CLAIMS

1. An artificial intelligence-based method of base calling, the method including:

accessing a series of per-cycle analyte channel sets of images depicting clusters, wherein the images depict intensity emissions generated as a result of nucleotide incorporation in clusters of associated analytes on a substrate during sequencing cycles of a sequencing run and the per-cycle analyte channel sets results from applying distinct illumination and/or filter wavelength bands;

processing, through a spatial network of a convolutional neural network-based base caller, a first window of per-cycle analyte channel sets of images depicting clusters in the series for a first window of sequencing cycles of the sequencing run, applying 1D, 2D or 3D convolutions, and generating respective sequences of spatial output sets for respective sequencing cycles in the first window of sequencing cycles;

processing, through a compression network of the convolutional neural network-based base caller, respective final spatial output sets in the respective sequences of spatial output sets, applying a number of convolution filters based on a number of channels in the per-cycle analyte channel sets, and generating respective compressed spatial output sets for the respective sequencing cycles in the first window of sequencing cycles;

storing, in memory, the compressed spatial output sets for the respective sequencing cycles; and

generating, based on the respective compressed spatial output sets stored in memory, base call predictions for one or more sequencing cycles in the first window of sequencing cycles.

2. The artificial intelligence-based method of claim 1, wherein the respective final spatial output sets have M channels, wherein the respective compressed spatial output sets have N channels, and wherein M > N.

3. The artificial intelligence-based method of claim 1, further including:

for a second window of sequencing cycles of the sequencing run that shares, with the first window of sequencing cycles, one or more overlapping sequencing cycles for which the spatial network previously generated spatial output sets, and at least one non-overlapping sequencing cycle,

processing, through the spatial network, a per-cycle analyte channel set only for the non-overlapping sequencing cycle, and generating a sequence of spatial output sets for the non-overlapping sequencing cycle;

processing, through the compression network, a final spatial output set in the sequence of spatial output sets, and generating a compressed spatial output set for the non-overlapping

sequencing cycle, wherein the final spatial output has M channels, wherein the compressed spatial output has N channels, and wherein M > N; and

generating, based on respective compressed spatial output sets for the overlapping sequencing cycles previously generated for the first window of sequencing cycles and on the compressed spatial output set, base call predictions for one or more sequencing cycles in the second window of sequencing cycles.

4. The artificial intelligence-based method of claim 3, further including:

for a third window of sequencing cycles of the sequencing run that shares, with the first and second windows of sequencing cycles, one or more overlapping sequencing cycles for which the spatial network previously generated spatial output sets, and at least one non-overlapping sequencing cycle,

processing, through the spatial network, a per-cycle analyte channel set only for the non-overlapping sequencing cycle, and generating a sequence of spatial output sets for the non-overlapping sequencing cycle;

processing, through the compression network, a final spatial output set in the sequence of spatial output sets, and generating a compressed spatial output set for the non-overlapping sequencing cycle, wherein the final spatial output has M channels, wherein the compressed spatial output has N channels, and wherein M > N; and

generating, based on respective compressed spatial output sets for the overlapping sequencing cycles previously generated for the first and second windows of sequencing cycles and on the compressed spatial output set, base call predictions for one or more sequencing cycles in the third window of sequencing cycles.

5. The artificial intelligence-based method of claim 1, wherein the spatial network has a sequence of spatial convolution layers that separately processes each per-cycle analyte channel set in a particular window of per-cycle analyte channel sets in the series for a particular window of sequencing cycles of the sequencing run, and produce a sequence of spatial output sets for each sequencing cycle in the particular window of sequencing cycles, including beginning with a first spatial convolution layer that combines intensities only within a per-cycle analyte channel set of a subject sequencing cycle and not between per-cycle analyte channel sets of different sequencing cycles in the particular window of sequencing cycles, and continuing with successive spatial convolution layers that combine spatial outputs of preceding spatial convolution layers only within a subject sequencing cycle and not between the different sequencing cycles in the particular window of sequencing cycles.

6. The artificial intelligence-based method of claim 5, wherein respective spatial convolution layers in the sequence of spatial convolution layers have different counts of convolution filters, wherein a final spatial convolution layer in the sequence of spatial convolution layers has M convolution filters, and wherein M is an integer greater than four.

