**Supplementary Materials**

**A picture containing diagram

Description automatically generated**

Figure 6. Example of low dose CT denoising. (a-1) The original full dose CT image; (b-1) High-noise image; (c-1) Image denoised using non-local means; (d-1) Image denoised by encoder-decoder network (Training at 25 epochs); (e-1) Image denoised by CGAN; (a-2) to (e-2) Zoomed ROIs for (a-1) to (e-1). We regard the higher noise in (d-2) by comparing with (b-2) as a coincidence.

A screenshot of a cell phone

Description automatically generated

Supplementary Figure 2. Heatmap of radiomic features’ reproducibility based on low-noise/denoised images. \*1 represent CCC of radiomic features calculated based on high-noise images; 2-5 represent CCC of radiomic features calculated based on denoised images by using CGAN when network trained at 25, 50, 75,100 epochs; 6-9 represent CCC of radiomic features calculated based on denoised images by using encoder-decoder network when network trained at 25, 50, 75,100 epochs; 10-13 represent CCC of radiomic features calculated based on denoised images by using cycle GAN when network trained at 25, 50, 75,100 epochs.

A close up of a map

Description automatically generated

Supplementary Figure 3. Cumulative distribution function of CCC when Encoder decoder network was trained in different epochs

Supplementary Table 1. Index of available patients for experiments in LUNG 1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LUNG1-001 | LUNG1-145 | LUNG1-206 | LUNG1-244 | LUNG1-280 | LUNG1-315 |
| LUNG1-029 | LUNG1-147 | LUNG1-210 | LUNG1-245 | LUNG1-282 | LUNG1-317 |
| LUNG1-032 | LUNG1-148 | LUNG1-211 | LUNG1-247 | LUNG1-283 | LUNG1-318 |
| LUNG1-051 | LUNG1-151 | LUNG1-212 | LUNG1-249 | LUNG1-284 | LUNG1-320 |
| LUNG1-072 | LUNG1-152 | LUNG1-213 | LUNG1-252 | LUNG1-285 | LUNG1-321 |
| LUNG1-098 | LUNG1-156 | LUNG1-214 | LUNG1-253 | LUNG1-287 | LUNG1-323 |
| LUNG1-100 | LUNG1-157 | LUNG1-215 | LUNG1-255 | LUNG1-288 | LUNG1-326 |
| LUNG1-105 | LUNG1-160 | LUNG1-216 | LUNG1-256 | LUNG1-289 | LUNG1-328 |
| LUNG1-109 | LUNG1-161 | LUNG1-217 | LUNG1-257 | LUNG1-290 | LUNG1-331 |
| LUNG1-115 | LUNG1-162 | LUNG1-218 | LUNG1-259 | LUNG1-293 | LUNG1-332 |
| LUNG1-116 | LUNG1-163 | LUNG1-220 | LUNG1-260 | LUNG1-294 | LUNG1-334 |
| LUNG1-119 | LUNG1-165 | LUNG1-221 | LUNG1-262 | LUNG1-295 | LUNG1-335 |
| LUNG1-120 | LUNG1-169 | LUNG1-222 | LUNG1-263 | LUNG1-296 | LUNG1-337 |
| LUNG1-121 | LUNG1-171 | LUNG1-223 | LUNG1-264 | LUNG1-297 | LUNG1-339 |
| LUNG1-122 | LUNG1-172 | LUNG1-224 | LUNG1-266 | LUNG1-298 | LUNG1-340 |
| LUNG1-124 | LUNG1-174 | LUNG1-225 | LUNG1-267 | LUNG1-299 | LUNG1-341 |
| LUNG1-126 | LUNG1-176 | LUNG1-226 | LUNG1-268 | LUNG1-300 | LUNG1-342 |
| LUNG1-127 | LUNG1-178 | LUNG1-227 | LUNG1-269 | LUNG1-303 | LUNG1-343 |
| LUNG1-128 | LUNG1-179 | LUNG1-229 | LUNG1-270 | LUNG1-304 | LUNG1-345 |
| LUNG1-130 | LUNG1-189 | LUNG1-231 | LUNG1-271 | LUNG1-305 | LUNG1-347 |
| LUNG1-131 | LUNG1-191 | LUNG1-233 | LUNG1-272 | LUNG1-306 | LUNG1-349 |
| LUNG1-132 | LUNG1-192 | LUNG1-234 | LUNG1-273 | LUNG1-307 | LUNG1-353 |
| LUNG1-133 | LUNG1-195 | LUNG1-235 | LUNG1-274 | LUNG1-308 |  |
| LUNG1-134 | LUNG1-196 | LUNG1-236 | LUNG1-275 | LUNG1-309 |  |
| LUNG1-139 | LUNG1-197 | LUNG1-237 | LUNG1-276 | LUNG1-310 |  |
| LUNG1-141 | LUNG1-199 | LUNG1-239 | LUNG1-277 | LUNG1-311 |  |
| LUNG1-142 | LUNG1-205 | LUNG1-243 | LUNG1-278 | LUNG1-313 |  |

