569	400_GLSZM_SALGLE	0.65140	0.61601	800_GLSZM_SALGLE	0.83345	0.16857
0_NGTDM_Coarseness	0.05743	0.90682	400_NGTDM_Coarseness	0.13729	0.00066	800_NGTDM_Coarseness	0.26109	0.28513
0_NGTDM_Complexity	0.51610	0.45937	400_NGTDM_Complexity	0.04418	0.74538	800_NGTDM_Complexity	0.53531	0.02361
0_NGTDM_Strength	0.67047	0.07930	400_NGTDM_Strength	0.02561	0.91787	800_NGTDM_Strength	0.03983	0.23924
0_NGTDM_Contrast	0.02473	0.79057	400_NGTDM_Contrast	0.93900	0.06192	800_NGTDM_Contrast	0.01265	0.49524
0_NGTDM_Busyness	0.01138	0.09536	400_NGTDM_Busyness	0.05849	0.25408	800_NGTDM_Busyness	0.12789	0.07086

Features with *P* value < 0.1 were labeled with pink color and removed. IH: Intensity histogram; GLDM: Gray-level dependence matrix; GLCM: Gray-level cooccurrence matrix; GLRLM: Gray-level run-length matrix; NGTDM: Neighboring gray-tone difference matrix.

Table S2. The results of RELIEFF selection of plan 1.

Model 1				Model 2			
GLDM_Features	**Ranking Weights**	**GLCM_Features**	**Ranking Weights**	**GLDM_Features**	**Ranking Weights**	**GLCM_Features**	**Ranking Weights**
0_GLDM_DE	0.0136	0_GLCM_Contrast	0.0144	0_GLDM_DV	0.0165	0_GLCM_ClusProm	-0.0119
0_GLDM_LDLGLE	0.0097	0_GLCM_Correlation	-0.0055	0_GLDM_GLNU	0.0006	0_GLCM_Correlation	-0.0139
0_GLDM_LGLE	-0.0007	0_GLCM_DiffAverage	-0.0068	0_GLDM_LDE	0.0019	0_GLCM_Id	0.0079
0_GLDM_SDHGLE	0.0013	0_GLCM_Id	0.0048	0_GLDM_SDHGLE	0.0138	0_GLCM_Idmn	0.0147
400_GLDM_DE	0.0031	0_GLCM_Idn	0.0031	400_GLDM_DNU	-0.0137	0_GLCM_JointEntropy	0.0074
400_GLDM_DNUN	0.0117	0_GLCM_JointEntropy	0.0192	400_GLDM_HGLE	0.0085	400_GLCM_Correlation	0.0011
400_GLDM_DV	0.0171	0_GLCM_SumSquares	0.0028	400_GLDM_LDHGLE	0.0080	400_GLCM_Idmn	0.0076
400_GLDM_LDHGLE	0.0042	400_GLCM_ClusterShade	-0.0027	400_GLDM_SDE	0.0014	400_GLCM_JointAverage	0.0047
800_GLDM_DE	0.0046	400_GLCM_Contrast	-0.0025	800_GLDM_GLV	0.0091	400_GLCM_SumSquares	0.0158
800_GLDM_DNUN	0.0102	400_GLCM_Correlation	-0.0068	800_GLDM_LDHGLE	-0.0066	800_GLCM_ClusProm	0.0070
800_GLDM_GLNU	-0.0149	400_GLCM_DiffVariance	-0.0064	800_GLDM_LDLGLE	0.0054	800_GLCM_InveVariance	0.0036
800_GLDM_SDE	-0.0025	400_GLCM_Id	-0.0008	800_GLDM_SDLGLE	0.0057	800_GLCM_JointAverage	-0.0138
800_GLDM_SDLGLE	-0.0038	400_GLCM_Imc2	-0.0095			800_GLCM_MaxProb	0.0002
		400_GLCM_JointAverage	0.0059	**IH_Features**	**Ranking Weights**		
IH_Features	**Ranking Weights**	400_GLCM_SumEntropy	-0.0035	0_IH_Energy	0.0086	**GLRLM_Features**	**Ranking Weights**
0_IH_Entropy	0.0026	800_GLCM_Contrast	0.0005	0_IH_Maximum	-0.0027	0_GLRLM_GLN	0.0014
0_IH_Kurtosis	0.0039	800_GLCM_DiffAverage	0.0069	0_IH_Mean	0.0084	0_GLRLM_HGLRE	0.0124
0_IH_RMAD	-0.0016	800_GLCM_Idn	0.0156	400_IH_InteRange	0.0167	0_GLRLM_RunPercentage	-0.0129
0_IH_RMS	-0.0059	800_GLCM_Imc2	0.0091	400_IH_Mean	0.0094	400_GLRLM_RLNUN	0.0087

