SUPPLEMENTALS ***For Test Retest Reproducibility Analysis of Lung CT Image Features (JDI)***

Supplemental S.1. Description of the quantitative features used to describe the lung tumors*.

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77	F77	3D-Laws-19(E5 S5 S5 Layer 1)	
78	F78	3D-Laws-20(E5 S5 W5 Layer 1)	
79	F79	3D-Laws-21(E5 W5 E5 Layer 1)	
80	F80	3D-Laws-22(E5 W5 L5 Layer 1)	
81	F81	3D-Laws-23(E5 W5 R5 Layer 1)	
82	F82	3D-Laws-24(E5 W5 S5 Layer 1)	
83	F83	3D-Laws-25(E5 W5 W5 Layer 1)	
84	F84	3D-Laws-26(L5 E5 E5 Layer 1)	
85	F85	3D-Laws-27(L5 E5 L5 Layer 1)	

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92	F92	3D-Laws-34(L5 L5 S5 Layer 1)	
93	F93	3D-Laws-35(L5 L5 W5 Layer 1)	
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101	F101	3D-Laws-43(L5 S5 R5 Layer 1)	
102	F102	3D-Laws-44(L5 S5 S5 Layer 1)	
103	F103	3D-Laws-45(L5 S5 W5 Layer 1)	
104	F104	3D-Laws-46(L5 W5 E5 Layer 1)	
105	F105	3D-Laws-47(L5 W5 L5 Layer 1)	
106	F106	3D-Laws-48(L5 W5 R5 Layer 1)	
107	F107	3D-Laws-49(L5 W5 S5 Layer 1)	
108	F108	3D-Laws-50(L5 W5 W5 Layer 1)	
109	F109	3D-Laws-51(R5 E5 E5 Layer 1)	
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111	F111	3D-Laws-53(R5 E5 R5 Layer 1)	
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113	F113	3D-Laws-55(R5 E5 W5 Layer 1)	
114	F114	3D-Laws-56(R5 L5 E5 Layer 1)	
115	F115	3D-Laws-57(R5 L5 L5 Layer 1)	
116	F116	3D-Laws-58(R5 L5 R5 Layer 1)	
117	F117	3D-Laws-59(R5 L5 S5 Layer 1)	
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119	F119	3D-Laws-70(R5 R5 E5 Layer 1)	
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122	F122	3D-Laws-73(R5 R5 S5 Layer 1)	
123	F123	3D-Laws-74(R5 R5 W5 Layer 1)	
124	F124	3D-Laws-75(R5 S5 E5 Layer 1)	
125	F125	3D-Laws-76(R5 S5 L5 Layer 1)	
126	F126	3D-Laws-77(R5 S5 R5 Layer 1)	
127	F127	3D-Laws-78(R5 S5 S5 Layer 1)	
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130	F130	3D-Laws-81(R5 W5 L5 Layer 1)	
131	F131	3D-Laws-82(R5 W5 R5 Layer 1)	
132	F132	3D-Laws-83(R5 W5 S5 Layer 1)	
133	F133	3D-Laws-84(R5 W5 W5 Layer 1)	
134	F134	3D-Laws-85(S5 E5 E5 Layer 1)	
135	F135	3D-Laws-86(S5 E5 L5 Layer 1)	

136	F136	3D-Laws-87(S5 E5 R5 Layer 1)	
137	F137	3D-Laws-88(S5 E5 S5 Layer 1)	
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139	F139	3D-Laws-90(S5 L5 E5 Layer 1)	
140	F140	3D-Laws-91(S5 L5 L5 Layer 1)	
141	F141	3D-Laws-92(S5 L5 R5 Layer 1)	
142	F142	3D-Laws-93(S5 L5 S5 Layer 1)	
143	F143	3D-Laws-94(S5 L5 W5 Layer 1)	
144	F144	3D-Laws-95(S5 R5 E5 Layer 1)	
145	F145	3D-Laws-96(S5 R5 L5 Layer 1)	
146	F146	3D-Laws-97(S5 R5 R5 Layer 1)	
147	F147	3D-Laws-98(S5 R5 S5 Layer 1)	
148	F148	3D-Laws-99(S5 R5 W5 Layer 1)	
149	F149	3D-Laws-100(S5 S5 E5 Layer 1)	
150	F150	3D-Laws-101(S5 S5 L5 Layer 1)	
151	F151	3D-Laws-102(S5 S5 R5 Layer 1)	
152	F152	3D-Laws-103(S5 S5 S5 Layer 1)	
153	F153	3D-Laws-104(S5 S5 W5 Layer 1)	
154	F154	3D-Laws-105(S5 W5 E5 Layer 1)	
155	F155	3D-Laws-106(S5 W5 L5 Layer 1)	
156	F156	3D-Laws-107(S5 W5 R5 Layer 1)	
157	F157	3D-Laws-108(S5 W5 S5 Layer 1)	
158	F158	3D-Laws-109(S5 W5 W5 Layer 1)	
159	F159	3D-Laws-110(W5 E5 E5 Layer 1)	
160	F160	3D-Laws-111(W5 E5 L5 Layer 1)	
161	F161	3D-Laws-112(W5 E5 R5 Layer 1)	
162	F162	3D-Laws-113(W5 E5 S5 Layer 1)	
163	F163	3D-Laws-114(W5 E5 W5 Layer 1)	
164	F164	3D-Laws-115(W5 L5 E5 Layer 1)	
165	F165	3D-Laws-116(W5 L5 L5 Layer 1)	
166	F166	3D-Laws-117(W5 L5 R5 Layer 1)	
167	F167	3D-Laws-118(W5 L5 S5 Layer 1)	
168	F168	3D-Laws-119(W5 L5 W5 Layer 1)	
169	F169	3D-Laws-120(W5 R5 E5 Layer 1)	
170	F170	3D-Laws-121(W5 R5 L5 Layer 1)	
171	F171	3D-Laws-122(W5 R5 R5 Layer 1)	
172	F172	3D-Laws-123(W5 R5 S5 Layer 1)	
173	F173	3D-Laws-124(W5 S5 E5 Layer 1)	
174	F174	3D-Laws-125(W5 S5 L5 Layer 1)	
175	F175	3D-Laws-126(W5 R5 W5 Layer 1)	
176	F176	3D-Laws-127(W5 S5 R5 Layer 1)	
177	F177	3D-Laws-128(W5 S5 S5 Layer 1)	
178	F178	3D-Laws-129(W5 S5 W5 Layer 1)	
179	F179	3D-Laws-130(W5 W5 E5 Layer 1)	
180	F180	3D-Laws-131(W5 W5 L5 Layer 1)	
181	F181	3D-Laws-132(W5 W5 R5 Layer 1)	
182	F182	3D-Laws-133(W5 W5 S5 Layer 1)	
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190	F190	3D-Wave-1(P2 L2 C9 Layer 1)	C7. Wavelets Texture
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192	F192	3D-Wave-3(P2 L2 C10 Layer 1)	(feature at different layers)
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194	F194	3D-Wave-5(P2 L2 C12 Layer 1)	
195	F195	3D-Wave-6(P2 L2 C13 Layer 1)	
196	F196	3D-Wave-7(P2 L2 C14 Layer 1)	
197	F197	3D-Wave-8(P2 L2 C15 Layer 1)	
198	F198	3D-Wave-9(P2 L2 C1 Layer 1)	
199	F199	3D-Wave-10(P2 L2 C2 Layer 1)	
200	F200	3D-Wave-11(P2 L2 C3 Layer 1)	
201	F201	3D-Wave-12(P2 L2 C4 Layer 1)	
202	F202	3D-Wave-13(P2 L2 C5 Layer 1)	
203	F203	3D-Wave-14(P2 L2 C6 Layer 1)	
204	F204	3D-Wave-15(P2 L2 C7 Layer 1)	
205	F205	3D-Wave-16(P2 L2 C8 Layer 1)	
206	F206	3D-Wave-17(P1 L2 C11 Layer 1)	
207	F207	3D-Wave-18(P1 L2 C10 Layer 1)	
208	F208	3D-Wave-19(P1 L2 C12 Layer 1)	
209	F209	3D-Wave-20(P1 L2 C13 Layer 1)	
210	F210	3D-Wave-21(P1 L2 C14 Layer 1)	
211	F211	3D-Wave-22(P1 L2 C15 Layer 1)	
212	F212	3D-Wave-23(P1 L2 C1 Layer 1)	
213	F213	3D-Wave-24(P1 L2 C2 Layer 1)	
214	F214	3D-Wave-25(P1 L2 C3 Layer 1)	
215	F215	3D-Wave-26(P1 L2 C4 Layer 1)	
216	F216	3D-Wave-27(P1 L2 C5 Layer 1)	
217	F217	3D-Wave-28(P1 L2 C6 Layer 1)	
218	F218	3D-Wave-29(P1 L2 C7 Layer 1)	
219	F219	3D-Wave-30(P1 L2 C8 Layer 1)	
**See description in (1)*			