Supplementary Table 2. Radiomics features calculated by using O-RAW

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Features | Index | Features |
| 1 | original\_firstorder\_10Percentile | 46 | original\_glrlm\_LongRunLowGrayLevelEmphasis |
| 2 | original\_firstorder\_90Percentile | 47 | original\_glrlm\_LowGrayLevelRunEmphasis |
| 3 | original\_firstorder\_Energy | 48 | original\_glrlm\_RunEntropy |
| 4 | original\_firstorder\_Entropy | 49 | original\_glrlm\_RunLengthNonUniformity |
| 5 | original\_firstorder\_InterquartileRange | 50 | original\_glrlm\_RunLengthNonUniformityNormalized |
| 6 | original\_firstorder\_Kurtosis | 51 | original\_glrlm\_RunPercentage |
| 7 | original\_firstorder\_Maximum | 52 | original\_glrlm\_RunVariance |
| 8 | original\_firstorder\_Mean | 53 | original\_glrlm\_ShortRunEmphasis |
| 9 | original\_firstorder\_MeanAbsoluteDeviation | 54 | original\_glrlm\_ShortRunHighGrayLevelEmphasis |
| 10 | original\_firstorder\_Median | 55 | original\_glrlm\_ShortRunLowGrayLevelEmphasis |
| 11 | original\_firstorder\_Minimum | 56 | original\_glszm\_GrayLevelNonUniformity |
| 12 | original\_firstorder\_Range | 57 | original\_glszm\_GrayLevelNonUniformityNormalized |
| 13 | original\_firstorder\_RobustMeanAbsoluteDeviation | 58 | original\_glszm\_GrayLevelVariance |
| 14 | original\_firstorder\_RootMeanSquared | 59 | original\_glszm\_HighGrayLevelZoneEmphasis |
| 15 | original\_firstorder\_Skewness | 60 | original\_glszm\_LargeAreaEmphasis |
| 16 | original\_firstorder\_Uniformity | 61 | original\_glszm\_LargeAreaHighGrayLevelEmphasis |
| 17 | original\_firstorder\_Variance | 62 | original\_glszm\_LargeAreaLowGrayLevelEmphasis |
| 18 | original\_glcm\_Autocorrelation | 63 | original\_glszm\_LowGrayLevelZoneEmphasis |
| 19 | original\_glcm\_JointAverage | 64 | original\_glszm\_SizeZoneNonUniformity |
| 20 | original\_glcm\_ClusterProminence | 65 | original\_glszm\_SizeZoneNonUniformityNormalized |
| 21 | original\_glcm\_ClusterShade | 66 | original\_glszm\_SmallAreaEmphasis |
| 22 | original\_glcm\_ClusterTendency | 67 | original\_glszm\_SmallAreaHighGrayLevelEmphasis |
| 23 | original\_glcm\_Contrast | 68 | original\_glszm\_SmallAreaLowGrayLevelEmphasis |
| 24 | original\_glcm\_Correlation | 69 | original\_glszm\_ZoneEntropy |
| 25 | original\_glcm\_DifferenceAverage | 70 | original\_glszm\_ZonePercentage |
| 26 | original\_glcm\_DifferenceEntropy | 71 | original\_glszm\_ZoneVariance |
| 27 | original\_glcm\_DifferenceVariance | 72 | original\_gldm\_DependenceEntropy |
| 28 | original\_glcm\_JointEnergy | 73 | original\_gldm\_DependenceNonUniformity |
| 29 | original\_glcm\_JointEntropy | 74 | original\_gldm\_DependenceNonUniformityNormalized |
| 30 | original\_glcm\_Imc1 | 75 | original\_gldm\_DependenceVariance |
| 31 | original\_glcm\_Imc2 | 76 | original\_gldm\_GrayLevelNonUniformity |
| 32 | original\_glcm\_Idm | 77 | original\_gldm\_GrayLevelVariance |
| 33 | original\_glcm\_Idmn | 78 | original\_gldm\_HighGrayLevelEmphasis |
| 34 | original\_glcm\_Id | 79 | original\_gldm\_LargeDependenceEmphasis |
| 35 | original\_glcm\_Idn | 80 | original\_gldm\_LargeDependenceHighGrayLevelEmphasis |
| 36 | original\_glcm\_InverseVariance | 81 | original\_gldm\_LargeDependenceLowGrayLevelEmphasis |
| 37 | original\_glcm\_MaximumProbability | 82 | original\_gldm\_LowGrayLevelEmphasis |
| 38 | original\_glcm\_SumEntropy | 83 | original\_gldm\_SmallDependenceEmphasis |
| 39 | original\_glcm\_SumSquares | 84 | original\_gldm\_SmallDependenceHighGrayLevelEmphasis |
| 40 | original\_glrlm\_GrayLevelNonUniformity | 85 | original\_gldm\_SmallDependenceLowGrayLevelEmphasis |
| 41 | original\_glrlm\_GrayLevelNonUniformityNormalized | 86 | original\_ngtdm\_Busyness |
| 42 | original\_glrlm\_GrayLevelVariance | 87 | original\_ngtdm\_Coarseness |
| 43 | original\_glrlm\_HighGrayLevelRunEmphasis | 88 | original\_ngtdm\_Complexity |
| 44 | original\_glrlm\_LongRunEmphasis | 89 | original\_ngtdm\_Contrast |
| 45 | original\_glrlm\_LongRunHighGrayLevelEmphasis | 90 | original\_ngtdm\_Strength |

Supplementary Table 3. CCCs of radiomic features of images denoised using an encoder-decoder network