0_IH_Skewness	0.0169
400_IH_Entropy	0.0073
400_IH_Median	-0.0041
400_IH_Skewness	0.0067
800_IH_Kurtosis	0.0119
800_IH_MAD	-0.0036
800_IH_Median	0.0091
800_IH_RMS	-0.0079
800_IH_Skewness	0.0144

GLSZM_Features	Ranking Weights
0_GLSZM_GLNUN	0.0092
0_GLSZM_LAE	-0.0011
0_GLSZM_SAE	0.0114
400_GLSZM_HGLZE	0.0026
400_GLSZM_SZNUM	-0.0035
400_GLSZM_ZoneEntropy	0.0067
800_GLSZM_LALGLE	-0.0013
800_GLSZM_SAE	0.0007
800_GLSZM_SZNUM	0.0028

800_GLCM_JointEntropy	-0.0016
800_GLCM_MaxProb	-0.0039
800_GLCM_SumEntropy	-0.0151

GLRLM_Features	Ranking Weights
0_GLRLM_GLN	0.0079
0_GLRLM_GLNUN	-0.0055
0_GLRLM_RunEntropy	0.0113
0_GLRLM_RunPercentage	0.0101
400_GLRLM_GLN	0.0009
400_GLRLM_RLNU	0.0015
400_GLRLM_RLNUN	0.0041
400_GLRLM_RunEntropy	0.0085
800_GLRLM_GLNUN	-0.0054
800_GLRLM_RunPercentage	-0.0017

NGTDM_Features	Ranking Weights
0_NGTDM_Busyness	0.0102
0_NGTDM_Coarseness	-0.0062
0_NGTDM_Contrast	0.0043
400_NGTDM_Busyness	0.0106
400_NGTDM_Complexity	0.0039

400_IH_RMAD	-0.0037
400_IH_RMS	0.0048
400_IH_Skewness	0.0010
800_IH_9Percentile	0.0072
800_IH_Kurtosis	0.0093
800_IH_Median	0.0014
800_IH_Minimum	-0.0108

GLSZM_Features	Ranking Weights
0_GLSZM_HGLZE	0.0124
0_GLSZM_LALGLE	0.0038
0_GLSZM_SAHGLE	0.0106
0_GLSZM_SZNU	0.0009
400_GLSZM_LALGLE	0.0118
400_GLSZM_LGLZE	0.0029
400_GLSZM_SZNUM	0.0114
400_GLSZM_ZoneEntropy	-0.0061
800_GLSZM_LAE	0.0078

400_GLRLM_RunVariance	0.0025
400_GLRLM_SRE	0.0046
800_GLRLM_GLN	0.0098
800_GLRLM_HGLRE	-0.0102
800_GLRLM_LRHGLE	0.0015
800_GLRLM_RLNU	-0.0072
800_GLRLM_RLNUN	0.0067

NGTDM_Features	Ranking Weights
0_NGTDM_Busyness	0.0070
0_NGTDM_Strength	0.0115
400_NGTDM_Coarseness	0.0026
400_NGTDM_Contrast	-0.0054
800_NGTDM_Busyness	0.0027
800_NGTDM_Complexity	0.0048

400_NGTDM_Strength	0.0017
800_NGTDM_Contrast	0.0094
800_NGTDM_Strength	-0.0033

Selected features by RELIEFF were labeled with yellow color. IH: Intensity histogram; GLDM: Gray-level dependence matrix; GLCM: Gray-level cooccurrence matrix; GLRLM: Gray-level run-length matrix; NGTDM: Neighboring gray-tone difference matrix.

Results of univariate analysis and RELIEFF selection of models in Plan 2

Table S3. The results of univariate analysis of plan 1.