Supplemental S.2. Description of Texture Features

A. **Run-length analysis:** Run-length texture features (2) examine runs of similar gray values in an image. Runs may be labeled according to their length, gray value, and direction (either horizontal or vertical). Long runs of the same gray value correspond to coarser textures, whereas shorter runs correspond to finer textures. In our study, texture information was quantified by computing 11 features (3) derived from the run-length distribution matrix. They are: 1: Short Run Emphasis (SRE). 2: Long Run Emphasis (LRE). 3: Gray-Level Non-uniformity (GLN). 4: Run Length Non-uniformity (RLN). 5: Run Percentage (RP). 6: Low Gray-Level Run Emphasis (LGRE). 7: High Gray-Level Run Emphasis (HGRE). 8: Short Run Low Gray-Level Emphasis (SRLGE). 9: Short Run High Gray-Level Emphasis (SRHGE). 10: Long Run Low Gray-Level Emphasis (LRLGE). 11: Long Run High Gray-Level Emphasis (LGHGE).

Let $p(i,j)$ be the element of run-length matrix, let M be the number of gray levels, N be the maximum run length. n_r is the total number of runs, n_p is the number of pixels in the image. Define 3 new matrices first.

(a) $p_p(i,j) = p(i,j) * j$
(b) $p_g(i) = \sum_{j=1}^{N} p(i,j)$
(c) $p_r(j) = \sum_{i=1}^{M} p(i,j)$

1. Short Run Emphasis (SRE). $SRE = \frac{1}{n_r} \sum_{j=1}^{N} \frac{p_r(j)}{j^2}$
2. Long Run Emphasis (LRE). $LRE = \frac{1}{n_r} \sum_{j=1}^{N} p_r(j) * j^2$
3. Gray-Level Nonuniformity. $GLN = \frac{1}{n_r} \sum_{i=1}^{M} p_g(i)^2$

4. Run Length Nonuniformity. $RLN=\frac{1}{n_r}\sum_{j=1}^{N} p_r(j)^2$
5. Run Percentage. $RP=\frac{n_r}{n_p}$
6. Low Gray-Level Run Emphasis. $LGRE=\frac{1}{n_r}\sum_{i=1}^{M} \frac{p_g(i)}{i^2}$
7. High Gray-Level Run Emphasis. $HGRE=\frac{1}{n_r}\sum_{i=1}^{M} p_g(i) * i^2$
8. Short Run Low Gray-Level Emphasis.
   $SRLGE=\frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N} \frac{p(i,j)}{i^{2*}j^2}$
9. Short Run High Gray-Level Emphasis.
   $SRHGE=\frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N} \frac{p(i,j)*i^2}{j^2}$
10. Long Run Low Gray-Level Emphasis.
    $LRLGE=\frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N} \frac{p(i,j)*j^2}{i^2}$
11. Long Run High Gray-Level Emphasis.

    $LRHGE=\frac{1}{n_r}\sum_{i=1}^{M}\sum_{j=1}^{N} p(i,j) * i^2 * j^2$

The Co-occurrence matrices and run-length analysis features can be obtained in 3D (4), the features are calculated in 13 different directions, with each direction, processing is done by plane instead of slice. Hence, information between slices is not ignored.

B. **Co-occurrence matrices:** the co-occurrence matrix (5) is a matrix that contains the frequency of one gray level intensity appearing in a specified spatial linear relationship with another gray level intensity within a certain range. Computation of features requires first constructing the co-occurrence matrix, then different measurements (6) can be calculated based on the matrix. The measurements include: contrast, energy, homogeneity, entropy, mean and max probability.

Let $p(i,j)$ be the element of the co-occurrence matrix.

1. Contrast=$\sum_{i,j} |i-j|^2 * p(i,j)$
2. Energy=$\sum_{i,j} p(i,j) * p(i,j)$
3. Homogeneity=$\sum_{i,j} \frac{p(i,j)}{1+|i-j|}$
4. Entropy=$-\sum_{i,j} p(i,j) * \log(p(i,j))$
5. Sum Mean=0.5*$\sum_{i,j}(i+j) * p(i,j)$

Max probability=max($p(i,j)$).

C. **Laws features :** Laws features (7) were constructed from a set of five one-dimensional filters, each designed to reflect a different type of structure in the image. These one-dimensional filters are defined as E5 (edges), S5 (spots), R5 (ripples), W5 (waves), and L5 (low pass, or average gray value). By using these 1-D convolution filters, 2-D filters are generated by convolving pairs of these filters, such as L5L5, E5L5, S5L5, W5L5, R5L5, etc. Totally we can generate 25 different 2-D filters. 3D laws filters were constructed similarly to 2D. 3D filters are generated by convolving 3 types of 1D filter, such as L5L5L5, L5L5E5, L5L5S5, L5L5R5, L5L5W5, etc. The total number of 3-D filters is 125. For the 3D case, after the convolution with the 3D filters for the image, the energy (8) of the texture feature was computed by the following equation:

$$Energy = \frac{1}{R}\sum_{i=N+1}^{I-N}\sum_{j=N+1}^{J-N}\sum_{k=N+1}^{K-N} h^2(i,j,k),$$

where R is a normalizing factor, I and J, K are image dimensions, h(i,j,k) is derived from the convolution filters and original image. For the 2D case, the above equation is very similar, but without the 3rd (z direction) dimension.

D. Wavelet Decomposition: the discrete wavelet transform (9) can iteratively decompose an image (2D) into four components. Each iteration splits the image both horizontally and vertically into low-frequency (low pass) and high-frequency (high pass) components. Thus, four components are generated: a high-pass/high-pass component consisting of mostly diagonal structure, a high-pass/low-pass component consisting mostly of vertical structures, a low-pass/high-pass component consisting mostly of horizontal structure, and a low-pass/low-pass component that represents a blurred version of the original image. Subsequent iterations then repeat the decomposition on the low-pass/low-pass component from the previous iteration. These subsequent iterations highlight broader diagonal, vertical, and horizontal textures. And for each component, we calculated the energy (referred to with a suffix P1) & entropy (referred to with a suffix P2) feature. A wavelet transform of a 3D signal can be achieved by applying the 1D wavelet transform along all the three directions (x,y,z). Featured obtained in each level of decomposition is referred with suffix L (example: L1, L2) and level of decomposition is referred to with a prefix C (example: C1 to C9).

$$Energy = \frac{1}{MxNxL}\sum_{i=1}^{M}\sum_{j=1}^{N}\sum_{k=1}^{L} I^2(i,j,k)$$

$$Entropy = \frac{-1}{MxNxL}\sum_{i=1}^{M}\sum_{j=1}^{N}\sum_{k=1}^{L}\left(\frac{I^2(i,j,k)}{norm^2}\right)\log\left(\frac{I^2(i,j,k)}{norm^2}\right)$$

$I(i,j,k)$ shows the subblock elements and M, N, and L are the dimensions of each subblock and

$$norm^2 = \sum_i \sum_j \sum_k I^2(i,j,k)$$

The number of features really depends on the number of decomposition level selected. 1 level: 2* 8(block) = 16 features, In 2 levels: 2* 15(block) = 30 features

E. Pixel Histogram Features: the pixel intensity histogram h(a) is the number of pixels that occurred for brightness level "a" plotted against their brightness level. The probability distribution of the brightness Prob(a) can be calculated as well. Six features: mean, standard deviation, skewness, kurtosis, energy, and entropy were then incorporated.

$$\text{mean}=\sum_{i=1}^{range} i * prob(i)$$

$$\text{sd}=\sqrt{\sum_{i=1}^{range}(i-mean)^2 * prob(i)}$$

$$\text{skewness}=\frac{\sum_{i=1}^{range}(i-mean)^3 * prob(i)}{(\sum_{i=1}^{range}(i-mean)^2 * prob(i))^{1.5}}$$

$$\text{kurtosis}=\frac{\sum_{i=1}^{range}(i-mean)^4 * prob(i)}{(\sum_{i=1}^{range}(i-mean)^2 * prob(i))^2}$$

$$\text{energy}=\sum_{i=1}^{range} prob(i) * prob(i)$$

$$\text{entropy}=-\sum_{i=1}^{range} prob(i) * Log(prob(i))$$

Where intensity range is [0,range] (normalized).