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Results  Radiomics | Weakly  Noisy | 25 Epochs | 50 Epochs | 75 Epochs | 100 Epochs | Strongly Noisy | 25 Epochs | 50 Epochs | 75 Epochs | 100 Epochs |
| 1\* | 0.9951 | 0.9964 | 0.9955 | 0.9965 | 0.9964 | 0.9826 | 0.9973 | 0.9962 | 0.9957 | 0.9965 |
| 2 | 0.8285 | 0.8609 | 0.8507 | 0.8307 | 0.7819 | 0.6296 | 0.8119 | 0.8299 | 0.8075 | 0.8344 |
| 3 | 0.9997 | 0.9998 | 0.9996 | 0.9999 | 0.9999 | 0.9998 | 0.9998 | 0.9999 | 0.9997 | 1.0000 |
| 4 | 0.9369 | 0.9798 | 0.9855 | 0.9871 | 0.9892 | 0.6420 | 0.9516 | 0.9457 | 0.9712 | 0.9701 |
| 5 | 0.9834 | 0.9908 | 0.9870 | 0.9893 | 0.9856 | 0.9311 | 0.9879 | 0.9868 | 0.9887 | 0.9860 |
| 6 | 0.8063 | 0.9338 | 0.9464 | 0.9593 | 0.9578 | 0.3854 | 0.8823 | 0.8374 | 0.9027 | 0.8874 |
| 7 | 0.9015 | 0.8796 | 0.8707 | 0.8674 | 0.8799 | 0.8464 | 0.8635 | 0.8824 | 0.8738 | 0.8943 |
| 8 | 0.9886 | 0.9974 | 0.9961 | 0.9983 | 0.9968 | 0.9868 | 0.9981 | 0.9978 | 0.9966 | 0.9983 |
| 9 | 0.9905 | 0.9932 | 0.9901 | 0.9912 | 0.9877 | 0.9535 | 0.9938 | 0.9933 | 0.9934 | 0.9911 |
| 10 | 0.9711 | 0.9867 | 0.9854 | 0.9916 | 0.9854 | 0.9551 | 0.9911 | 0.9917 | 0.9928 | 0.9906 |
| 11 | 0.9969 | 0.9954 | 0.9927 | 0.9926 | 0.9927 | 0.9845 | 0.9972 | 0.9956 | 0.9939 | 0.9954 |
| 12 | 0.9744 | 0.9709 | 0.9648 | 0.9601 | 0.9587 | 0.9363 | 0.9728 | 0.9748 | 0.9706 | 0.9721 |
| 13 | 0.9878 | 0.9920 | 0.9886 | 0.9905 | 0.9869 | 0.9447 | 0.9920 | 0.9903 | 0.9916 | 0.9888 |
| 14 | 0.9822 | 0.9952 | 0.9937 | 0.9962 | 0.9927 | 0.9823 | 0.9969 | 0.9971 | 0.9954 | 0.9962 |
| 15 | 0.8905 | 0.9444 | 0.9522 | 0.9713 | 0.9659 | 0.4901 | 0.9108 | 0.8743 | 0.9318 | 0.9202 |
| 16 | 0.7774 | 0.9475 | 0.9531 | 0.9611 | 0.9658 | 0.3356 | 0.8594 | 0.8052 | 0.8912 | 0.8849 |
| 17 | 0.9865 | 0.9891 | 0.9854 | 0.9862 | 0.9799 | 0.9806 | 0.9934 | 0.9929 | 0.9915 | 0.9870 |
| 18 | 0.9834 | 0.9816 | 0.9765 | 0.9770 | 0.9740 | 0.9847 | 0.9904 | 0.9888 | 0.9881 | 0.9859 |
| 19 | 0.9871 | 0.9854 | 0.9800 | 0.9794 | 0.9767 | 0.9742 | 0.9919 | 0.9903 | 0.9889 | 0.9877 |
| 20 | 0.9870 | 0.9953 | 0.9934 | 0.9955 | 0.9930 | 0.9852 | 0.9973 | 0.9966 | 0.9971 | 0.9957 |
| 21 | 0.9877 | 0.9929 | 0.9925 | 0.9946 | 0.9929 | 0.9829 | 0.9956 | 0.9955 | 0.9963 | 0.9952 |
| 22 | 0.9945 | 0.9961 | 0.9928 | 0.9943 | 0.9915 | 0.9908 | 0.9971 | 0.9966 | 0.9964 | 0.9945 |
| 23 | 0.9313 | 0.9426 | 0.9453 | 0.9305 | 0.9071 | 0.9080 | 0.9588 | 0.9647 | 0.9518 | 0.9324 |
| 24 | 0.9553 | 0.8326 | 0.9159 | 0.8418 | 0.8236 | 0.8491 | 0.8959 | 0.9648 | 0.9194 | 0.9157 |
| 25 | 0.9699 | 0.9784 | 0.9796 | 0.9697 | 0.9616 | 0.7814 | 0.9841 | 0.9844 | 0.9821 | 0.9759 |
| 26 | 0.9369 | 0.9761 | 0.9815 | 0.9721 | 0.9691 | 0.5668 | 0.9795 | 0.9688 | 0.9837 | 0.9810 |
| 27 | 0.8824 | 0.9134 | 0.9262 | 0.9187 | 0.8949 | 0.8689 | 0.9337 | 0.9447 | 0.9373 | 0.9165 |
| 28 | 0.4727 | 0.8778 | 0.8887 | 0.8903 | 0.9039 | 0.0951 | 0.6880 | 0.5392 | 0.7113 | 0.6914 |
| 29 | 0.8785 | 0.9694 | 0.9757 | 0.9765 | 0.9791 | 0.4260 | 0.9296 | 0.9025 | 0.9537 | 0.9519 |
| 30 | 0.9915 | 0.9547 | 0.9852 | 0.9597 | 0.9622 | 0.9724 | 0.9871 | 0.9950 | 0.9923 | 0.9918 |
| 31 | 0.9844 | 0.8270 | 0.9402 | 0.8907 | 0.8919 | 0.9379 | 0.9298 | 0.9861 | 0.9693 | 0.9744 |
| 32 | 0.7766 | 0.9356 | 0.9609 | 0.9382 | 0.9412 | 0.2775 | 0.9400 | 0.8766 | 0.9472 | 0.9412 |
| 33 | 0.9414 | 0.9535 | 0.9644 | 0.9624 | 0.9630 | 0.7555 | 0.9556 | 0.9596 | 0.9628 | 0.9609 |
| 34 | 0.8175 | 0.9447 | 0.9673 | 0.9463 | 0.9486 | 0.3382 | 0.9497 | 0.8999 | 0.9566 | 0.9516 |
| 35 | 0.8944 | 0.9629 | 0.9770 | 0.9706 | 0.9730 | 0.5522 | 0.9697 | 0.9542 | 0.9737 | 0.9710 |
| 36 | 0.9081 | 0.9784 | 0.9842 | 0.9802 | 0.9812 | 0.3698 | 0.9791 | 0.9654 | 0.9877 | 0.9880 |
| 37 | 0.3903 | 0.8487 | 0.8726 | 0.8704 | 0.8673 | 0.0649 | 0.6689 | 0.4773 | 0.6947 | 0.6451 |
| 38 | 0.9502 | 0.9797 | 0.9862 | 0.9907 | 0.9921 | 0.6993 | 0.9465 | 0.9468 | 0.9689 | 0.9679 |
| 39 | 0.9885 | 0.9914 | 0.9874 | 0.9881 | 0.9827 | 0.9823 | 0.9946 | 0.9937 | 0.9926 | 0.9885 |
| 40 | 0.9812 | 0.9901 | 0.9960 | 0.9955 | 0.9958 | 0.8264 | 0.9875 | 0.9858 | 0.9926 | 0.9928 |
| 41 | 0.8559 | 0.9544 | 0.9658 | 0.9709 | 0.9744 | 0.4136 | 0.9028 | 0.8758 | 0.9346 | 0.9313 |
| 42 | 0.9848 | 0.9861 | 0.9810 | 0.9831 | 0.9759 | 0.9813 | 0.9914 | 0.9894 | 0.9885 | 0.9828 |
| 43 | 0.9829 | 0.9809 | 0.9769 | 0.9755 | 0.9715 | 0.9821 | 0.9904 | 0.9894 | 0.9881 | 0.9855 |
| 44 | 0.4526 | 0.8021 | 0.8965 | 0.8257 | 0.8416 | 0.1360 | 0.7776 | 0.5999 | 0.7519 | 0.7252 |
