CLAIMS

WHAT IS CLAIMED IS:

1. A computer-implemented method for improving image quality with shortened acquisition time, the method comprising:

(a) determining an accelerated image acquisition scheme for imaging a subject using a medical imaging apparatus, wherein the accelerated image acquisition scheme is determined based at least in part on real-time simulated output images, and wherein the simulated output images are output of a deep network model;

(b) acquiring, using the medical imaging apparatus, a medical image of the subject according to the accelerated image acquisition scheme;

(c) applying the deep network model to the medical image to improve the quality of the medical image; and

(d) outputting an improved quality `image of the subject for analysis by a physician.

2. The computer-implemented method of claim 1, wherein the medical image includes a magnetic resonance image.

3. The computer-implemented method of claim 1, wherein determining the accelerated image acquisition scheme comprises:

(i) receiving a target acceleration factor or target acquisition speed via a graphical user interface, and

(ii) selecting the accelerated image acquisition scheme from a plurality of accelerated image acquisition schemes based on the target acceleration factor or the target acquisition speed.

4. The computer-implemented method of claim 3, wherein selecting the accelerated image acquisition scheme comprises applying the plurality of accelerated image acquisition schemes to a portion of the medical image for simulation.

5. The computer-implemented method of claim 1, wherein the real-time simulated output images have an image quality improved over respective input images to the deep network model.

6. The computer-implemented method of claim 1, wherein the accelerated image acquisition scheme comprises one or more parameters related to an undersampled k-space, an undersampling pattern, and a reduced number of repetitions.

7. The computer-implemented method of claim 6, wherein the undersampling pattern is selected from a group consisting of a uniform undersampling pattern, a random undersampling pattern, and a variable undersampling pattern.

8. The computer-implemented method of claim 1, wherein the medical image comprises undersampled k-space image or image acquired using reduced number of repetitions.

9. The computer-implemented method of claim 1, wherein the deep learning model is trained with adaptively optimized metrics based on user input and real-time simulated output images.

10. The computer-implemented method of claim 1, wherein the deep learning model is trained using training datasets comprising at least a low quality image and a high quality image.

11. The computer-implemented method of claim 10, wherein the low quality image is generated by applying one or more filters or adding synthetic noise to the high quality image to create noise or undersampling artifacts.

12. The computer-implemented method of claim 1, wherein the deep learning model is trained using image patches that comprise a portion of at least a low quality image and a high quality image.

13. The computer-implemented method of claim 12, wherein the image patches are selected based on one or more metrics quantifying an image similarity.

14. The computer-implemented method of claim 1, wherein the deep learning model is a deep residual learning model.

15. The computer-implemented method of claim 1, wherein the deep learning model is trained by adaptively tuning one or more model parameters to approximate a reference image.

16. The computer-implemented method of claim 1, wherein the improved quality image of the subject has greater SNR, higher resolution, or less aliasing compared with the medical image acquired using the medical imaging apparatus.

17. A non-transitory computer-readable storage medium including instructions that, when executed by one or more processors, cause the one or more processors to perform operations comprising:

(a) determining an accelerated image acquisition scheme for imaging a subject using a medical imaging apparatus, wherein the accelerated image acquisition scheme is determined based at least in part on real-time simulated output images, and wherein the simulated output images are output of a deep network model;

(b) acquiring, using the medical imaging apparatus, a medical image of the subject according to the accelerated image acquisition scheme;

(c) applying the deep network model to the medical image to improve the quality of the medical image; and

(d) outputting an improved quality image of the subject for analysis by a physician.

18. The non-transitory computer-readable storage medium of claim 17, wherein the medical image includes a magnetic resonance image.

19. The non-transitory computer-readable storage medium of claim 17, wherein the real-time simulated output images have an image quality improved over respective input images to the deep network model.

20. The non-transitory computer-readable storage medium of claim 17, wherein the accelerated image acquisition scheme comprises one or more parameters related to an undersampled k-space, an undersampling pattern, and a reduced number of repetitions.