F. Tumor Shape & Size: In additional to direct size (Univariate, bivariate) and volume measurement various surrounding tumor parenchyma are measured, some of such measurements are described below.

Border Length:

The border length of a 3D image object is the sum of border lengths of all image object slices multiplied by the spatial distance between the slices.

$$b_v = \left(\sum_{n=1}^{\#(slices)} b_v\,(Slice) \right) * u_{slices} + b_v(Z)$$

Where, b_v: border length of image object v, b_v(slice): border length of image object slice, b_v(z): border length of image object in z-direction, u_{slices}: spatial distance between slices in the coordinate system unit.

Asymmetry:

The asymmetry (Asy) is calculated from the ratio between the smallest and largest eigenvalues of the image object.

$$Asy = 1 - \frac{\sqrt{\lambda_{min}}}{\sqrt{\lambda_{max}}}$$

Where λmin is the minimal eigenvalue and λmax is the maximal eigenvalue.

Compactness: The compactness (Comp) of a 3D image object is calculated by a scaled product of its three eigenvalues 2∗λ1, 2∗λ2, 2∗λ3 divided by the number of its pixel/voxel.

$$Comp = 2\,\lambda 1 * 2\,\lambda 2 * 2\,\lambda 3 / Vv$$

Where, λ1: eigenvalue 1 of a 3D image object v, λ2: eigenvalue 2 of a 3D image

object v, λ3: eigenvalue 3 of a 3D image object v, Vv: volume of image object v.

Density:

The Density(D) feature describes the spatial distribution of the pixels of an Image object. The ideal compact shape on a pixel raster is the cube. The more the shape of an image object is like a cube, the higher its density

$$D = \frac{\sqrt[3]{V_v}}{\sqrt{Var(X)+Var(Y)+Var(Z)}}$$

Where, Vv: volume of image object v, 3√V: edge of the volume fitted cube, √Var(X) + Var(Y) + Var (Z): radius of the fitted sphere

Roundness: Describes how much the shape of an image object is similar to an ellipsoid. The more the shape of an image object is similar to an ellipsoid, the lower its roundness. It is calculated by the difference of the enclosing ellipsoid and the enclosed ellipsoid.

$$Roundness = \varepsilon_v^{max} - \varepsilon_v^{min}$$

Where εv (max) is the: radius of smallest enclosing ellipsoid

Ev (min) is the radius of largest enclosed ellipsoid

Supplemental Table S.3. Representative features at different cutoffs.

A) Number of Features

Manual Segmentation:					
CCC_{TreT} & DR ≥ 0.95	**Combine features with R^2_{Bet}**				
Category	$R^2_{Bet} \geq 0.99$	$R^2_{Bet} \geq 0.95$	$R^2_{Bet} \geq 0.90$	$R^2_{Bet} \geq 0.85$	$R^2_{Bet} \geq 0.75$
C1: Tumor Size	10	9	2	1	1
C2:Tumor Shape	2	2	2	2	2
C3:Tumor Location	6	6	5	5	4
C4:Histogram	3	3	3	3	2
C5:Grayscale	4	4	3	3	3
C6:Laws	2	2	1	1	1
C7:Wavelets	3	2	1	1	1
Total	30	28	17	16	14
CCC_{TreT} & DR ≥ 0.90	**Combine features with R^2_{Bet}**				
Category	$R^2_{Bet} \geq 0.99$	$R^2_{Bet} \geq 0.95$	$R^2_{Bet} \geq 0.90$	$R^2_{Bet} \geq 0.85$	$R^2_{Bet} \geq 0.75$
C1: Tumor Size	11	10	3	2	2
C2:Tumor Shape	5	5	5	5	5
C3:Tumor Location	9	9	8	8	7
C4:Histogram	5	5	5	4	2
C5:Grayscale	5	5	4	4	4
C6:Laws	12	5	2	1	1
C7:Wavelets	4	3	1	1	1
Total	**51**	**42**	**28**	**25**	**22**
CCC_{TreT} & DR ≥ 0.85	**Combine features with R^2_{Bet}**				
Category	$R^2_{Bet} \geq 0.99$	$R^2_{Bet} \geq 0.95$	$R^2_{Bet} \geq 0.90$	$R^2_{Bet} \geq 0.85$	$R^2_{Bet} \geq 0.75$
C1: Tumor Size	11	10	3	2	2
C2:Tumor Shape	6	6	6	6	6
C3:Tumor Location	11	11	10	10	8
C4:Histogram	7	7	7	6	4
C5:Grayscale	5	5	4	4	4
C6:Laws	33	11	3	2	2
C7:Wavelets	4	3	1	1	1
Total	77	53	34	31	27

B) Features details at different cutoffs.

1. **Cutoff: $CCC_{TreT} \geq 0.95$ & DR ≥ 0.95:** Representative Feature obtained at different R^2_{Bet} Settings: (*prefix represent feature index in the total list of 219*).

Category C1:

Representative Features (10): *Combine features with $R^2_{Bet} \geq 0.99$*

F1:LongDia; F2:ShortAx-LongDia; F3:ShortAx; F6:Vol-cm; F33:Area-Pxl; F34:Volume-pxl; F36:Width-Pxl ; F37:Thickness-Pxl; F38:Length-Pxl; F41:Border-Leng-Pxl

Representative Features (9): *Combine features with $R^2_{Bet} \geq 0.95$*

F1:LongDia; F2:ShortAx-LongDia; F3:ShortAx; F6:Vol-cm; F33:Area-Pxl; F36:Width-Pxl; F37:Thickness-Pxl; F38:Length-Pxl; F41:Border-Leng-Pxl

Representative Features (2): *Combine features with $R^2_{Bet} \geq 0.90$*

F6:Vol-cm; F38:Length-Pxl

Category C2:

Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.99$ / 0.95/ 0.90*

F14:9c-3D-Compact; F30:Shape-Index

Category C3:

Representative Features (6): *Combine features with $R^2_{Bet} \geq 0.99/0.95$*

F9:8b-3D-Bord-to-Lung; F15:9d-3D-AV-Dist-COG-to-Border; F18:9g-3D-Max-Dist-COG-to-Border; F19:10a-3D-Relat-Vol-Airspaces; F21:10c-3D-Av-Vol-AirSpaces; F22:10d-3D-SD-Vol-AirSpaces

Representative Features (5): *Combine features with $R^2_{Bet} \geq 0.90$*

F9:8b-3D-Bord-to-Lung; F15:9d-3D-AV-Dist-COG-to-Border
F19:10a-3D-Relat-Vol-Airspaces; F21:10c-3D-Av-Vol-AirSpaces; F22:10d-3D-SD-Vol-AirSpaces

Category C4:

Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.99/0.95/0.90$*

F4:Mn-Hu; F186:Hist-Energy-L1; F188:Hist-Kurt-L1

Category C5:

Representative Features (4): *Combine features with $R^2_{Bet} \geq 0.99/0.95$*

F48:AvgGLN; F51:AvgLRE; F54:AvgRLN; F55:AvgRP

Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.90$*

F48:AvgGLN; F51:AvgLRE; F54:AvgRLN

Category C6:

Representative Features (2): *Combine features with $R^2_{Bet} \geq 0.99/0.95$*

F74:3D-Laws-16; F99:3D-Laws-41

Representative Features (2): *Combine features with $R^2_{Bet} \geq 0.90$*

F99:3D-Laws-41

Category C7:

Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.99/0.95$*

F195:3D-WaveP2-L2-6; F198:3D-WaveP2-L2-9; F205:3D-WaveP2-L2-16

Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.95$*

F195:3D-WaveP2-L2-6; F205:3D-WaveP2-L2-16

Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.90$*

F195:3D-WaveP2-L2-6

2. **Cutoff: $CCC_{TreT} \geq 0.9$ & DR ≥ 0.9**

Category C1:

Representative Features (11): *Combine features with $R^2_{Bet} \geq 0.99$* F1:LongDia; F2:ShortAx-LongDia; F3:ShortAx; F6:Vol-cm; F33:Area-Pxl; F34:Volume-pxl; F36:Width-Pxl; F37:Thickness-Pxl; F38:Length-Pxl; F39:Length-by-Thick; F41:Border-Leng-Pxl Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.90$* F6:Vol-cm; F38:Length-Pxl ; F39:Length-by-Thick
Category C2: Representative Features (5): *Combine features with $R^2_{Bet} \geq 0.99 / 0.95/ 0.90$* F14:9c-3D-Compact; F23:Asymmetry; F25:Density; F30:Shape-Index F32:RectangularFit
Category C3: Representative Features (9): *Combine features with $R^2_{Bet} \geq 0.99/0.95$* F8:8a-3D-Attch-Pleural; F9:8b-3D-Bord-to-Lung; F12:9a-3D-FractionalAnisotropy; F15:9d-3D-AV-Dist-COG-to-Border; F17:9f-3D-Min-Dist-COG-to-Border; F18:9g-3D-Max-Dist-COG-to-Border F19:10a-3D-Relat-Vol-Airspaces; F21:10c-3D-Av-Vol-AirSpaces; F22:10d-3D-SD-Vol-AirSpaces Representative Features (8): *Combine features with $R^2_{Bet} \geq 0.90$* F8:8a-3D-Attch-Pleural; F9:8b-3D-Bord-to-Lung; F12:9a-3D-FractionalAnisotropy; F15:9d-3D-AV-Dist-COG-to-Border; F17:9f-3D-Min-Dist-COG-to-Border; F19:10a-3D-Relat-Vol-Airspaces F21:10c-3D-Av-Vol-AirSpaces; F22:10d-3D-SD-Vol-AirSpaces
Category C4: Representative Features (5): *Combine features with $R^2_{Bet} \geq 0.99/0.95/0.90$* F4:Mn-Hu; F185:Hist-SD-L1; F186:Hist-Energy-L1; F187:Hist-Entropy-L1 F188:Hist-Kurt-L1
Category C5: Representative Features (5): *Combine features with $R^2_{Bet} \geq 0.99/0.95$* F44:AvgCooC-Constrast; F48:AvgGLN; F51:AvgLRE; F54:AvgRLN; F55:AvgRP Representative Features (4): *Combine features with $R^2_{Bet} \geq 0.90$* F44:AvgCooC-Constrast; F48:AvgGLN; F51:AvgLRE; F54:AvgRLN
Category C6: Representative Features (12): *Combine features with $R^2_{Bet} \geq 0.99$* F59:3D-Laws-1; F74:3D-Laws-16; F75:3D-Laws-17; F77:3D-Laws-19; F78:3D-Laws-20; F99:3D-Laws-41; F102:3D-Laws-44; F103:3D-Laws-45; F127:3D-Laws-78; F128:3D-Laws-79; F149:3D-Laws-100; F152:3D-Laws-103 Representative Features (2): *Combine features with $R^2_{Bet} \geq 0.90$* F99:3D-Laws-41; F128:3D-Laws-79
Category C7: Representative Features (4): *Combine features with $R^2_{Bet} \geq 0.99$* F195:3D-WaveP2-L2-6; F198:3D-WaveP2-L2-9; F204:3D-WaveP2-L2-15; F205:3D-WaveP2-L2-16 Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.90$* F195:3D-WaveP2-L2-6

3. **Cutoff: $CCC_{TreT} \geq 0.85$ & DR ≥ 0.85 :**

Category C1:
Representative Features (11): *Combine features with $R^2_{Bet} \geq 0.99$*
F1:LongDia; F2:ShortAx-LongDia; F3:ShortAx; F6:Vol-cm; F33:Area-Pxl; F34:Volume-pxl; F36:Width-Pxl; F37:Thickness-Pxl; F38:Length-Pxl; F39:Length-by-Thick; F41:Border-Leng-Pxl
Representative Features (10): *Combine features with $R^2_{Bet} \geq 0.95$*
F1:LongDia; F2:ShortAx-LongDia; F3:ShortAx; F6:Vol-cm; F33:Area-Pxl; F36:Width-Pxl; F37:Thickness-Pxl; F38:Length-Pxl; F39:Length-by-Thick; F41:Border-Leng-Pxl
Representative Features (3): *Combine features with $R^2_{Bet} \geq 0.90$*
F6:Vol-cm; F38:Length-Pxl; F39:Length-by-Thick

Category C2:
Representative Features (6): *Combine features with $R^2_{Bet} \geq 0.99$ / 0.95/ 0.90*
F14:9c-3D-Compact ; F23:Asymmetry; F25:Density; F26:EllipticFit
F30:Shape-Index; F32:RectangularFit

Category C3:

Representative Features (11): *Combine features with $R^2_{Bet} \geq 0.99$ /0.95*
F8:8a-3D-Attch-Pleural; F9:8b-3D-Bord-to-Lung; F12:9a-3D-FractionalAnisotropy; F15:9d-3D-AV-Dist-COG-to-Border; F16:9e-3D-SD-Dist-COG-to-Border; F17:9f-3D-Min-Dist-COG-to-Border; F18:9g-3D-Max-Dist-COG-to-Border; F19:10a-3D-Relat-Vol-Airspaces
F21:10c-3D-Av-Vol-AirSpaces; F22:10d-3D-SD-Vol-AirSpaces; F27:Main-Direction

Representative Features (10): *Combine features with $R^2_{Bet} \geq 0.90$*
F8:8a-3D-Attch-Pleural; F9:8b-3D-Bord-to-Lung; F12:9a-3D-FractionalAnisotropy; F15:9d-3D-AV-Dist-COG-to-Border; F16:9e-3D-SD-Dist-COG-to-Border; F17:9f-3D-Min-Dist-COG-to-Border; F19:10a-3D-Relat-Vol-Airspaces; F21:10c-3D-Av-Vol-AirSpaces
F22:10d-3D-SD-Vol-AirSpaces; F27:Main-Direction

Category C4:
Representative Features (7): *Combine features with $R^2_{Bet} \geq 0.99$ /0.95/0.90*
F4:Mn-Hu; F5:Std-Hu; F185:Hist-SD-L1; F186:Hist-Energy-L1; F187:Hist-Entropy-L1
F188:Hist-Kurt-L1; F189:Hist-Skew-L1

Category C5:
Representative Features (5): *Combine features with $R^2_{Bet} \geq 0.99$ /0.95*
F44:AvgCooC-Constrast; F48:AvgGLN; F51:AvgLRE; F54:AvgRLN; F55:AvgRP

Representative Features (4): *Combine features with $R^2_{Bet} \geq 0.90$*
F44:AvgCooC-Constrast; F48:AvgGLN; F51:AvgLRE; F54:AvgRLN

Category C6:

Representative Features (33): *Combine features with $R^2_{Bet} \geq 0.99$*
F59:3D-Laws-1; F62:3D-Laws-4; F64:3D-Laws-6; F67:3D-Laws-9; F69:3D-Laws-11; F72:3D-Laws-14; F74:3D-Laws-16; F75:3D-Laws-17; F77:3D-Laws-19; F78:3D-Laws-20; F99:3D-Laws-41; F102:3D-Laws-44; F103:3D-Laws-45; F112:3D-Laws-54; F124:3D-Laws-75; F127:3D-Laws-78; F128:3D-Laws-79; F134:3D-Laws-85; F137:3D-Laws-88;F139:3D-Laws-90
F144:3D-Laws-95; F147:3D-Laws-98; F148:3D-Laws-99; F149:3D-Laws-100
F150:3D-Laws-101; F152:3D-Laws-103; F153:3D-Laws-104; F157:3D-Laws-108
F162:3D-Laws-113; F163:3D-Laws-114; F177:3D-Laws-128; F178:3D-Laws-129
F182:3D-Laws-133
Representative Features (11): *Combine features with $R^2_{Bet} \geq 0.95$*
F59:3D-Laws-1; F64:3D-Laws-6; F67:3D-Laws-9; F69:3D-Laws-11; F99:3D-Laws-41; F103:3D-

Laws-45; F112:3D-Laws-54; F124:3D-Laws-75; F128:3D-Laws-79; F147:3D-Laws-98; F163:3D-Laws-114 **Representative Features (3):** *Combine features with* $R^2_{Bet} \geq 0.90$ F64:3D-Laws-6; F69:3D-Laws-11; F99:3D-Laws-41
Category C7: **Representative Features (4):** *Combine features with* $R^2_{Bet} \geq 0.99$ F195:3D-WaveP2-L2-6; F198:3D-WaveP2-L2-9; F204:3D-WaveP2-L2-15; F205:3D-WaveP2-L2-16 **Representative Features (3):** *Combine features with* $R^2_{Bet} \geq 0.95$ F195:3D-WaveP2-L2-6; F204:3D-WaveP2-L2-15; F205:3D-WaveP2-L2-16 **Representative Features (1):** *Combine features with* $R^2_{Bet} \geq 0.90$ F195:3D-WaveP2-L2-6

Supplemental S.4. Radiologist scoring of the lesion on a five point scale (1-5), using five common factors considered to establish prognosis. Each prognostic scoring parameter (*P*) is scaled on a five point scale (*M=5*).