Features	*P* value		Features	*P* value		Features	*P* value	
	Model 1	Model 2		Model 1	Model 2		Model 1	Model 2
0_GLDM_GLV	0.17471	0.17649	400_GLDM_GLV	0.97249	0.86496	800_GLDM_GLV	0.07980	0.78831
0_GLDM_HGLE	0.30135	0.08473	400_GLDM_HGLE	0.53143	0.47052	800_GLDM_HGLE	0.45841	0.50158
0_GLDM_DE	0.07711	0.02151	400_GLDM_DE	0.07359	0.07985	800_GLDM_DE	0.20493	0.63669
0_GLDM_DNU	0.74395	0.43990	400_GLDM_DNU	0.05745	0.33537	800_GLDM_DNU	0.44731	0.38686
0_GLDM_GLNU	0.73808	0.08214	400_GLDM_GLNU	0.91947	0.82015	800_GLDM_GLNU	0.07955	0.81274
0_GLDM_SDE	0.65474	0.59176	400_GLDM_SDE	0.84738	0.33693	800_GLDM_SDE	0.47945	0.27650
0_GLDM_SDHGLE	0.21132	0.83737	400_GLDM_SDHGLE	0.62615	0.18281	800_GLDM_SDHGLE	0.37855	0.67297
0_GLDM_DNUN	0.03775	0.09077	400_GLDM_DNUN	0.62417	0.84199	800_GLDM_DNUN	0.61306	0.06011
0_GLDM_LDE	0.64089	0.82734	400_GLDM_LDE	0.12610	0.78116	800_GLDM_LDE	0.74830	0.91214
0_GLDM_LDLGLE	0.63669	0.73195	400_GLDM_LDLGLE	0.42363	0.82983	800_GLDM_LDLGLE	0.88065	0.14408
0_GLDM_DV	0.07196	0.63532	400_GLDM_DV	0.78391	0.64498	800_GLDM_DV	0.15391	0.51572
0_GLDM_LDHGLE	0.20822	0.34933	400_GLDM_LDHGLE	0.03833	0.03772	800_GLDM_LDHGLE	0.24765	0.05344
0_GLDM_SDLGLE	0.24268	0.85902	400_GLDM_SDLGLE	0.80892	0.62407	800_GLDM_SDLGLE	0.15307	0.76294
0_GLDM_LGLE	0.73558	0.82967	400_GLDM_LGLE	0.42489	0.12569	800_GLDM_LGLE	0.86000	0.29396
0_GLCM_JointAverage	0.77237	0.09053	400_GLCM_JointAverage	0.81691	0.97923	800_GLCM_JointAverage	0.22724	0.89471
0_GLCM_SumAverage	0.85198	0.94856	400_GLCM_SumAverage	0.81170	0.87388	800_GLCM_SumAverage	0.44759	0.86828
0_GLCM_JointEntropy	0.02806	0.44033	400_GLCM_JointEntropy	0.76845	0.44060	800_GLCM_JointEntropy	0.02067	0.52672
0_GLCM_ClusterShade	0.57256	0.38388	400_GLCM_ClusterShade	0.72376	0.70311	800_GLCM_ClusterShade	0.05757	0.02597
0_GLCM_MaxProb	0.77235	0.27575	400_GLCM_MaxProb	0.48646	0.63104	800_GLCM_MaxProb	0.34786	0.22999
0_GLCM_Idmn	0.67353	0.00935	400_GLCM_Idmn	0.04027	0.01581	800_GLCM_Idmn	0.34010	0.03584
0_GLCM_JointEnergy	0.70536	0.86092	400_GLCM_JointEnergy	0.10226	0.88813	800_GLCM_JointEnergy	0.43231	0.11088

