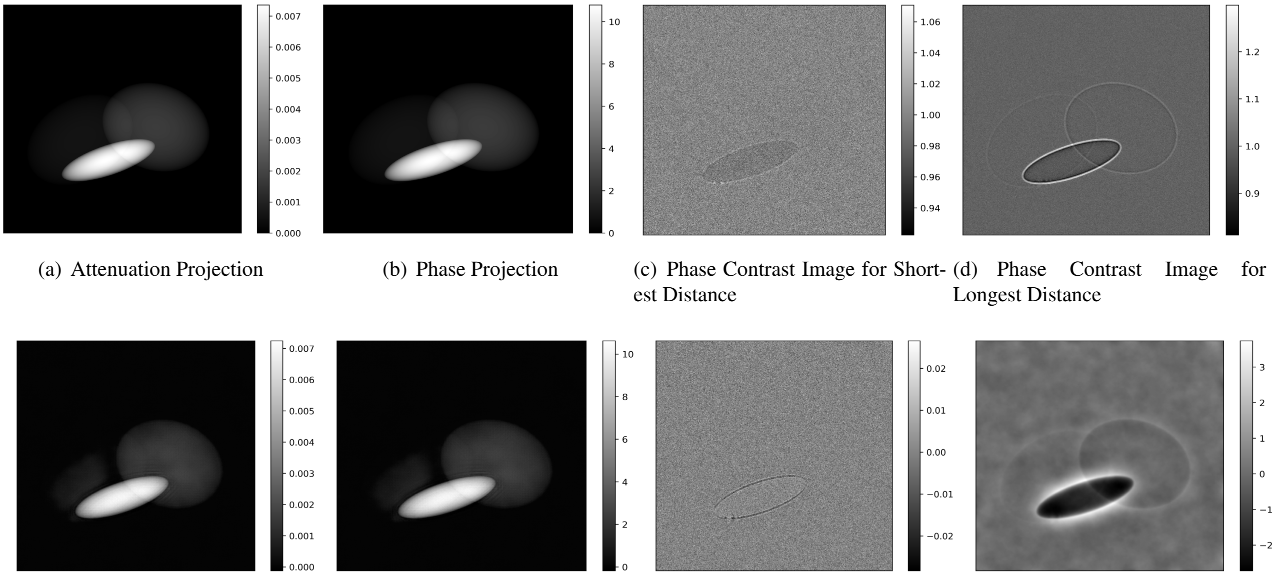
5.6.7 Worst Case of De-blurring and De-noising Capacity of Neural Network for Noisy Gaussian blurred images in Phase Retrieval



(a) Attenuation Projection (b) Phase Projection (c) Phase Contrast Image for Shortest Distance (d) Phase Contrast Image for Longest Distance

(e) MSD Attenuation Retrieval (f) MSD Phase Retrieval (g) CTF Attenuation Retrieval (h) CTF Phase Retrieval

Figure 5.12: Worst Case of De-blurring and De-noising Capacity of Neural Network for Noisy Gaussian blurred images in Phase Retrieval

Comparing with Fig 5.6, the mixed-scale dense network based reconstructions perform as good as the non-blurred the same noise level case. And the contrast transfer function based phase reconstruction performs as good as the non-blurred of same noise level. The attenuation reconstruction performs quite worse.

5.6.8 Conclusion

For both of noisy and non-noisy gaussian blurring cases, the mixed-scale dense network has capability to overcome the gaussian blurring. The contrast transfer function based phase reconstruction for noisy gaussian blurring case is also performing as good as non-noisy gaussian blurring case. The attenuation retrieval is not that good as for the non-noisy case.

5.7 Experiment of Exploration on Trained Neural Network Shape Generality in Phase Retrieval

5.7.1 Overview on Experiment of Exploration on Trained Neural Network Shape Generality in Phase Retrieval

Trained Network	Number of Density(s) involved in Training Data	Shape(s) involved in Training Data
N	1	ellipsoid
O	1	paraboloid

Table 5.16: Overview on Experiment of Exploration on Trained Neural Network Shape Generality in Phase Retrieval

5.7.2 Testing Error of Trained Network for Exploration on Trained Neural Network Shape Generality in Phase Retrieval

Applied Network	Shape(s) in Testing Data	Index	Average NMSE	Average MSE	Average SSIM	Average PSNR
Dataset Used for Testing: No.8						
N	ellipsoid	Attenuation	0.04153960	2.54793367e-09	0.99999672	88.45226307
O	ellipsoid	Attenuation	0.21751464	9.40085250e-08	0.99993389	72.91602013
N	ellipsoid	Phase	0.04153989	0.00547936	0.93622732	73.25761128
O	ellipsoid	Phase	0.21751398	0.20216571	0.83685336	57.72142121
Dataset Used for Testing: No.9						
N	paraboloid	Attenuation	0.07911911	2.63911244e-09	0.99999354	86.82489038
O	paraboloid	Attenuation	0.01583962	1.57508938e-10	0.99999983	101.82156917
N	paraboloid	Phase	0.07911906	0.00567541	0.92243509	71.63028354
O	paraboloid	Phase	0.01583863	0.00033872	0.98667416	86.62723075