| 45 | 0.8700 | 0.9478 | 0.9431 | 0.9633 | 0.9646 | 0.7770 | 0.9291 | 0.9014 | 0.9377 | 0.9303 |
| 46 | 0.7746 | 0.5768 | 0.7955 | 0.7734 | 0.7624 | 0.4132 | 0.6414 | 0.7317 | 0.7662 | 0.7939 |
| 47 | 0.7707 | 0.6703 | 0.7567 | 0.7692 | 0.7458 | 0.6675 | 0.7007 | 0.7235 | 0.7308 | 0.7442 |
| 48 | 0.9902 | 0.9259 | 0.9788 | 0.9632 | 0.9674 | 0.8809 | 0.9620 | 0.9856 | 0.9865 | 0.9864 |
| 49 | 0.9432 | 0.9515 | 0.9811 | 0.9588 | 0.9613 | 0.8427 | 0.9834 | 0.9685 | 0.9822 | 0.9811 |
| 50 | 0.7465 | 0.9155 | 0.9534 | 0.9204 | 0.9250 | 0.2830 | 0.9373 | 0.8638 | 0.9399 | 0.9324 |
| 51 | 0.6529 | 0.8833 | 0.9363 | 0.8927 | 0.9000 | 0.2236 | 0.8976 | 0.7858 | 0.8937 | 0.8804 |
| 52 | 0.3822 | 0.7820 | 0.8831 | 0.8103 | 0.8268 | 0.1092 | 0.7118 | 0.5186 | 0.6783 | 0.6472 |
| 53 | 0.6903 | 0.8899 | 0.9414 | 0.8970 | 0.9038 | 0.2419 | 0.9217 | 0.8275 | 0.9206 | 0.9100 |
| 54 | 0.9839 | 0.9794 | 0.9765 | 0.9718 | 0.9673 | 0.9671 | 0.9895 | 0.9881 | 0.9867 | 0.9844 |
| 55 | 0.7569 | 0.6992 | 0.7492 | 0.7615 | 0.7394 | 0.6972 | 0.7168 | 0.7180 | 0.7212 | 0.7302 |
| 56 | 0.9428 | 0.8445 | 0.9280 | 0.8736 | 0.8788 | 0.7807 | 0.9373 | 0.9822 | 0.9674 | 0.9735 |
| 57 | 0.9733 | 0.9095 | 0.9659 | 0.9630 | 0.9649 | 0.6837 | 0.9181 | 0.9599 | 0.9752 | 0.9736 |
| 58 | 0.9743 | 0.9791 | 0.9802 | 0.9738 | 0.9603 | 0.9679 | 0.9885 | 0.9892 | 0.9836 | 0.9776 |
| 59 | 0.9817 | 0.9782 | 0.9756 | 0.9684 | 0.9616 | 0.9358 | 0.9866 | 0.9854 | 0.9851 | 0.9806 |
| 60 | 0.6654 | 0.8763 | 0.9325 | 0.8748 | 0.8784 | 0.1367 | 0.9014 | 0.7984 | 0.8970 | 0.8910 |
| 61 | 0.7543 | 0.9354 | 0.9514 | 0.9478 | 0.9556 | 0.3429 | 0.9125 | 0.8425 | 0.9210 | 0.9138 |
| 62 | 0.6211 | 0.8338 | 0.8791 | 0.8209 | 0.7498 | 0.0575 | 0.8975 | 0.7983 | 0.8853 | 0.8896 |
| 63 | 0.7190 | 0.7952 | 0.8088 | 0.7585 | 0.7460 | 0.3270 | 0.8198 | 0.7936 | 0.7286 | 0.7891 |
| 64 | 0.9708 | 0.9515 | 0.9595 | 0.9454 | 0.9457 | 0.6572 | 0.9745 | 0.9875 | 0.9761 | 0.9759 |
| 65 | 0.8128 | 0.7318 | 0.7490 | 0.7278 | 0.7456 | 0.7174 | 0.7409 | 0.7682 | 0.7522 | 0.7817 |
| 66 | 0.8087 | 0.7316 | 0.7314 | 0.7174 | 0.7348 | 0.7215 | 0.7304 | 0.7551 | 0.7397 | 0.7699 |
| 67 | 0.9762 | 0.9584 | 0.9638 | 0.9508 | 0.9427 | 0.9404 | 0.9755 | 0.9802 | 0.9759 | 0.9658 |
| 68 | 0.6883 | 0.7829 | 0.8025 | 0.7484 | 0.7427 | 0.3289 | 0.7917 | 0.7745 | 0.6883 | 0.7753 |
| 69 | 0.9612 | 0.8691 | 0.9062 | 0.9239 | 0.9287 | 0.7113 | 0.8232 | 0.8789 | 0.9024 | 0.9137 |
| 70 | 0.9838 | 0.9893 | 0.9915 | 0.9871 | 0.9876 | 0.7662 | 0.9859 | 0.9900 | 0.9936 | 0.9920 |
| 71 | 0.6654 | 0.8765 | 0.9326 | 0.8750 | 0.8786 | 0.1367 | 0.9013 | 0.7983 | 0.8970 | 0.8909 |
| 72 | 0.9816 | 0.8538 | 0.9322 | 0.9276 | 0.9316 | 0.9434 | 0.9073 | 0.9634 | 0.9631 | 0.9717 |
| 73 | 0.9007 | 0.9387 | 0.9730 | 0.9485 | 0.9523 | 0.6211 | 0.9736 | 0.9435 | 0.9711 | 0.9676 |
| 74 | 0.9511 | 0.9768 | 0.9800 | 0.9751 | 0.9746 | 0.6622 | 0.9554 | 0.9636 | 0.9814 | 0.9786 |
| 75 | 0.3540 | 0.7366 | 0.8379 | 0.7852 | 0.7981 | 0.0840 | 0.6718 | 0.4626 | 0.6488 | 0.6091 |
| 76 | 0.9018 | 0.9826 | 0.9878 | 0.9841 | 0.9852 | 0.6358 | 0.9575 | 0.9311 | 0.9619 | 0.9587 |
| 77 | 0.9866 | 0.9889 | 0.9854 | 0.9861 | 0.9799 | 0.9804 | 0.9933 | 0.9928 | 0.9913 | 0.9869 |
| 78 | 0.9815 | 0.9804 | 0.9760 | 0.9762 | 0.9727 | 0.9827 | 0.9896 | 0.9886 | 0.9877 | 0.9850 |
| 79 | 0.4363 | 0.7970 | 0.8897 | 0.8208 | 0.8343 | 0.1126 | 0.7843 | 0.5928 | 0.7620 | 0.7335 |
| 80 | 0.5713 | 0.8481 | 0.8399 | 0.8951 | 0.9035 | 0.2301 | 0.7335 | 0.6222 | 0.7685 | 0.7538 |
| 81 | 0.6343 | 0.3637 | 0.6899 | 0.6730 | 0.6873 | 0.1564 | 0.4694 | 0.6101 | 0.6357 | 0.6433 |
| 82 | 0.7866 | 0.5896 | 0.7541 | 0.7900 | 0.7666 | 0.7207 | 0.6516 | 0.7280 | 0.7468 | 0.7566 |
| 83 | 0.9763 | 0.9820 | 0.9859 | 0.9784 | 0.9798 | 0.7382 | 0.9799 | 0.9872 | 0.9897 | 0.9891 |
| 84 | 0.9777 | 0.9576 | 0.9652 | 0.9502 | 0.9372 | 0.8696 | 0.9657 | 0.9737 | 0.9751 | 0.9640 |
| 85 | 0.8019 | 0.8386 | 0.8228 | 0.8173 | 0.8225 | 0.7991 | 0.8069 | 0.7964 | 0.8065 | 0.8085 |
| 86 | 0.9938 | 0.9871 | 0.9965 | 0.9960 | 0.9851 | 0.9393 | 0.9704 | 0.9968 | 0.9914 | 0.9965 |
| 87 | 0.9805 | 0.9808 | 0.9884 | 0.9854 | 0.9863 | 0.9825 | 0.9847 | 0.9883 | 0.9848 | 0.9827 |
| 88 | 0.9224 | 0.9019 | 0.9024 | 0.8849 | 0.8670 | 0.9041 | 0.9275 | 0.9405 | 0.9177 | 0.9140 |
| 89 | 0.9446 | 0.9423 | 0.9447 | 0.9506 | 0.9385 | 0.9262 | 0.9526 | 0.9596 | 0.9547 | 0.9391 |
| 90 | 0.9867 | 0.9916 | 0.9820 | 0.9783 | 0.9783 | 0.9884 | 0.9916 | 0.9858 | 0.9807 | 0.9740 |