0_GLCM_Contrast	0.07433	0.48787	400_GLCM_Contrast	0.87087	0.08412	800_GLCM_Contrast	0.61256	0.06597
0_GLCM_DiffEntropy	0.98552	0.35137	400_GLCM_DiffEntropy	0.81567	0.25068	800_GLCM_DiffEntropy	0.46131	0.40568
0_GLCM_InveVariance	0.77768	0.73103	400_GLCM_InveVariance	0.46459	0.15497	800_GLCM_InveVariance	0.16150	0.81360
0_GLCM_DiffVariance	0.57928	0.99887	400_GLCM_DiffVariance	0.61518	0.59538	800_GLCM_DiffVariance	0.80139	0.14420
0_GLCM_Idn	0.05701	0.08144	400_GLCM_Idn	0.49617	0.73251	800_GLCM_Idn	0.02372	0.03571
0_GLCM_Idm	0.76841	0.81802	400_GLCM_Idm	0.00743	0.66092	800_GLCM_Idm	0.96868	0.18296
0_GLCM_Correlation	0.89565	0.26845	400_GLCM_Correlation	0.27445	0.52655	800_GLCM_Correlation	0.58253	0.12679
0_GLCM_Autocorrelation	0.97364	0.77632	400_GLCM_Autocorrelation	0.98039	0.06393	800_GLCM_Autocorrelation	0.03363	0.78297
0_GLCM_SumEntropy	0.71970	0.10435	400_GLCM_SumEntropy	0.30892	0.98739	800_GLCM_SumEntropy	0.13870	0.78528
0_GLCM_MCC	0.69513	0.34019	400_GLCM_MCC	0.72780	0.28154	800_GLCM_MCC	0.04476	0.56951
0_GLCM_SumSquares	0.29646	0.92004	400_GLCM_SumSquares	0.70717	0.85469	800_GLCM_SumSquares	0.30336	0.60180
0_GLCM_ClusProm	0.01154	0.03275	400_GLCM_ClusProm	0.01434	0.91788	800_GLCM_ClusProm	0.45039	0.69463
0_GLCM_Imc2	0.85780	0.75589	400_GLCM_Imc2	0.39733	0.79876	800_GLCM_Imc2	0.69699	0.49353
0_GLCM_Imc1	0.66397	0.88390	400_GLCM_Imc1	0.10440	0.08426	800_GLCM_Imc1	0.83259	0.33422
0_GLCM_DiffAverage	0.91066	0.30052	400_GLCM_DiffAverage	0.94947	0.68378	800_GLCM_DiffAverage	0.44867	0.91248
0_GLCM_Id	0.06056	0.61530	400_GLCM_Id	0.05768	0.02714	800_GLCM_Id	0.06874	0.03256
0_GLCM_ClusTendency	0.41019	0.23325	400_GLCM_ClusTendency	0.44066	0.05079	800_GLCM_ClusTendency	0.13938	0.25848
0_IH_InteRange	0.72162	0.38343	400_IH_InteRange	0.94575	0.26307	800_IH_InteRange	0.10081	0.32530
0_IH_Skewness	0.03651	0.09682	400_IH_Skewness	0.03897	0.85327	800_IH_Skewness	0.04957	0.57676
0_IH_Uniformity	0.29621	0.01713	400_IH_Uniformity	0.11174	0.23486	800_IH_Uniformity	0.79234	0.98001
0_IH_Median	0.39108	0.19196	400_IH_Median	0.26114	0.48813	800_IH_Median	0.02582	0.11800
0_IH_Energy	0.32509	0.44581	400_IH_Energy	0.30080	0.19709	800_IH_Energy	0.52702	0.43548
0_IH_RMAD	0.89143	0.40009	400_IH_RMAD	0.15048	0.21100	800_IH_RMAD	0.63687	0.54272
0_IH_MAD	0.04192	0.30427	400_IH_MAD	0.82332	0.03367	800_IH_MAD	0.76881	0.03050
0_IH_TotalEnergy	0.37948	0.59585	400_IH_TotalEnergy	0.68957	0.38192	800_IH_TotalEnergy	0.94999	0.70039
0_IH_Maximum	0.45238	0.49092	400_IH_Maximum	0.38266	0.23503	800_IH_Maximum	0.55925	0.62813