Sample ID	**Longest Diameter (CM)**	**Prognostic Scoring Parameters**					
		P_1: Size-Flag	**P_2:Lobulation**	**P_3:Spiculation**	**P_4:Pleural Attachment**	**P_5:Texture**	**Normalized Prognostic Score:** $(NP = \frac{1}{n*M}\sum_{i=1}^{n=5} P_i)$
1	4.9	3	5	3	3	5	0.76
2	1.59	1	4	2	1	2	0.4
3	1.92	1	3	4	2	5	0.6
4	3.92	3	4	2	3	5	0.68
5	4.8	3	4	1	2	3	0.52
6	5.31	4	2	2	3	5	0.64
7	2.75	2	4	3	3	5	0.68
8	4.94	3	3	1	3	5	0.6
11*	3.62	3	3	4	3	5	0.72
12	1.41	1	2	4	1	5	0.52
13	4.16	3	3	3	4	5	0.72
14	2.71	2	N/A	N/A	5	5	0.48
15	4.05	3	3	2	4	5	0.68
16	2.8	2	2	5	1	5	0.6
17	4.53	3	2	3	3	5	0.64
18	2.61	2	4	5	3	3	0.68
19	1.74	1	2	2	1	2	0.32
20	6.71	4	4	4	2	5	0.76
21	2.84	2	2	2	4	3	0.52
22	3.63	3	3	2	1	3	0.48
23	0.88	1	3	4	1	5	0.56

24	1.81	1	2	4	1	5	0.52
25	3.81	3	2	2	5	5	0.68
26	8.28	5	3	2	3	5	0.72
27	1.94	1	4	4	1	3	0.52
28	4.16	3	4	4	3	5	0.76
29	2.35	2	2	2	3	4	0.52
30	7.87	5	5	2	4	5	0.84
31	4.61	3	3	5	4	5	0.8
32	0.99	1	2	3	3	5	0.56

**Sample index 9, 10 could not be scored based on above criteria and Sample index 14: was scored partly. These three samples were removed for prognostic analysis.*

Supplemental Table S.5. Confidence interval statistics for Univariate, Bivariate and Volumetric feature between Test and Tetest. The Concordance Correlation coefficient with 95% confidence limit are estimated by bootstrap resampling (n=5000).

Feature Name	**CCC (**with Confidence)
Univariate:	
Longest Diameter [mm]	0.9962 (0.9681, 0.9998)
Bivariate:	
Area (Pixel)	0.9907 (0.9481, 0.9997)
Volumetric:	
Volume [cm^3]	0.9935 (0.9583, 0.9997)

Supplemental Table S.6. Number of representative features obtained taking all the categories together after concordance correlation coefficient between the features. (A) Number of features (B) Feature description.

(A)

Conditions	**Number of Features**					
	CCC&DR	**Representative Features:** *Combine features with R-Square (R^2_{Bet}) greater than set value.*				
1.$CCC_{TreT} \geq 0.95$ & DR ≥ 0.95	45	$R^2_{Bet} \geq$ **0.99**	$R^2_{Bet} \geq$ **0.95**	$R^2_{Bet} \geq$ **0.9**	$R^2_{Bet} \geq$ **0.85**	$R^2_{Bet} \geq$ **0.75**
		45	29	21	11	7
2.$CCC_{TreT} \geq 0.90$ & DR ≥ 0.90	66	$R^2_{Bet} \geq$ **0.99**	$R^2_{Bet} \geq$ **0.95**	$R^2_{Bet} \geq$ **0.9**	$R^2_{Bet} \geq$ **0.85**	$R^2_{Bet} \geq$ **0.75**
		49	33	19	17	11
3.$CCC_{TreT} \geq 0.85$ & DR ≥ 0.85	93	$R^2_{Bet} \geq$ **0.99**	$R^2_{Bet} \geq$ **0.95**	$R^2_{Bet} \geq$ **0.9**	$R^2_{Bet} \geq$ **0.85**	$R^2_{Bet} \geq$ **0.75**
		75	44	25	23	16

B. List of representative reproducible Image features that was obtained by combining those with high R^2_{Bet}.

(i) **All Categories:** Representative Feature obtained at different R^2_{Bet} Settings (prefix represent feature index in the total list of 219).

1. $CCC_{TreT} \geq 0.95$ & DR ≥ 0.95 (45 Features)

Representative Features (29): *Combine features with $R^2_{Bet} \geq 0.99$*
Size:
F1:LongDia, F2:ShortAx-LongDia, F3:ShortAx, F6:Vol-cm,
Pixel Intensity Histogram: F4:Mn-Hu,
Location: F9:8b-3D-Bord-to-Lung, F15:9d-3D-AV-Dist-COG-to-Border, F18:9g-3D-Max-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D-SD-Vol-AirSpaces,
Shape- Roundness: F14:9c-3D-Compact, F30:Shape-Index, F33:Area-Pxl, F34:Volume-pxl, F36:Width-Pxl, F37:Thickness-Pxl, F38:Length-Pxl, F41:Border-Leng-Pxl
Texture – Run length: F48:AvgGLN, F51:AvgLRE, F55:AvgRP,
Image Histogram: F186:Hist-Energy-L1, F188:Hist-Kurt-L1,
Texture/Transformed Features: Laws, Wavelets: F74:3D-Laws-16, F99:3D-Laws-41, F195:3D-WaveP2-L2-6, F198:3D-WaveP2-L2-9, F205:3D-WaveP2-L2-16.

Representative Features (21): *Combine features with $R^2_{Bet} \geq 0.95$*
Size: F1:LongDia, F2:ShortAx-LongDia, F3:ShortAx, F6:Vol-cm,
Pixel Intensity Histogram: F4:Mn-Hu,
Location: F9:8b-3D-Bord-to-Lung, F15:9d-3D-AV-Dist-COG-to-Border, F18:9g-3D-Max-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D-SD-Vol-AirSpaces,
Shape - Roundness: F30:Shape-Index, F33:Area-Pxl, F37:Thickness-Pxl,
Texture - Run-length: F48:AvgGLN,
Texture/Transformed Features: Laws, Wavelets: F74:3D-Laws-16, F99:3D-Laws-41, F186:Hist-Energy-L1, F195:3D-WaveP2-L2-6, F205:3D-WaveP2-L2-16.
Image Histogram: F188:Hist-Kurt-L1,

Representative Features (11): *Combine features with* $R^2_{Bet} \geq 0.90$
Shape: F6:Vol-cm,
Location: F9:8b-3D-Bord-to-Lung, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D- SD-Vol-AirSpaces,
Shape – Roundness: F30:Shape-Index,
Texture: Run length: F48:AvgGLN,
Image Histogram: F186:Hist-Energy-L1, F188:Hist-Kurt-L1,
Texture/Transformed: Laws, Wavelets: F99:3D-Laws-41, F195:3D-WaveP2-L2-6.