\* represents name of radiomic features indexed in Supplementary Table 2

Supplementary Table 4. CCCs of radiomic features of images denoised using a CGAN

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Results  Radiomics | Weakly  Noisy | 25 Epochs | 50 Epochs | 75 Epochs | 100 Epochs | Strongly Noisy | 25 Epochs | 50 Epochs | 75 Epochs | 100 Epochs |
| 1 | 0.9951 | 0.9990 | 0.9990 | 0.9993 | 0.9993 | 0.9826 | 0.9986 | 0.9983 | 0.9988 | 0.9986 |
| 2 | 0.8285 | 0.9336 | 0.9144 | 0.8997 | 0.9102 | 0.6296 | 0.8459 | 0.8329 | 0.8505 | 0.7996 |
| 3 | 0.9997 | 0.9999 | 1.0000 | 0.9999 | 1.0000 | 0.9998 | 1.0000 | 1.0000 | 1.0000 | 0.9999 |
| 4 | 0.9369 | 0.9840 | 0.9849 | 0.9852 | 0.9851 | 0.6420 | 0.9536 | 0.9472 | 0.9582 | 0.9521 |
| 5 | 0.9834 | 0.9971 | 0.9972 | 0.9971 | 0.9970 | 0.9311 | 0.9942 | 0.9945 | 0.9948 | 0.9945 |
| 6 | 0.8063 | 0.9748 | 0.9603 | 0.9667 | 0.9558 | 0.3854 | 0.9183 | 0.8907 | 0.9172 | 0.9128 |
| 7 | 0.9015 | 0.8902 | 0.9172 | 0.9103 | 0.9068 | 0.8464 | 0.8533 | 0.8664 | 0.8545 | 0.8579 |
| 8 | 0.9886 | 0.9989 | 0.9996 | 0.9995 | 0.9998 | 0.9868 | 0.9994 | 0.9997 | 0.9997 | 0.9994 |
| 9 | 0.9905 | 0.9988 | 0.9989 | 0.9990 | 0.9990 | 0.9535 | 0.9968 | 0.9971 | 0.9975 | 0.9969 |
| 10 | 0.9711 | 0.9944 | 0.9970 | 0.9959 | 0.9965 | 0.9551 | 0.9949 | 0.9957 | 0.9956 | 0.9972 |
| 11 | 0.9969 | 0.9982 | 0.9979 | 0.9980 | 0.9985 | 0.9845 | 0.9974 | 0.9984 | 0.9978 | 0.9983 |
| 12 | 0.9744 | 0.9771 | 0.9839 | 0.9815 | 0.9822 | 0.9363 | 0.9681 | 0.9730 | 0.9696 | 0.9700 |
| 13 | 0.9878 | 0.9986 | 0.9985 | 0.9986 | 0.9986 | 0.9447 | 0.9968 | 0.9966 | 0.9972 | 0.9966 |
| 14 | 0.9822 | 0.9985 | 0.9996 | 0.9993 | 0.9996 | 0.9823 | 0.9991 | 0.9995 | 0.9996 | 0.9988 |
| 15 | 0.8905 | 0.9638 | 0.9696 | 0.9762 | 0.9692 | 0.4901 | 0.9041 | 0.8868 | 0.9108 | 0.8927 |
| 16 | 0.7774 | 0.9651 | 0.9520 | 0.9481 | 0.9438 | 0.3356 | 0.8774 | 0.8586 | 0.8884 | 0.8743 |
| 17 | 0.9865 | 0.9984 | 0.9990 | 0.9990 | 0.9992 | 0.9806 | 0.9964 | 0.9982 | 0.9978 | 0.9972 |
| 18 | 0.9834 | 0.9935 | 0.9925 | 0.9923 | 0.9952 | 0.9847 | 0.9929 | 0.9946 | 0.9919 | 0.9940 |
| 19 | 0.9871 | 0.9942 | 0.9935 | 0.9931 | 0.9958 | 0.9742 | 0.9933 | 0.9943 | 0.9932 | 0.9948 |
| 20 | 0.9870 | 0.9993 | 0.9993 | 0.9993 | 0.9995 | 0.9852 | 0.9991 | 0.9993 | 0.9992 | 0.9991 |
| 21 | 0.9877 | 0.9994 | 0.9990 | 0.9990 | 0.9995 | 0.9829 | 0.9993 | 0.9988 | 0.9989 | 0.9993 |
| 22 | 0.9945 | 0.9992 | 0.9995 | 0.9995 | 0.9995 | 0.9908 | 0.9982 | 0.9989 | 0.9989 | 0.9984 |
| 23 | 0.9313 | 0.9922 | 0.9947 | 0.9923 | 0.9957 | 0.9080 | 0.9835 | 0.9919 | 0.9887 | 0.9885 |
| 24 | 0.9553 | 0.9750 | 0.9442 | 0.9420 | 0.9370 | 0.8491 | 0.9784 | 0.9813 | 0.9799 | 0.9840 |
| 25 | 0.9699 | 0.9928 | 0.9933 | 0.9925 | 0.9926 | 0.7814 | 0.9826 | 0.9861 | 0.9874 | 0.9857 |
| 26 | 0.9369 | 0.9888 | 0.9811 | 0.9798 | 0.9788 | 0.5668 | 0.9661 | 0.9610 | 0.9692 | 0.9643 |
| 27 | 0.8824 | 0.9914 | 0.9889 | 0.9867 | 0.9927 | 0.8689 | 0.9884 | 0.9875 | 0.9843 | 0.9874 |
| 28 | 0.4727 | 0.9235 | 0.8570 | 0.8293 | 0.8061 | 0.0951 | 0.7169 | 0.6707 | 0.7360 | 0.7113 |