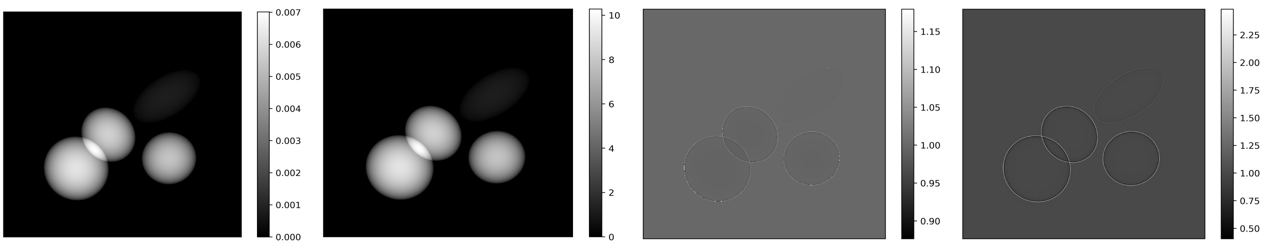
Table 5.17: Testing Error of Trained Network for Exploration on Trained Neural Network Shape Generality in Phase Retrieval

From Table 5.17 we can see the network trained with one kind of shape, i.e. shape A, performs better than the network trained with another kind of shape, i.e. shape B when testing on dataset of shape A, and vice versa. But the performance of network trained with shape A on testing data of shape B is not bad, it means the shape generality of network in application could work.

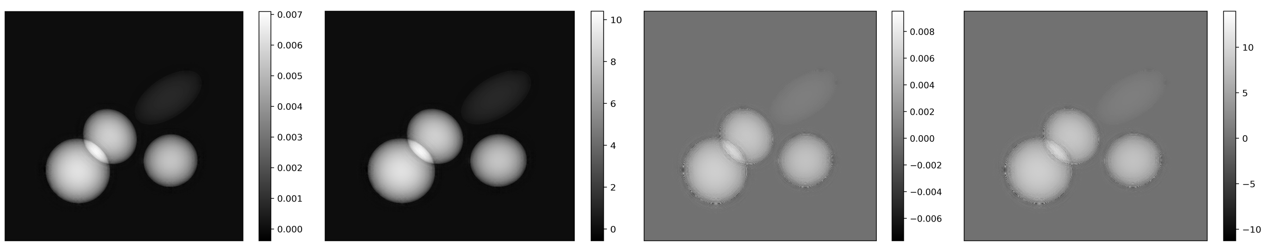
We can also see that in terms of NMSE, the gap between two networks for the same reconstruction is larger in the upper semi-part, it means the generalization from ellipsoid to paraboloid could be more difficult than generalization from paraboloid to ellipsoid.

5.7.3 Typical Case of of Shape Generality

5.7.3.1 Shape Involved in Testing Data is Ellipsoid



(a) Attenuation Projection (b) Phase Projection (c) Phase Contrast Image of Shortest Distance (d) Phase Contrast Image of Longest Distance

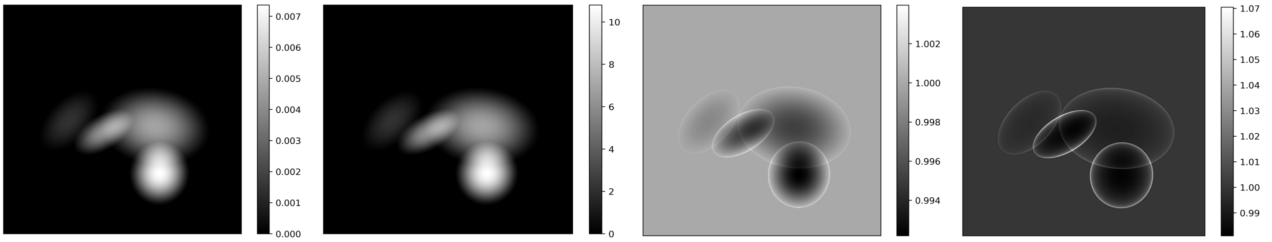


(e) Attenuation Retrieval by Network N (f) Phase Retrieval by Network N (g) Attenuation Retrieval by Network O (h) Phase Retrieval by Network O

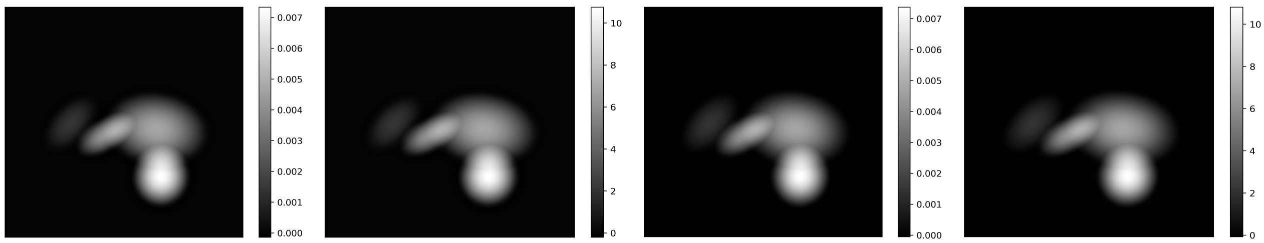
Figure 5.13: Typical Case of of Shape Generality and Shape Involved in Testing Data is Ellipsoid

The network N behaves much better than network O visually because the network N was trained with ellipsoid shapes,

5.7.3.2 Shape Involved in Testing Data is Paraboloid



(a) Attenuation Projection (b) Phase Projection (c) Phase Contrast Image of Shortest Distance (d) Phase Contrast Image of Longest Distance



(e) Attenuation Retrieval by Network N (f) Phase Retrieval by Network N (g) Attenuation Retrieval by Network O (h) Phase Retrieval by Network O

Figure 5.14: Typical Case of of Shape Generality and Shape Involved in Testing Data is Paraboloid

The network N behaves similar to network O performance visually, which was trained with paraboloid shapes, it basically justifies the above deduction that the network N behaves much better than network O visually because the network N was trained with ellipsoid shapes.

5.7.4 Conclusion

In this section, we have studied the shape generalization properties of the network. The network gives the better results when trained with a shape and tested with the same shape.