[0091] In some embodiments, the reconstructed video data may be generated from a bitstream comprising decoded quantized video data and motion vector data. As an example, generating the reconstructed video data may include receiving a stream of video data including quantized video data and motion vector data. Then, generating the reconstructed video data may include dequantizing the stream of quantized data, using an inverse transformation, to obtain a recovered residual; and generating the reconstructed video data based on the recovered residual and the motion vector data.

[0092] At operation 615, one or more substitute quality factors may be generated via a plurality of iterations using one or more original quality factors, wherein the one or more substitute quality factors are a modified version of the one or more original quality factors.

[0093] According to embodiments of the present disclosure, in a first iteration of the plurality of iterations, the one or more substitute quality factors may be initialized to as the one or more original quality control factors prior to a computing of the target loss. For each of the subsequent iterations, a target loss may be computed based on the enhanced video data and the input video data. A gradient of the target loss may also be computed and back propagated through the model/system. Based on the gradient of the target loss, the one or more substitute quality factors may be updated. In a final iteration or last iteration, the one or more substitute quality factors may be updated to one or more final substitute quality control factors.

[0094] According to embodiments of the present disclosure, the number of iterations in the plurality of iterations may be based on a pre-determined maximum number of iterations. According to some embodiments of the present disclosure, the number of iterations in the plurality of iterations may be adaptively based on the ~~received~~ input video data and the neural network based loop filter. According to some embodiments of the present disclosure, the number of

WHAT IS CLAIMED IS:

1. A method for video enhancement based on neural network based loop filtering using meta learning, the method being executed by at least one processor, the method comprising:

receiving input video data and one or more original quality control factors;

generating one or more substitute quality factors via a plurality of iterations using the one or more original quality factors, wherein the one or more substitute quality factors are a modified version of the one or more original quality factors;

determining a neural network based loop filter comprising neural network based loop filter parameters and a plurality of layers, wherein the neural network based loop filter parameters include shared parameters and adaptive parameters; and

generating enhanced video data, based on the one or more substitute quality factors and the input video data, using the neural network based loop filter.

2. The method of claim 1, wherein generating the one or more substitute quality factors comprises:

for each of the plurality of iterations:

computing a target loss based on the enhanced video data and the input video data;

computing a gradient of the target loss using backpropagation; and

updating the one or more substitute quality factors based on the gradient of the target loss.

3. The method of claim 2, wherein a first iteration of generating the one or more substitute quality factors comprises initializing the one or more substitute quality factors as the one or more original quality control factors prior to the computing of the target loss.

4. The method of claim 1, wherein a number of iterations in the plurality of iterations is based on a pre-determined maximum number of iterations.

5. The method of claim 1, wherein a number of iterations in the plurality of iterations is adaptively based on the ~~received~~ input video data and the neural network based loop filter.

6. The method of claim 2, wherein a number of iterations in the plurality of iterations is based on the updating the one or more substitute quality factors being less than a pre-determined threshold.

7. The method of claim 2, wherein a last iteration of generating the one or more substitute quality factors comprises updating the one or more substitute quality factors to one or more final substitute quality control factors.

8. The method of claim 1, wherein the generating the enhanced video data comprises:

for each of the plurality of layers in the neural network based loop filter:

generating shared features based on an output from a previous layer, using a first shared neural network loop filter having first shared parameters;

computing estimated adaptive parameters, based on the output from the previous layer, the shared features, first adaptive parameters from a first adaptive neural network loop filter, and the one or more substitute quality factors, using a prediction neural network; and

generating an output for a current layer, based on the shared features and the estimated adaptive parameters; and

generating the enhanced video data, based on an output of a last layer of the neural network based loop filter.

9. An apparatus comprising:

at least one memory configured to store program code; and

at least one processor configured to read the program code and operate as instructed by the program code, to perform the method according to any one of claims 1 to 8.