0_IH_RMS	0.83467	0.37072	400_IH_RMS	0.81456	0.27675	800_IH_RMS	0.66269	0.89688
0_IH_89Percentile	0.57357	0.15021	400_IH_89Percentile	0.35848	0.65333	800_IH_89Percentile	0.23339	0.51347
0_IH_Minimum	0.76729	0.51985	400_IH_Minimum	0.69302	0.31220	800_IH_Minimum	0.29666	0.74752
0_IH_Entropy	0.57882	0.94492	400_IH_Entropy	0.05422	0.02194	800_IH_Entropy	0.02166	0.01941
0_IH_Range	0.57329	0.52029	400_IH_Range	0.04994	0.59252	800_IH_Range	0.01604	0.76382
0_IH_Variance	0.54923	0.97969	400_IH_Variance	0.47539	0.82390	800_IH_Variance	0.67913	0.00666
0_IH_9Percentile	0.09778	0.49394	400_IH_9Percentile	0.68602	0.52199	800_IH_9Percentile	0.67726	0.60107
0_IH_Kurtosis	0.04817	0.02548	400_IH_Kurtosis	0.42783	0.09702	800_IH_Kurtosis	0.09748	0.06094
0_IH_Mean	0.50919	0.58930	400_IH_Mean	0.91341	0.15204	800_IH_Mean	0.02838	0.47287
0_GLRLM_SRLGLE	0.20461	0.42568	400_GLRLM_SRLGLE	0.55873	0.67935	800_GLRLM_SRLGLE	0.63880	0.44193
0_GLRLM_GLV	0.07979	0.28769	400_GLRLM_GLV	0.85480	0.77490	800_GLRLM_GLV	0.82213	0.65266
0_GLRLM_LGLRE	0.48404	0.43732	400_GLRLM_LGLRE	0.14600	0.51265	800_GLRLM_LGLRE	0.89984	0.98959
0_GLRLM_GLNUN	0.39758	0.06702	400_GLRLM_GLNUN	0.92103	0.55376	800_GLRLM_GLNUN	0.02295	0.39064
0_GLRLM_RunVariance	0.53270	0.87550	400_GLRLM_RunVariance	0.01894	0.77742	800_GLRLM_RunVariance	0.21595	0.99508
0_GLRLM_GLN	0.80942	0.37014	400_GLRLM_GLN	0.44304	0.56671	800_GLRLM_GLN	0.91623	0.39517
0_GLRLM_LRE	0.23222	0.47415	400_GLRLM_LRE	0.10653	0.05609	800_GLRLM_LRE	0.65837	0.37057
0_GLRLM_SRHGLE	0.44596	0.57411	400_GLRLM_SRHGLE	0.26196	0.01382	800_GLRLM_SRHGLE	0.99381	0.08698
0_GLRLM_RLNU	0.65729	0.01592	400_GLRLM_RLNU	0.53155	0.44081	800_GLRLM_RLNU	0.86361	0.63889
0_GLRLM_SRE	0.53328	0.21220	400_GLRLM_SRE	0.03040	0.75895	800_GLRLM_SRE	0.94756	0.98639
0_GLRLM_LRHGLE	0.36449	0.33966	400_GLRLM_LRHGLE	0.44649	0.20620	800_GLRLM_LRHGLE	0.05069	0.02844
0_GLRLM_RunPercentage	0.00397	0.39379	400_GLRLM_RunPercentage	0.00398	0.06478	800_GLRLM_RunPercentage	0.24447	0.58279
0_GLRLM_LRLGLE	0.92669	0.84644	400_GLRLM_LRLGLE	0.90007	0.08649	800_GLRLM_LRLGLE	0.92655	0.50590
0_GLRLM_RunEntropy	0.05227	0.34858	400_GLRLM_RunEntropy	0.04438	0.96074	800_GLRLM_RunEntropy	0.03301	0.20791
0_GLRLM_HGLRE	0.36606	0.23237	400_GLRLM_HGLRE	0.83981	0.94693	800_GLRLM_HGLRE	0.86802	0.09556
0_GLRLM_RLNUN	0.99056	0.05975	400_GLRLM_RLNUN	0.07143	0.03172	800_GLRLM_RLNUN	0.65129	0.75432
0_GLSZM_GLV	0.00341	0.96951	400_GLSZM_GLV	0.85121	0.01175	800_GLSZM_GLV	0.94678	0.22717