| 29 | 0.8785 | 0.9749 | 0.9699 | 0.9694 | 0.9681 | 0.4260 | 0.9191 | 0.9069 | 0.9260 | 0.9165 |
| 30 | 0.9915 | 0.9883 | 0.9793 | 0.9725 | 0.9669 | 0.9724 | 0.9948 | 0.9937 | 0.9931 | 0.9924 |
| 31 | 0.9844 | 0.9625 | 0.9195 | 0.9078 | 0.8833 | 0.9379 | 0.9892 | 0.9874 | 0.9889 | 0.9862 |
| 32 | 0.7766 | 0.9611 | 0.9283 | 0.9204 | 0.9111 | 0.2775 | 0.9115 | 0.8900 | 0.9122 | 0.9065 |
| 33 | 0.9414 | 0.9774 | 0.9718 | 0.9738 | 0.9712 | 0.7555 | 0.9767 | 0.9690 | 0.9662 | 0.9685 |
| 34 | 0.8175 | 0.9671 | 0.9386 | 0.9307 | 0.9220 | 0.3382 | 0.9256 | 0.9081 | 0.9265 | 0.9215 |
| 35 | 0.8944 | 0.9812 | 0.9703 | 0.9696 | 0.9631 | 0.5522 | 0.9732 | 0.9700 | 0.9709 | 0.9725 |
| 36 | 0.9081 | 0.9796 | 0.9779 | 0.9698 | 0.9668 | 0.3698 | 0.9550 | 0.9511 | 0.9572 | 0.9542 |
| 37 | 0.3903 | 0.8741 | 0.8205 | 0.7806 | 0.7513 | 0.0649 | 0.6664 | 0.6595 | 0.7111 | 0.7105 |
| 38 | 0.9502 | 0.9896 | 0.9912 | 0.9915 | 0.9916 | 0.6993 | 0.9624 | 0.9575 | 0.9672 | 0.9615 |
| 39 | 0.9885 | 0.9985 | 0.9991 | 0.9990 | 0.9993 | 0.9823 | 0.9965 | 0.9983 | 0.9979 | 0.9972 |
| 40 | 0.9812 | 0.9945 | 0.9932 | 0.9913 | 0.9878 | 0.8264 | 0.9877 | 0.9883 | 0.9888 | 0.9857 |
| 41 | 0.8559 | 0.9715 | 0.9676 | 0.9686 | 0.9670 | 0.4136 | 0.9123 | 0.8991 | 0.9206 | 0.9075 |
| 42 | 0.9848 | 0.9982 | 0.9988 | 0.9987 | 0.9990 | 0.9813 | 0.9965 | 0.9980 | 0.9974 | 0.9973 |
| 43 | 0.9829 | 0.9930 | 0.9923 | 0.9918 | 0.9949 | 0.9821 | 0.9922 | 0.9934 | 0.9918 | 0.9928 |
| 44 | 0.4526 | 0.8825 | 0.7552 | 0.6761 | 0.6311 | 0.1360 | 0.7807 | 0.7207 | 0.7716 | 0.7459 |
| 45 | 0.8700 | 0.9722 | 0.9623 | 0.9445 | 0.9253 | 0.7770 | 0.9538 | 0.9353 | 0.9417 | 0.9451 |
| 46 | 0.7746 | 0.8545 | 0.7807 | 0.7393 | 0.7539 | 0.4132 | 0.7959 | 0.8198 | 0.8176 | 0.8512 |
| 47 | 0.7707 | 0.7945 | 0.7780 | 0.7488 | 0.8177 | 0.6675 | 0.7661 | 0.8126 | 0.7687 | 0.8585 |
| 48 | 0.9902 | 0.9682 | 0.9570 | 0.9432 | 0.9256 | 0.8809 | 0.9764 | 0.9761 | 0.9785 | 0.9725 |
| 49 | 0.9432 | 0.9781 | 0.9312 | 0.9220 | 0.9107 | 0.8427 | 0.9838 | 0.9789 | 0.9802 | 0.9769 |
| 50 | 0.7465 | 0.9536 | 0.9060 | 0.8948 | 0.8833 | 0.2830 | 0.9111 | 0.8865 | 0.9104 | 0.9043 |
| 51 | 0.6529 | 0.9356 | 0.8644 | 0.8391 | 0.8162 | 0.2236 | 0.8760 | 0.8403 | 0.8752 | 0.8654 |
| 52 | 0.3822 | 0.8599 | 0.7223 | 0.6223 | 0.5675 | 0.1092 | 0.7347 | 0.6683 | 0.7237 | 0.6911 |
| 53 | 0.6903 | 0.9433 | 0.8771 | 0.8601 | 0.8451 | 0.2419 | 0.8954 | 0.8643 | 0.8939 | 0.8848 |
| 54 | 0.9839 | 0.9911 | 0.9900 | 0.9892 | 0.9924 | 0.9671 | 0.9882 | 0.9878 | 0.9885 | 0.9878 |
| 55 | 0.7569 | 0.7885 | 0.7680 | 0.7388 | 0.8110 | 0.6972 | 0.7648 | 0.8083 | 0.7600 | 0.8560 |
| 56 | 0.9428 | 0.9129 | 0.8553 | 0.8539 | 0.8400 | 0.7807 | 0.9887 | 0.9829 | 0.9854 | 0.9832 |
| 57 | 0.9733 | 0.9353 | 0.9460 | 0.9443 | 0.9267 | 0.6837 | 0.9327 | 0.9391 | 0.9504 | 0.9347 |
| 58 | 0.9743 | 0.9899 | 0.9954 | 0.9958 | 0.9937 | 0.9679 | 0.9827 | 0.9885 | 0.9882 | 0.9871 |
| 59 | 0.9817 | 0.9832 | 0.9857 | 0.9870 | 0.9892 | 0.9358 | 0.9737 | 0.9762 | 0.9779 | 0.9747 |