2. $CCC_{TreT} \geq 0.90$ & DR ≥ 0.90 (66 Features)

Representative Features (50): *Combine features with $R^2_{Bet} \geq 0.99$*
Size: F1:LongDia, F2:ShortAx-LongDia, F3:ShortAx, F6:Vol-cm,
Pixel Intensity Histogram: F4:Mn-Hu,
Location: F8:8a-3D-Attch-Pleural, F9:8b-3D-Bord-to-Lung, F12:9a-3D-FractionalAnisotropy,

F15:9d-3D-AV-Dist-COG-to-Border, F17:9f-3D-Min-Dist-COG-to-Border, F18:9g-3D-Max-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D-SD-Vol-AirSpaces,
Shape - Roundness: F14:9c-3D-Compact, F23:Asymmetry, F25:Density, F30:Shape-Index, F32:RectangularFit, F33:Area-Pxl, F34:Volume-pxl, F36:Width-Pxl, F37:Thickness-Pxl, F38:Length-Pxl, F39:Length-by-Thick, F41:Border-Leng-Pxl,
Texture: Co-occurrence, Run length : F44:AvgCooC-Constrast, F48:AvgGLN, F51:AvgLRE, F55:AvgRP,
Texture: Laws, Wavelets: F59:3D-Laws-1, F74:3D-Laws-16, F75:3D-Laws-17, F77:3D-Laws-19, F78:3D-Laws-20, F99:3D-Laws-41, F102:3D-Laws-44, F103:3D-Laws-45, F127:3D-Laws-78, F128:3D-Laws-79, F149:3D-Laws-100, F152:3D-Laws-103, F195:3D-WaveP2-L2-6, F198:3D-WaveP2-L2-9, F204:3D-WaveP2-L2-15, F205:3D-WaveP2-L2-16.
Image Histogram: F185:Hist-SD-L1, F186:Hist-Energy-L1, F187:Hist-Entropy-L1,F188:Hist-Kurt-L1

Representative Features (33): *Combine features with* $R^2_{Bet} \geq 0.95$
Size: F1:LongDia, F2:ShortAx-LongDia, F3:ShortAx, F6:Vol-cm,
Pixel Intensity Histogram: F4:Mn-Hu,
Location: F8:8a-3D-Attch-Pleural, F9:8b-3D-Bord-to-Lung, F15:9d-3D-AV-Dist-COG-to-Border, F17:9f-3D-Min-Dist-COG-to-Border, F18:9g-3D-Max-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D-SD-Vol-AirSpaces,
Shape –Roundness: F23:Asymmetry, F25:Density, F30:Shape-Index, F32:RectangularFit, F33:Area-Pxl, F37:Thickness-Pxl, F39:Length-by-Thick,
Texture: Run length: F48:AvgGLN, F59:3D-Laws-1, F75:3D-Laws-17, F99:3D-Laws-41, F103:3D-Laws-45, F128:3D-Laws-79,
Image Histogram: F185:Hist-SD-L1, F186:Hist-Energy-L1, F187:Hist-Entropy-L1, F188:Hist-Kurt-L1,
Texture /Tranformed: Wavelets: F195:3D-WaveP2-L2-6, F204:3D-WaveP2-L2-15, F205:3D-WaveP2-L2-16

Representative Features (19): *Combine features with* $R^2_{Bet} \geq 0.90$
Size: F6:Vol-cm,
Location: F8:8a-3D-Attch-Pleural, F9:8b-3D-Bord-to-Lung, F17:9f-3D-Min-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces,
F22:10d-3D-SD-Vol-AirSpaces,
Shape: Roundness: F25:Density, F30:Shape-Index, F32:RectangularFit, F39:Length-by-Thick,
Texture: Run-Length: F48:AvgGLN,
Histogram: F185:Hist-SD-L1, F186:Hist-Energy-L1, F187:Hist-Entropy-L1, F188:Hist-Kurt-L1,
Texture: Laws, Wavelets: F99:3D-Laws-41, F128:3D-Laws-79, F195:3D-WaveP2-L2-6.

3. $CCC_{TreT} \geq 0.85$ & DR ≥ 0.85 (93 Features)

Representative Features (25): *Combine features with* $R^2_{Bet} \geq 0.99$
Size: F6:Vol-cm,
Pixel Intensity Histogram: F5:Std-Hu,
Location: F8:8a-3D-Attch-Pleural, F9:8b-3D-Bord-to-Lung, F16:9e-3D-SD-Dist-COG-to-Border, F17:9f-3D-Min-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D-SD-Vol-AirSpaces,
Shape: Roundness: F25:Density, F26:EllipticFit, F27:Main-Direction, F30:Shape-Index, F32:RectangularFit, F39:Length-by-Thick,
Texture: Run-length: F48:AvgGLN,
Histogram: F185:Hist-SD-L1,
F186:Hist-Energy-L1, F187:Hist-Entropy-L1, F188:Hist-Kurt-L1,

F189:Hist-Skew-L1,
Texture: Laws, Wavelets: F64:3D-Laws-6, F69:3D-Laws-11, F99:3D-Laws-41, F195:3D-WaveP2-L2-6.

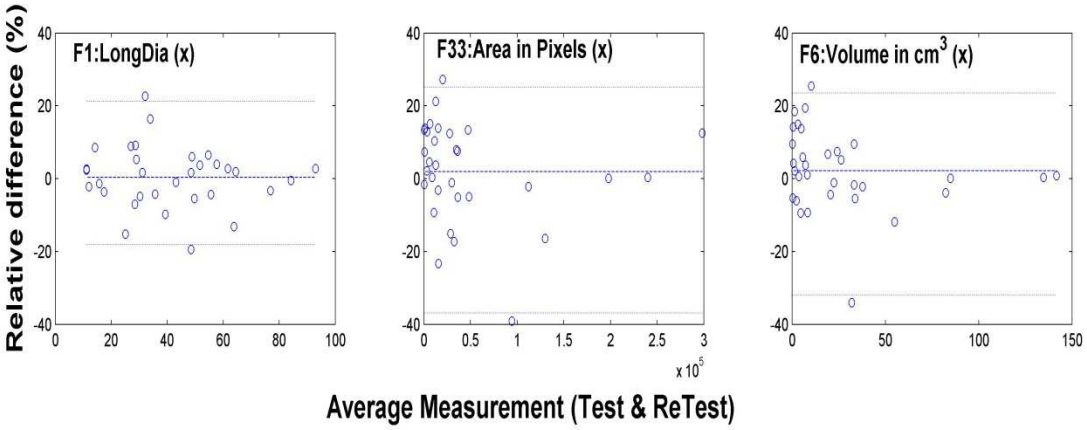
Representative Features (44): *Combine features with* $R^2_{Bet.} \geq 0.95$
Size: F1:LongDia, F2:ShortAx-LongDia, F3:ShortAx, F6:Vol-cm
Pixel Intensity Histogram: F4:Mn-Hu, F5:Std-Hu,
Location: F8:8a-3D-Attch-Pleural, F9:8b-3D-Bord-to-Lung,
F15:9d-3D-AV-Dist-COG-to-Border, F16:9e-3D-SD-Dist-COG-to-Border, F17:9f-3D-Min-Dist-COG-to-Border, F18:9g-3D-Max-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D-SD-Vol-AirSpaces,
Shape: Roundness: F23:Asymmetry, F25:Density, F26:EllipticFit, F27:Main-Direction, F30:Shape-Index,F32:RectangularFit, F33:Area-Pxl, F37:Thickness-Pxl, F39:Length-by-Thick,
Texture: Run-Length: F48:AvgGLN,
Histogram: F185:Hist-SD-L1, F186:Hist-Energy-L1, F187:Hist-Entropy-L1, F188:Hist-Kurt-L1, F189:Hist-Skew-L1,
Texture: Laws, Wavelets: F59:3D-Laws-1, F64:3D-Laws-6, F67:3D-Laws-9, F69:3D-Laws-11, F99:3D-Laws-41, F103:3D-Laws-45, F112:3D-Laws-54, F124:3D-Laws-75, F128:3D-Laws-79, F147:3D-Laws-98, F163:3D-Laws-114, F195:3D-WaveP2-L2-6, F204:3D-WaveP2-L2-15, F205:3D-WaveP2-L2-16.