0_GLSZM_ZoneVariance	0.06539	0.08053	400_GLSZM_ZoneVariance	0.27435	0.69059	800_GLSZM_ZoneVariance	0.78235	0.60901
0_GLSZM_GLNUN	0.10561	0.60905	400_GLSZM_GLNUN	0.83545	0.54277	800_GLSZM_GLNUN	0.45669	0.09329
0_GLSZM_SZNUM	0.70840	0.39644	400_GLSZM_SZNUM	0.78129	0.70356	800_GLSZM_SZNUM	0.38719	0.10895
0_GLSZM_SZNU	0.46293	0.62187	400_GLSZM_SZNU	0.08805	0.23816	800_GLSZM_SZNU	0.41080	0.06292
0_GLSZM_GLNU	0.31377	0.57694	400_GLSZM_GLNU	0.74676	0.13226	800_GLSZM_GLNU	0.99355	0.90497
0_GLSZM_LAE	0.70175	0.60497	400_GLSZM_LAE	0.68423	0.89180	800_GLSZM_LAE	0.03678	0.72830
0_GLSZM_SAHGLE	0.30229	0.06161	400_GLSZM_SAHGLE	0.22901	0.79274	800_GLSZM_SAHGLE	0.84887	0.28045
0_GLSZM_ZonePercentage	0.64132	0.23141	400_GLSZM_ZonePercentage	0.52859	0.01869	800_GLSZM_ZonePercentage	0.09314	0.05429
0_GLSZM_LALGLE	0.65975	0.36466	400_GLSZM_LALGLE	0.90206	0.19572	800_GLSZM_LALGLE	0.27471	0.84472
0_GLSZM_LAHGLE	0.66143	0.13620	400_GLSZM_LAHGLE	0.28351	0.44392	800_GLSZM_LAHGLE	0.76596	0.06074
0_GLSZM_HGLZE	0.57001	0.21297	400_GLSZM_HGLZE	0.24894	0.57008	800_GLSZM_HGLZE	0.33628	0.78386
0_GLSZM_SAE	0.01739	0.06478	400_GLSZM_SAE	0.91976	0.19139	800_GLSZM_SAE	0.56793	0.86145
0_GLSZM_LGLZE	0.64226	0.29951	400_GLSZM_LGLZE	0.85601	0.76937	800_GLSZM_LGLZE	0.08349	0.70050
0_GLSZM_ZoneEntropy	0.07493	0.34890	400_GLSZM_ZoneEntropy	0.03322	0.58257	800_GLSZM_ZoneEntropy	0.84392	0.87586
0_GLSZM_SALGLE	0.50872	0.61300	400_GLSZM_SALGLE	0.52066	0.03303	800_GLSZM_SALGLE	0.54754	0.39133
0_NGTDM_Coarseness	0.14461	0.34716	400_NGTDM_Coarseness	0.01181	0.72263	800_NGTDM_Coarseness	0.32453	0.04039
0_NGTDM_Complexity	0.04305	0.22044	400_NGTDM_Complexity	0.75594	0.86037	800_NGTDM_Complexity	0.31410	0.55346
0_NGTDM_Strength	0.41766	0.13776	400_NGTDM_Strength	0.84589	0.58251	800_NGTDM_Strength	0.09148	0.90963
0_NGTDM_Contrast	0.83210	0.09638	400_NGTDM_Contrast	0.23227	0.02207	800_NGTDM_Contrast	0.69821	0.61651
0_NGTDM_Busyness	0.00545	0.61649	400_NGTDM_Busyness	0.08669	0.02935	800_NGTDM_Busyness	0.03582	0.09703

Features with *P* value < 0.1 were labeled with pink color and removed. IH: Intensity histogram; GLDM: Gray-level dependence matrix; GLCM: Gray-level cooccurrence matrix; GLRLM: Gray-level run-length matrix; NGTDM: Neighboring gray-tone difference matrix.

Table S4. The results of RELIEFF selection of plan 2.