| 60 | 0.6654 | 0.9664 | 0.8344 | 0.8463 | 0.8304 | 0.1367 | 0.8719 | 0.8540 | 0.8615 | 0.8315 |
| 61 | 0.7543 | 0.9733 | 0.9466 | 0.9320 | 0.9206 | 0.3429 | 0.9233 | 0.9029 | 0.9083 | 0.9012 |
| 62 | 0.6211 | 0.9506 | 0.7007 | 0.7953 | 0.7842 | 0.0575 | 0.8412 | 0.8478 | 0.8511 | 0.7994 |
| 63 | 0.7190 | 0.8063 | 0.7880 | 0.7707 | 0.8512 | 0.3270 | 0.7397 | 0.7737 | 0.8102 | 0.8240 |
| 64 | 0.9708 | 0.9789 | 0.9668 | 0.9667 | 0.9670 | 0.6572 | 0.9901 | 0.9891 | 0.9890 | 0.9871 |
| 65 | 0.8128 | 0.8304 | 0.8544 | 0.8252 | 0.8612 | 0.7174 | 0.7907 | 0.8301 | 0.8670 | 0.8712 |
| 66 | 0.8087 | 0.8267 | 0.8434 | 0.8261 | 0.8561 | 0.7215 | 0.8123 | 0.8341 | 0.8649 | 0.8700 |
| 67 | 0.9762 | 0.9796 | 0.9819 | 0.9842 | 0.9860 | 0.9404 | 0.9711 | 0.9793 | 0.9756 | 0.9732 |
| 68 | 0.6883 | 0.7957 | 0.7805 | 0.7634 | 0.8504 | 0.3289 | 0.7225 | 0.7525 | 0.7885 | 0.8034 |
| 69 | 0.9612 | 0.8833 | 0.9085 | 0.9170 | 0.9121 | 0.7113 | 0.8666 | 0.8719 | 0.8837 | 0.8893 |
| 70 | 0.9838 | 0.9915 | 0.9898 | 0.9903 | 0.9897 | 0.7662 | 0.9807 | 0.9788 | 0.9829 | 0.9789 |
| 71 | 0.6654 | 0.9665 | 0.8346 | 0.8465 | 0.8306 | 0.1367 | 0.8718 | 0.8540 | 0.8614 | 0.8315 |
| 72 | 0.9816 | 0.9115 | 0.9097 | 0.9038 | 0.8879 | 0.9434 | 0.9498 | 0.9507 | 0.9549 | 0.9433 |
| 73 | 0.9007 | 0.9565 | 0.9144 | 0.9028 | 0.8909 | 0.6211 | 0.9745 | 0.9670 | 0.9695 | 0.9647 |
| 74 | 0.9511 | 0.9783 | 0.9741 | 0.9754 | 0.9739 | 0.6622 | 0.9547 | 0.9574 | 0.9622 | 0.9558 |
| 75 | 0.3540 | 0.8198 | 0.6898 | 0.6299 | 0.5734 | 0.0840 | 0.7164 | 0.6297 | 0.7168 | 0.7045 |
| 76 | 0.9018 | 0.9924 | 0.9736 | 0.9719 | 0.9693 | 0.6358 | 0.9618 | 0.9585 | 0.9635 | 0.9570 |
| 77 | 0.9866 | 0.9984 | 0.9990 | 0.9989 | 0.9992 | 0.9804 | 0.9965 | 0.9980 | 0.9978 | 0.9972 |
| 78 | 0.9815 | 0.9936 | 0.9928 | 0.9924 | 0.9954 | 0.9827 | 0.9931 | 0.9948 | 0.9923 | 0.9942 |
| 79 | 0.4363 | 0.8849 | 0.7570 | 0.7053 | 0.6640 | 0.1126 | 0.7841 | 0.7243 | 0.7837 | 0.7648 |
| 80 | 0.5713 | 0.9111 | 0.8801 | 0.8638 | 0.8289 | 0.2301 | 0.8114 | 0.7027 | 0.7785 | 0.7710 |
| 81 | 0.6343 | 0.9006 | 0.7543 | 0.7204 | 0.7067 | 0.1564 | 0.8312 | 0.8168 | 0.8446 | 0.8317 |
| 82 | 0.7866 | 0.8084 | 0.8013 | 0.7703 | 0.8350 | 0.7207 | 0.7869 | 0.8352 | 0.7795 | 0.8719 |
| 83 | 0.9763 | 0.9887 | 0.9865 | 0.9847 | 0.9850 | 0.7382 | 0.9759 | 0.9758 | 0.9817 | 0.9763 |
| 84 | 0.9777 | 0.9729 | 0.9755 | 0.9796 | 0.9803 | 0.8696 | 0.9560 | 0.9637 | 0.9626 | 0.9552 |
| 85 | 0.8019 | 0.8319 | 0.8257 | 0.8013 | 0.8594 | 0.7991 | 0.8600 | 0.8697 | 0.8120 | 0.8806 |
| 86 | 0.9938 | 0.9897 | 0.9919 | 0.9943 | 0.9805 | 0.9393 | 0.9767 | 0.9915 | 0.9921 | 0.9872 |
| 87 | 0.9805 | 0.9810 | 0.9909 | 0.9929 | 0.9913 | 0.9825 | 0.9807 | 0.9890 | 0.9912 | 0.9921 |
| 88 | 0.9224 | 0.9870 | 0.9888 | 0.9828 | 0.9878 | 0.9041 | 0.9761 | 0.9811 | 0.9763 | 0.9822 |
| 89 | 0.9446 | 0.9201 | 0.9765 | 0.9784 | 0.9853 | 0.9262 | 0.9413 | 0.9831 | 0.9753 | 0.9803 |
| 90 | 0.9867 | 0.9936 | 0.9924 | 0.9902 | 0.9922 | 0.9884 | 0.9910 | 0.9896 | 0.9860 | 0.9910 |