Representative Features (76): *Combine features with* $R^2_{Bet.} \geq 0.90$
Size: F1:LongDia, F2:ShortAx-LongDia, F3:ShortAx, F6:Vol-cm,
Pixel Intensity Histogram: F4:Mn-Hu, F5:Std-Hu,
Location: F8:8a-3D-Attch-Pleural, F9:8b-3D-Bord-to-Lung, F12:9a-3D-FractionalAnisotropy, F15:9d-3D-AV-Dist-COG-to-Border, F16:9e-3D-SD-Dist-COG-to-Border, F17:9f-3D-Min-Dist-COG-to-Border, F18:9g-3D-Max-Dist-COG-to-Border, F19:10a-3D-Relat-Vol-Airspaces, F21:10c-3D-Av-Vol-AirSpaces, F22:10d-3D-SD-Vol-AirSpaces,
Shape: Roundness: F14:9c-3D-Compact, F23:Asymmetry, F25:Density, F26:EllipticFit, F27:Main-Direction, F30:Shape-Index,F32:RectangularFit, F33:Area-Pxl, F34:Volume-pxl, F36:Width-Pxl,F37:Thickness-Pxl, F38:Length-Pxl, F39:Length-by-Thick, F41:Border-Leng-Pxl,
Texture: Co occurrence: F44:AvgCooC-Constrast, Texture: Run-length
F48:AvgGLN,F51:AvgLRE, F55:AvgRP,
Texture: Laws, Wavelets: F59:3D-Laws-1, F62:3D-Laws-4,
F64:3D-Laws-6, F67:3D-Laws-9, F69:3D-Laws-11, F72:3D-Laws-14, F74:3D-Laws-16, F75:3D-Laws-17, F77:3D-Laws-19, F78:3D-Laws-20, F99:3D-Laws-41, F102:3D-Laws-44, F103:3D-Laws-45,
F112:3D-Laws-54, F124:3D-Laws-75, F127:3D-Laws-78, F128:3D-Laws-79, F134:3D-Laws-85, F137:3D-Laws-88, F139:3D-Laws-90,
F144:3D-Laws-95, F147:3D-Laws-98, F148:3D-Laws-99, F149:3D-Laws-100, F150:3D-Laws-101, F152:3D-Laws-103, F153:3D-Laws-104, F157:3D-Laws-108, F162:3D-Laws-113, F163:3D-Laws-114, F177:3D-Laws-128, F178:3D-Laws-129, F182:3D-Laws-133, F195:3D-WaveP2-L2-6, F198:3D-WaveP2-L2-9, F204:3D-WaveP2-L2-15, F205:3D-WaveP2-L2-16.
Histogram: F185:Hist-SD-L1, F186:Hist-Energy-L1, F187:Hist-Entropy-L1,
F188:Hist-Kurt-L1, F189:Hist-Skew-L1,

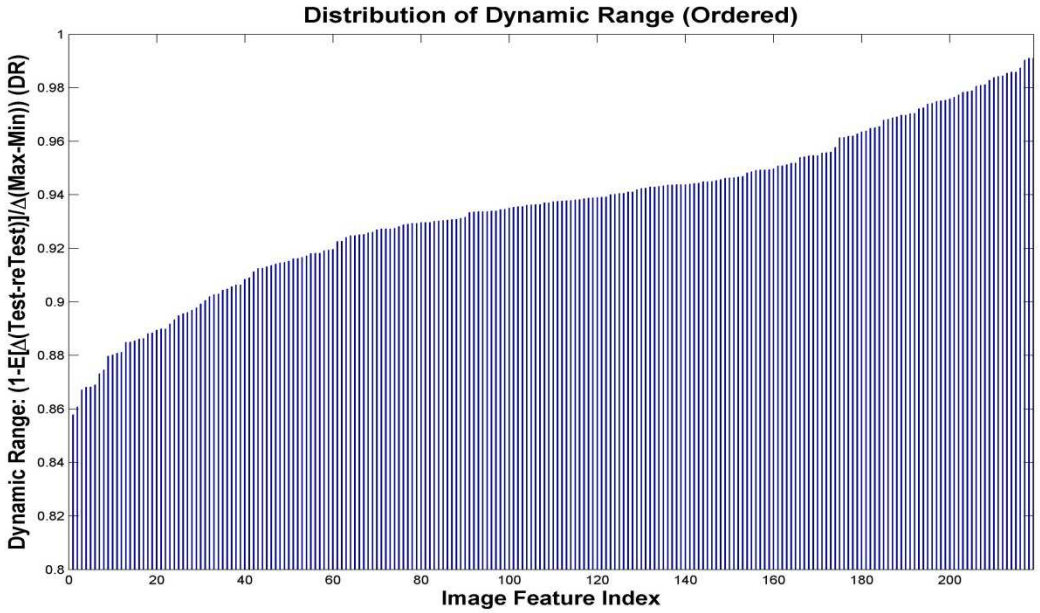
Supplemental Table 7. Features listed are those that are reproducible (CCC & DR ≥ 0.90) and discriminate prognostic groups in the Test/Retest data set, features were selected based on false discovery rates (on two sided T-test) computed independently for each category.

Category	**Significant Features (False Discovery Rate ≤ 0.05)**	
	Number of Features (Percent)	Feature Names
C1: Tumor Size	9 (69.23%)	F1:LongDia; F2:ShortAx-LongDia F33:Area-Pxl; F37:Thickness-Pxl F36:Width-Pxl; F41:Border-Leng-Pxl F3:ShortAx; F38:Length-Pxl F6:Vol-cm
C2: Tumor Shape (Roundness)	2 (16.67%)	F30:Shape-Index; F14:9c-3D-Compact
C3: Tumor Location	4 (28.57%)	F15:9d-3D-AV-Dist-COG-to-Border; F17:9f-3D-Min-Dist-COG-to-Border; F18:9g-3D-Max-Dist-COG-to-Border; F8:8a-3D-Attch-Pleural
C4: Pixel Intensity Histogram	5 (62.5%)	F185:Hist-SD-L1; F187:Hist-Entropy-L1; F186:Hist-Energy-L1; F188:Hist-Kurt-L1; F4:Mn-Hu
C5: Grayscale: Runlength & CoOccurrence	5 (29.41%)	F55:AvgRP; F44:AvgCooC-Constrast; F54:AvgRLN; F48:AvgGLN; F51:AvgLRE
C6: Texture: Laws features	5 (4%)	F59:3D-Laws-1; F99:3D-Laws-41; F75:3D-Laws-17; F128:3D-Laws-79 F103:3D-Laws-45
C7: Texture: Wavelets	3 (10%)	F204:3D-WaveP2-L2-15; F195:3D-WaveP2-L2-6; F205:3D-WaveP2-L2-16

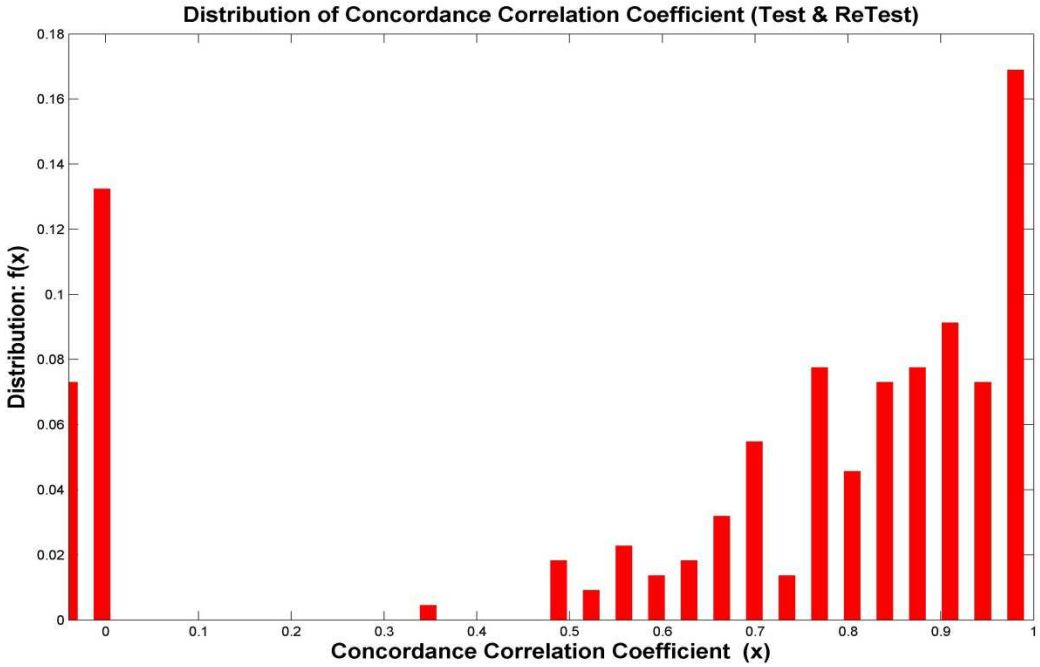
Supplemental Figure 1. Sample wise difference between test and retest to average measure (Bland-Altman Plot) is shown for Univariate, Bivariate and Volume features.



Supplemental Figure 2. Plot showing distribution of image features (A) Dynamic range (DR), sorted from low to high and (B) Concordance (CCC).