GLDM_Features	Ranking Weights	GLCM_Features	Ranking Weights	GLDM_Features	Ranking Weights	GLCM_Features	Ranking Weights
0_GLDM_DV	0.0054	0_GLCM_JointEntropy	0.0055	0_GLDM_DE	0.0088	0_GLCM_Idmn	0.0117
0_GLDM_DNUN	0.0060	0_GLCM_Idn	0.0107	0_GLDM_DNUN	0.0062	0_GLCM_ClusProm	0.0070
0_GLDM_DE	0.0114	0_GLCM_Id	-0.0037	0_GLDM_GLNU	0.0079	0_GLCM_Idn	-0.0078
400_GLDM_DE	0.0129	0_GLCM_Contrast	0.0130	0_GLDM_HGLE	0.0054	0_GLCM_JointAverage	0.0073
400_GLDM_DNU	0.0038	0_GLCM_ClusProm	0.0015	400_GLDM_DE	0.0116	400_GLCM_Autocorrelation	0.0014
400_GLDM_LDHGLE	0.0012	400_GLCM_ClusProm	0.0073	400_GLDM_LDHGLE	-0.0069	400_GLCM_ClusTendency	-0.0019
800_GLDM_GLNU	0.0091	400_GLCM_Id	0.0091	800_GLDM_DNUN	0.0074	400_GLCM_Contrast	0.0140
800_GLDM_GLV	-0.0080	400_GLCM_Idm	0.0035	800_GLDM_LDHGLE	0.0041	400_GLCM_Id	0.0060
		400_GLCM_Idmn	0.0086			400_GLCM_Idmn	0.0033
IH_Features	**Ranking Weights**	800_GLCM_Autocorrelation	0.0061	**IH_Features**	**Ranking Weights**	400_GLCM_Imc1	0.0008
0_IH_Skewness	0.0033	800_GLCM_ClusterShade	0.0087	0_IH_Kurtosis	0.0003	800_GLCM_ClusterShade	0.0053
0_IH_MAD	-0.0093	800_GLCM_Id	-0.0132	0_IH_Skewness	0.0093	800_GLCM_Contrast	-0.0063
0_IH_Kurtosis	0.0018	800_GLCM_Idn	0.0159	0_IH_Uniformity	0.0004	800_GLCM_Id	0.0099
0_IH_9Percentile	0.0019	800_GLCM_JointEntropy	-0.0096	400_IH_Entropy	0.0065	800_GLCM_Idmn	0.0102
400_IH_Entropy	0.0101	800_GLCM_MCC	0.0100	400_IH_Kurtosis	0.0086	800_GLCM_Idn	0.0116
400_IH_Range	0.0041			400_IH_MAD	0.0043		
400_IH_Skewness	0.0124	**GLRLM_Features**	**Ranking Weights**	800_IH_Entropy	0.0094	**GLRLM_Features**	**Ranking Weights**
800_IH_Entropy	0.0001	0_GLRLM_RunPercentage	-0.0056	800_IH_Kurtosis	-0.0007	0_GLRLM_GLNUN	0.0051
800_IH_Kurtosis	0.0048	0_GLRLM_RunEntropy	0.0107	800_IH_MAD	0.0032	0_GLRLM_RLNU	0.0012
800_IH_Mean	-0.0061	0_GLRLM_GLV	0.0074	800_IH_Variance	-0.0022	0_GLRLM_RLNUN	0.0064

800_IH_Median	0.0015	400_GLRLM_RLNUN	0.0017			400_GLRLM_SRHGLE	0.0029
800_IH_Range	-0.0129	400_GLRLM_RunEntropy	0.0023	**GLSZM_Features**	**Ranking Weights**	400_GLRLM_LRE	-0.0036
800_IH_Skewness	0.0113	400_GLRLM_RunPercentage	0.0144	0_GLSZM_SAE	0.0114	400_GLRLM_LRLGLE	0.0057
		400_GLRLM_RunVariance	0.0026	0_GLSZM_SAHGLE	0.0024	400_GLRLM_RLNUN	0.0078
GLSZM_Features	**Ranking Weights**	400_GLRLM_SRE	0.0105	0_GLSZM_ZoneVariance	0.0085	400_GLRLM_RunPercentage	0.0115
0_GLSZM_ZoneVariance	0.0014	800_GLRLM_GLNUN	0.0126	400_GLSZM_GLV	-0.0108	800_GLRLM_HGLRE	-0.0061
0_GLSZM_ZoneEntropy	-0.0095	800_GLRLM_LRHGLE	-0.0083	400_GLSZM_SALGLE	0.0124	800_GLRLM_LRHGLE	-0.0031
0_GLSZM_GLV	0.0012	800_GLRLM_RunEntropy	0.0040	400_GLSZM_ZonePercentage	0.0020	800_GLRLM_SRHGLE	0.0013
0_GLSZM_SAE	0.0040			800_GLSZM_GLNUN	0.0010		
400_GLSZM_SZNU	0.0039	**NGTDM_Features**	**Ranking Weights**	800_GLSZM_LAHGLE	0.0046	**NGTDM_Features**	**Ranking Weights**
400_GLSZM_ZoneEntropy	-0.0074	0_NGTDM_Complexity	0.0047	800_GLSZM_SZNU	-0.0021	0_NGTDM_Contrast	0.0120
800_GLSZM_LAE	0.0033	0_NGTDM_Busyness	0.0055	800_GLSZM_ZonePercentage	-0.0010	400_NGTDM_Busyness	-0.0019
800_GLSZM_LGLZE	0.0121	400_NGTDM_Busyness	0.0066			400_NGTDM_Contrast	0.0035
800_GLSZM_ZonePercentage	0.0086	400_NGTDM_Coarseness	0.0067			800_NGTDM_Busyness	0.0093
		800_NGTDM_Busyness	-0.0035			800_NGTDM_Coarseness	0.0021
		800_NGTDM_Strength	0.0053				