~~the program code comprising:~~

~~receiving code configured to cause the at least one processor to receive input video data and one or more original quality control factors;~~

~~first generating code configured to cause the at least one processor to generate one or more substitute quality factors via a plurality of iterations using the one or more original quality factors, wherein the one or more substitute quality factors are a modified version of the one or more original quality factors;~~

~~first determining code configured to cause the at least one processor to determine a neural network based loop filter comprising neural network based loop filter parameters and a plurality of layers, wherein the neural network based loop filter parameters include shared parameters and adaptive parameters; and~~

second generating code configured to cause the at least one processor to generate enhanced video data, based on the one or more substitute quality factors and the input video data, using the neural network based loop filter.

10. The apparatus of claim 9, wherein the first generating code comprises:

for each of the plurality of iterations:

computing a target loss based on the enhanced video data and the input video data;

computing a gradient of the target loss using backpropagation; and

updating the one or more substitute quality factors based on the gradient of the target loss.

11. The apparatus of claim 10, wherein a first iteration of the plurality of iterations comprises initializing the one or more substitute quality factors as the one or more original quality control factors prior to the computing of the target loss.

12. The apparatus of claim 9, wherein a number of iterations in the plurality of iterations is based on a pre-determined maximum number of iterations.

13. The apparatus of claim 9, wherein a number of iterations in the plurality of iterations is adaptively based on the received video data and the neural network based loop filter.

~~14. The apparatus of claim 10, wherein a number of iterations in the plurality of iterations is based on the updating the one or more substitute quality factors being less than a pre-determined threshold.~~

~~15. The apparatus of claim 10, wherein a last iteration of the plurality of iterations comprises updating the one or more substitute quality factors to one or more final substitute quality control factors.~~

~~16. The apparatus of claim 9, wherein the second generating code comprises:~~

~~for each of the plurality of layers in the neural network based loop filter:~~

~~third generating code configured to cause the at least one processor to generate shared features based on an output from a previous layer, using a first shared neural network loop filter having first shared parameters;~~

~~first computing code configured to cause the at least one processor to compute estimated adaptive parameters, based on the output from the previous layer, the shared features, first adaptive parameters from a first adaptive neural network loop filter, and the one or more substitute quality factors, using a prediction neural network; and~~

~~fourth generating code configured to cause the at least one processor to generate an output for a current layer, based on the shared features and the estimated adaptive parameters; and~~

~~fifth generating code configured to cause the at least one processor to generate the enhanced video data, based on an output of a last layer of the neural network based loop filter.~~

~~17~~10. A non-transitory computer-readable medium storing instructions that, when executed by at least one processor, causes the at least one processor to~~:~~ perform the method according to any one of claims 1 to 8.

~~receive input video data and one or more original quality control factors;~~

~~generate one or more substitute quality factors via a plurality of iterations using the one or more original quality factors, wherein the one or more substitute quality factors are a modified version of the one or more original quality factors;~~

~~determine a neural network based loop filter comprising neural network based loop filter parameters and a plurality of layers, wherein the neural network based loop filter parameters include shared parameters and adaptive parameters; and~~

~~generate enhanced video data, based on the one or more substitute quality factors and the input video data, using the neural network based loop filter.~~

~~18. The non-transitory computer-readable medium of claim 17, wherein the generating the one or more substitute quality factors comprises:~~

~~for each of the plurality of iterations:~~

~~computing a target loss based on the enhanced video data and the input video data;~~

~~computing a gradient of the target loss using backpropagation; and~~

~~updating the one or more substitute quality factors based on the gradient of the target loss.~~

~~19. The non-transitory computer-readable medium of claim 18, wherein a first iteration of generating the one or more substitute quality factors comprises initializing the one or more~~

~~substitute quality factors as the one or more original quality control factors prior to the computing of the target loss.~~

~~20. The non-transitory computer-readable medium of claim 18, wherein a last iteration of generating the one or more substitute quality factors comprises updating the one or more substitute quality factors to one or more final substitute quality control factors.~~