CLAIMS

1. An image processing method, comprising:

obtaining multiple original images which are collected by a Time of Flight (TOF) sensor in the same exposure process and have a signal-noise rate lower than a first numerical value, wherein phase parameter values corresponding to same pixel points in the multiple original images are different; and

performing optimization processing on the multiple original images by means of a neural network to obtain depth maps corresponding to the multiple original images, wherein the processing comprises at least one convolution processing and at least one nonlinear function mapping processing~~;~~.

~~wherein the optimization processing performed by the neural network comprises Q groups of optimization procedures which are performed sequentially, and each group of optimization procedures comprises at least one convolution processing and/or at least one nonlinear mapping processing, and~~

wherein performing optimization processing on the multiple original images by means of the neural network comprises:

using the multiple original images as input information of a first group of optimization procedures, and obtaining a feature optimal matrix for the first group of optimization procedures after the processing of the first group of optimization procedures;

using a feature optimal matrix output in the n-th group of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, or using feature optimal matrices output in the first n groups of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, wherein n is an integer greater than 1 and less than Q; and

obtaining an output result based on a feature optimal matrix obtained after the processing of the Q-th group of optimization procedures.

2. The method according to claim 1, wherein performing optimization processing on the multiple original images by means of the neural network to obtain depth maps

corresponding to the multiple original images comprises:

performing optimization processing on the multiple original images by means of the neural network, and outputting multiple optimized images of the multiple original images, wherein the signal-noise rate of the optimized image is higher than that of the original image~~;~~, and

performing post-processing on the multiple optimized images to obtain the depth maps corresponding to the multiple original images~~.~~; or

~~3. The method according to claim 1, wherein performing optimization processing on the multiple original images by means of the neural network to obtain depth maps corresponding to the multiple original images comprises:~~

performing optimization processing on the multiple original images by means of the neural network, and outputting the depth maps corresponding to the multiple original images~~.~~; or

~~4. The method according to any one of claims 1 to 3, wherein performing optimization processing on the multiple original images by means of the neural network to obtain depth maps corresponding to the multiple original images comprises:~~

inputting the multiple original images into the neural network for optimization processing, to obtain the depth maps corresponding to the multiple original images.

~~5~~3. The method according to ~~any one of claims~~claim 1 ~~to 3~~or 2, further comprising:

performing preprocessing on the multiple original images to obtain the multiple preprocessed original images, the preprocessing comprising at least one of the following operations: image calibration, image correction, linear processing between any two original images, or nonlinear processing between any two original images; and

performing optimization processing on the multiple original images by means of the neural network to obtain depth maps corresponding to the multiple original images comprises:

inputting the multiple preprocessed original images into the neural network for optimization processing, to obtain the depth maps corresponding to the multiple original images.

4. The method according to any one of claims 1 to 3, wherein the optimization processing performed by the neural network comprises Q groups of optimization procedures which are performed sequentially, and each group of optimization procedures comprises at least one

convolution processing and/or at least one nonlinear mapping processing;

wherein performing optimization processing on the multiple original images by means of the neural network comprises:

using the multiple original images as input information of a first group of optimization procedures, and obtaining a feature optimal matrix for the first group of optimization procedures after the processing of the first group of optimization procedures;

using a feature optimal matrix output in the n-th group of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, or using feature optimal matrices output in the first n groups of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, wherein n is an integer greater than 1 and less than Q; and

obtaining an output result based on a feature optimal matrix obtained after the processing of the Q-th group of optimization procedures.

~~6~~5. The method according to claim ~~1~~4, wherein the Q groups of optimization procedures comprise down-sampling processing, residual processing, and up-sampling processing which are performed sequentially, and performing optimization processing on the multiple original images by means of the neural network comprises:

performing the down-sampling processing on the multiple original images to obtain first feature matrix fusing feature information of the multiple original images;

performing the residual processing on the first feature matrix to obtain a second feature matrix; and

performing the up-sampling processing on the second feature matrix to obtain a feature optimal matrix, wherein the output result of the neural network is obtained based on the feature optimal matrix.

~~7~~6. The method according to claim ~~6~~5, wherein performing the up-sampling processing on the second feature matrix to obtain the feature optimal matrix comprises:

using a feature matrix obtained in the down-sampling processing procedure to perform the up-sampling processing on the second feature matrix to obtain the feature optimal

matrix.