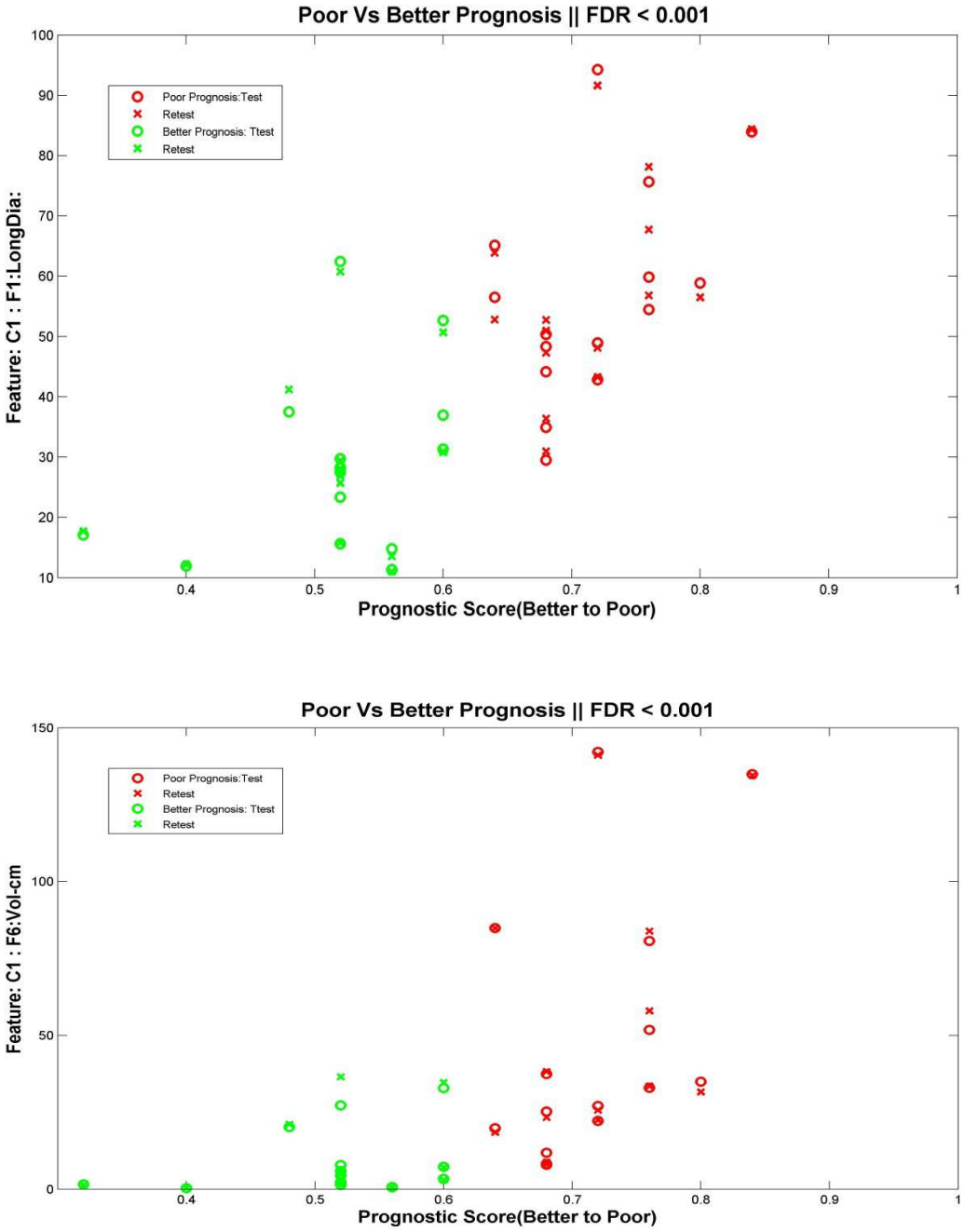


(A)

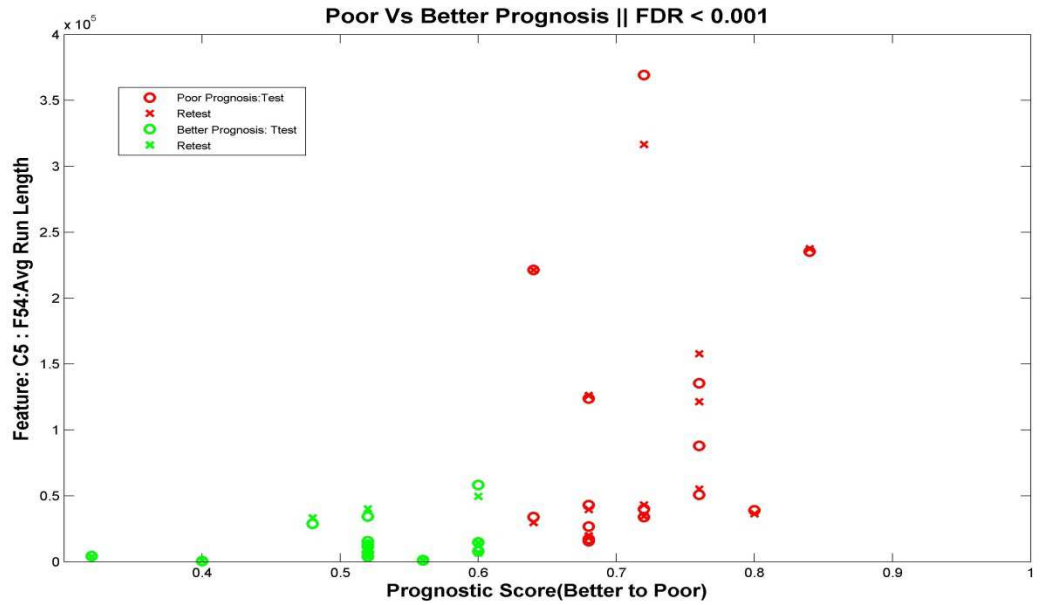


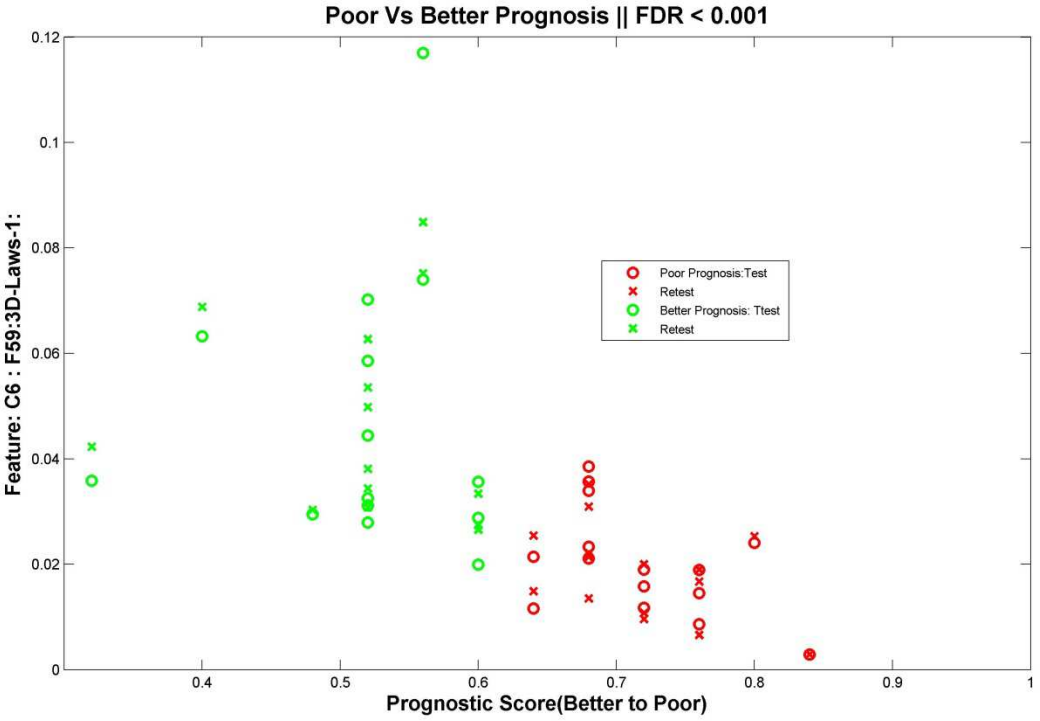
(B)

Supplemental Figure 3. Discriminating Feature shown with test and retest repeated measurements plotted against the prognostic score (A) Size based features (B) Other category of features (Run length & Laws).



(A)


Poor Vs Better Prognosis || FDR < 0.001
x 10^5
Poor Prognosis:Test
Retest
Better Prognosis: Ttest
Retest
Feature: C5 : F54:Avg Run Length
Prognostic Score(Better to Poor)


Poor Vs Better Prognosis || FDR < 0.001
Poor Prognosis:Test
Retest
Better Prognosis: Ttest
Retest
Feature: C6 : F59:3D-Laws-1:
Prognostic Score(Better to Poor)

(B)

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