Selected features by RELIEFF were labeled with yellow color. IH: Intensity histogram; GLDM: Gray-level dependence matrix; GLCM: Gray-level cooccurrence matrix; GLRLM: Gray-level run-length matrix; NGTDM: Neighboring gray-tone difference matrix.

Results of feature selection in Plan 1 and Plan 2.

Table S5. The results of feature selection in each plan.

Feature Category	Plan 1		Plan 2	
	Model 1	Model 2	Model 1	Model 2
IH	0_IH_Skewness	400_IH_InteRange	400_IH_Entropy	0_IH_Skewness
	800_IH_Skewness	400_IH_Mean	400_IH_Skewness	400_IH_Kurtosis
	800_IH_Kurtosis	800_IH_Kurtosis	800_IH_Skewness	800_IH_Entropy
GLDM	0_GLDM_DE	0_GLDM_DV	0_GLDM_DE	0_GLDM_DE
	400_GLDM_DV	0_GLDM_SDHGLE	400_GLDM_DE	0_GLDM_GLNU
	400_GLDM_DNUN	800_GLDM_GLV	800_GLDM_GLNU	400_GLDM_DE
GLCM	0_GLCM_JointEntropy	0_GLCM_Id	0_GLCM_Idn	0_GLCM_Idmn
	0_GLCM_Contrast	0_GLCM_Idmn	0_GLCM_Contrast	400_GLCM_Contrast
	800_GLCM_Idn	400_GLCM_SumSquares	800_GLCM_Idn	800_GLCM_Idn
GLRLM	0_GLRLM_RunEntropy	0_GLRLM_HGLRE	0_GLRLM_RunEntropy	0_GLRLM_RLNUN
	0_GLRLM_RunPercentage	400_GLRLM_RLNUN	400_GLRLM_RunPercentage	400_GLRLM_RLNUN
	400_GLRLM_RunEntropy	800_GLRLM_GLN	800_GLRLM_GLNUN	400_GLRLM_RunPercentage
GLSZM	0_GLSZM_SAE	0_GLSZM_HGLZE	0_GLSZM_SAE	0_GLSZM_SAE
	0_GLSZM_GLNUN	400_GLSZM_LALGLE	800_GLSZM_LGLZE	0_GLSZM_ZoneVariance
	400_GLSZM_ZoneEntropy	400_GLSZM_SZNUM	800_GLSZM_ZonePercentage	400_GLSZM_SALGLE
NGTDM	0_NGTDM_Busyness	0_NGTDM_Busyness	0_NGTDM_Busyness	0_NGTDM_Contrast
	400_NGTDM_Busyness	0_NGTDM_Strength	400_NGTDM_Busyness	400_NGTDM_Contrast
	800_NGTDM_Contrast	800_NGTDM_Complexity	400_NGTDM_Coarseness	800_NGTDM_Busyness

IH: Intensity histogram; GLDM: Gray-level dependence matrix; GLCM: Gray-level cooccurrence matrix; GLRLM: Gray-level run-length matrix; NGTDM: Neighboring gray-tone difference matrix.