~~8~~7. The method according to any one of claims 1 to ~~7~~6, wherein the neural network is obtained by training a train set, wherein each of multiple training samples comprised in the train set comprises multiple first sample images, multiple second sample images corresponding to the multiple first sample images, and depth maps corresponding to the multiple second sample images, wherein the second sample image and the corresponding first sample image are images for the same object, and the signal-noise rate of the second sample image is higher than that of the first sample image;

wherein the neural network is a generative network in a generative adversarial network obtained by training;

a network loss value of the neural network is a weighted sum of a first network loss and a second network loss, wherein

the first network loss is obtained based on differences between multiple predicted optimization images obtained by processing the multiple first sample images comprised in the training sample by means of the neural network and the multiple second sample images comprised in the training sample, and

the second network loss is obtained based on differences between predicted depth maps obtained by post-processing the multiple predicted optimization images and depth maps comprised in the training sample.

~~9~~8. An image processing method, comprising:

obtaining multiple original images which are collected by a Time of Flight (TOF) sensor in the same exposure process and have a signal-noise rate lower than a first numerical value, wherein phase parameter values corresponding to same pixel points in the multiple original images are different; and

performing optimization processing on the multiple original images by means of a neural network to obtain depth maps corresponding to the multiple original images, wherein the neural network is obtained by training a train set, each of multiple training samples comprised in the train set comprises multiple first sample images, multiple second sample images corresponding to the multiple first sample images, and depth maps corresponding to the multiple second sample

images, wherein the second sample image and the corresponding first sample image are images for the same object, and the signal-noise rate of the second sample image is higher than that of the first sample image~~;~~.

~~wherein the optimization processing performed by the neural network comprises Q groups of optimization procedures which are performed sequentially, and each group of optimization procedures comprises at least one convolution processing and/or at least one nonlinear mapping processing, and~~

wherein performing optimization processing on the multiple original images by means of the neural network comprises:

using the multiple original images as input information of the first group of optimization procedures, and obtaining a feature optimal matrix for the first group of optimization procedures after the processing of the first group of optimization procedures;

using a feature optimal matrix output in the n-th group of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, or using feature optimal matrices output in the first n groups of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, wherein n is an integer greater than 1 and less than Q; and

obtaining an output result based on a feature optimal matrix obtained after the processing of the Q-th group of optimization procedures.

~~10~~9. The method according to claim ~~9~~8, wherein performing optimization processing on the multiple original images by means of the neural network to obtain depth maps corresponding to the multiple original images comprises:

performing optimization processing on the multiple original images by means of the neural network, and outputting multiple optimized images of the multiple original images, wherein the signal-noise rate of the optimized image is higher than that of the original image~~;~~, and

performing post-processing on the multiple optimized images to obtain the depth maps corresponding to the multiple original images~~.~~; or

~~11. The method according to claim 9 or 10, wherein~~ performing optimization processing on the multiple original images by means of the neural network ~~to obtain~~, and outputting the depth maps corresponding to the multiple original images ~~comprises:~~; or

inputting the multiple original images into the neural network for optimization processing, to obtain the depth maps corresponding to the multiple original images.

~~12~~10. The method according to claim ~~9~~8 or ~~10~~9, further comprising:

performing preprocessing on the multiple original images to obtain the multiple preprocessed original images, the preprocessing comprising at least one of the following operations: image calibration, image correction, linear processing between any two original images, or nonlinear processing between any two original images; and

performing optimization processing on the multiple original images by means of the neural network to obtain depth maps corresponding to the multiple original images comprises:

inputting the multiple preprocessed original images into the neural network for optimization processing, to obtain the depth maps corresponding to the multiple original images.

11. The method according to any one of claims 8 to 10, wherein the optimization processing performed by the neural network comprises Q groups of optimization procedures which are performed sequentially, and each group of optimization procedures comprises at least one convolution processing and/or at least one nonlinear mapping processing;

wherein performing optimization processing on the multiple original images by means of the neural network comprises:

using the multiple original images as input information of the first group of optimization procedures, and obtaining a feature optimal matrix for the first group of optimization procedures after the processing of the first group of optimization procedures;

using a feature optimal matrix output in the n-th group of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, or using feature optimal matrices output in the first n groups of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization processing, wherein n is an integer greater than 1 and less than Q; and

obtaining an output result based on a feature optimal matrix obtained after the processing of the Q-th group of optimization procedures.

~~13~~12. The method according to claim ~~9~~11, wherein the Q groups of optimization procedures comprise down-sampling processing, residual processing, and up-sampling processing which are performed sequentially, and performing optimization processing on the multiple original images by means of the neural network comprises:

performing the down-sampling processing on the multiple original images to obtain first feature matrix fusing feature information of the multiple original images;

performing the residual processing on the first feature matrix to obtain a second feature matrix; and

performing the up-sampling processing on the second feature matrix to obtain a feature optimal matrix, wherein the output result of the neural network is obtained based on the feature optimal matrix.

~~14~~13. The method according to claim ~~13~~12, wherein performing the up-sampling processing on the second feature matrix to obtain the feature optimal matrix comprises:

using a feature matrix obtained in the down-sampling processing procedure to perform the up-sampling processing on the second feature matrix to obtain the feature optimal matrix.