Supplementary Table 5. RMSE, content loss and ratio of radiomic features with poor, medium, and good reproducibility in images denoised using the encoder-decoder network when trained for different numbers of epochs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Training Station  Noisy images | 25 Epochs | 50 Epochs | 75 Epochs | 100 Epochs |
| Low-noise Images | | | | |
| RMSE | 0.0190 | 0.0182 | 0.0174 | 0.0173 |
| Content loss | 0.0526 | 0.0462 | 0.0425 | 0.0427 |
| CCCs ≥ 0.85 | 70/90(78%) | 78/90(87%) | 73/90(81%) | 73/90(81%) |
| 0.65≤CCCs<0.85 | 17/90(19%) | 13/90(13%) | 17/90(19%) | 17/90(19%) |
| CCCs<0.65 | 3/90(3%) | 0/90(0%) | 0/90(0%) | 0/90(0%) |
| High-noise Images | | | | |
| RMSE | 0.0191 | 0.0184 | 0.0176 | 0.0175 |
| Content loss | 0.0543 | 0.0483 | 0.0442 | 0.0443 |
| CCCs ≥ 0.85 | 71/90(79%) | 64/90(71%) | 72/90(80%) | 72/90(80%) |
| 0.65≤CCCs<0.85 | 17/90(19%) | 18/90(20%) | 16/90(18%) | 14/90(16%) |
| CCCs<0.65 | 2/90(2%) | 8/90(9%) | 2/90(2%) | 4/90(4%) |