~~15~~14. The method according to any one of claims ~~9~~8 to ~~14~~13, wherein the neural network is a generative network in a generative adversarial network obtained by training;

a network loss value of the neural network is a weighted sum of a first network loss and a second network loss, wherein

the first network loss is obtained based on differences between multiple predicted optimization images obtained by processing the multiple first sample images comprised in the training sample by means of the neural network and the multiple second sample images comprised in the training sample, and

the second network loss is obtained based on differences between predicted depth maps obtained by post-processing the multiple predicted optimization images and depth

maps comprised in the training sample.

15. An image processing apparatus, comprising:

an obtaining module, configured to obtain multiple original images which are collected by a Time of Flight (TOF) sensor in the same exposure process and have a signal-noise rate lower than a first numerical value, wherein phase parameter values corresponding to same pixel points in the multiple original images are different; and

an optimizing module, configured to perform optimization processing on the multiple original images by means of a neural network to obtain depth maps corresponding to the multiple original images, wherein the processing comprises at least one convolution processing and at least one nonlinear function mapping processing.

16. An image processing apparatus, comprising:

an obtaining module, configured to obtain multiple original images which are collected by a Time of Flight (TOF) sensor in the same exposure process and have a signal-noise rate lower than a first numerical value, wherein phase parameter values corresponding to same pixel points in the multiple original images are different; and

~~an optimizing module, configured to perform optimization processing on the multiple original images by means of a neural network to obtain depth maps corresponding to the multiple original images, wherein the processing comprises at least one convolution processing and at least one nonlinear function mapping processing,~~

~~wherein the optimization processing performed by the optimizing module comprises Q groups of optimization procedures which are performed sequentially, and each group of optimization procedures comprises at least one convolution processing and/or at least one nonlinear mapping processing, and~~

~~the optimizing module is further configured to use the original images as input information of a first group of optimization procedures, and obtain a feature optimal matrix for the first group of optimization procedures after the processing of the first group of optimization procedures, and~~

~~use a feature optimal matrix output in the n-th group of optimization procedures as input information of the (n+1) th group of optimization procedures for optimization processing, or use~~

~~feature optimal matrices output in the first n groups of optimization procedures as input information of the (n+1) th group of optimization procedures for optimization processing, obtain an output result based on a feature optimal matrix obtained after the processing of the Q-th group of optimization procedures, wherein n is an integer greater than 1 and less than Q, and Q is the number of groups in the optimization procedures.~~

~~17~~. An image processing apparatus, comprising:

an obtaining module, configured to obtain multiple original images which are collected by a Time of Flight (TOF) sensor in the same exposure process and have a signal-noise rate lower than a first numerical value, wherein phase parameter values corresponding to same pixel points in the multiple original images are different; and

an optimizing module, configured to perform optimization processing on the multiple original images by means of a neural network to obtain depth maps corresponding to the multiple original images, wherein the neural network is obtained by training a train set, each of multiple training samples comprised in the train set comprises multiple first sample images, multiple second sample images corresponding to the multiple first sample images, and depth maps corresponding to the multiple second sample images, wherein the second sample image and the corresponding first sample image are images for the same object, and the signal-noise rate of the second sample image is higher than that of the first sample image~~,~~.

~~wherein the optimization processing performed by the neural network comprises Q groups of optimization procedures which are performed sequentially, and each group of optimization procedures comprises at least one convolution processing and/or at least one nonlinear mapping processing, and~~

~~wherein the optimizing module is further configured to:~~

~~use the multiple original images as input information of the first group of optimization procedures, and obtain a feature optimal matrix for the first group of optimization procedures after the processing of the first group of optimization procedures;~~

~~use a feature optimal matrix output in the n-th group of optimization procedures as input information of the (n+1)-th group of optimization procedures for optimization~~

~~processing, or use feature optimal matrices output in the first n groups of optimization procedures as input information of the (n+1) th group of optimization procedures for optimization processing, wherein n is an integer greater than 1 and less than Q; and~~

~~obtain an output result based on a feature optimal matrix obtained after the processing of the Q-th group of optimization procedures.~~

~~18~~17. An electronic device, comprising:

a processor; and

a memory configured to store processor-executable instructions;

wherein the processor is configured to invoke the instructions stored in the memory, so as to execute the method according to any one of claims 1 to ~~15~~7 or 8 to 14.

~~19~~18. A computer-readable storage medium, having computer program instructions stored thereon, wherein when the computer program instructions are executed by a processor, the method according to any one of claims 1 to ~~15~~7 or 8 to 14 is implemented.

~~20~~19. A computer program, comprising computer readable codes, wherein when run in an electronic device, the computer readable codes are executed by a processor in the electrode device to implement the method according to any one of claims 1 to ~~15~~7 or 8 to 14.