7. The artificial intelligence-based method of claim 6, wherein respective spatial convolution layers in the sequence of spatial convolution layers have a same count of convolution filters, wherein the same count is M, and wherein M is an integer greater than four.

8. The artificial intelligence-based method of claim 7, wherein the convolution filters in the spatial network use two-dimensional (2D) convolutions.

9. The artificial intelligence-based method of claim 7, wherein the convolution filters in the spatial network use three-dimensional (3D) convolutions.

10. The artificial intelligence-based method of claim 5, wherein the convolutional neural network-based base caller has a temporal network, wherein the temporal network has a sequence of temporal convolution layers that groupwise processes respective compressed spatial output sets for windows of successive sequencing cycles in the particular window of sequencing cycles, and produces a sequence of temporal output sets for the particular window of sequencing cycles, including beginning with a first temporal convolution layer that combines compressed spatial output sets between the different sequencing cycles in the particular window of sequencing cycles, and continuing with successive temporal convolution layers that combine successive temporal outputs of preceding temporal convolution layers.

11. The artificial intelligence-based method of claim 10, further including:

for the first window of sequencing cycles,

processing, through the first temporal convolution layer in the sequence of temporal convolution layers of the temporal network, the respective compressed spatial output sets for windows of successive sequencing cycles in the first window of sequencing cycles, and generating a plurality of temporal output sets for the first window of sequencing cycles;

processing, through the compression network, the plurality of temporal output sets, and generating respective compressed temporal output sets for respective temporal output sets in the plurality of temporal output sets, wherein the respective temporal output sets have M channels, wherein the respective compressed temporal output sets have N channels, and wherein M > N;

processing, through a final temporal convolution layer in the sequence of temporal convolution layers of the temporal network, the respective compressed temporal output sets, and generating a final temporal output set for the first window of sequencing cycles; and

generating, based on the final temporal output set, the base call predictions for one or more sequencing cycles in the first window of sequencing cycles,

wherein an output layer processes the final temporal output set and produces a final output for the first window of sequencing cycles, wherein the base call predictions are generated based on the final output.

12. The artificial intelligence-based method of claim 11, further including:

for a second window of sequencing cycles that shares, with the first window of sequencing cycles, one or more overlapping windows of successive sequencing cycles for which the first temporal convolution layer previously generated temporal output sets, and at least one non-overlapping window of successive sequencing cycles for which the first temporal convolution layer is yet to generate a temporal output set,

processing, through the first temporal convolution layer, respective compressed spatial output sets only for respective sequencing cycles in the non-overlapping window of successive sequencing cycles, and generating a temporal output set for the non-overlapping window of successive sequencing cycles;

processing, through the compression network, the temporal output set, and generating a compressed temporal output set for the non-overlapping window of successive sequencing cycles, wherein the temporal output set has M channels, wherein the compressed temporal output has N channels, and wherein M > N;

processing, through the final temporal convolution layer, respective compressed temporal output sets for the overlapping windows of successive sequencing cycles previously generated for the first window of sequencing cycles and on the compressed temporal output set, and generating a final temporal output set for the second window of sequencing cycles; and

generating, based on the final temporal output set, the base call predictions for one or more sequencing cycles in the second window of sequencing cycles,

wherein an output layer processes the final temporal output set and produces a final output for the second window of sequencing cycles, wherein the base call predictions are generated based on the final output.

13. The artificial intelligence-based method of claim 12, further including:

for a third window of sequencing cycles that shares, with the first and second windows of sequencing cycles, one or more overlapping windows of successive sequencing cycles for which the first temporal convolution layer previously generated temporal output sets, and at least one non-overlapping window of successive sequencing cycles,

processing, through the first temporal convolution layer, respective compressed spatial output sets only for respective sequencing cycles in the non-overlapping window of successive sequencing cycles, and generating a temporal output set for the non-overlapping window of successive sequencing cycles;

processing, through the compression network, the temporal output set, and generating a compressed temporal output set for the non-overlapping window of successive sequencing cycles, wherein the temporal output set has M channels, wherein the compressed temporal output has N channels, and wherein M > N; and

processing, through the final temporal convolution layer, respective compressed temporal output sets for the overlapping windows of successive sequencing cycles previously generated for the first and second windows of sequencing cycles and on the compressed temporal output set, and generating a final temporal output set for the third window of sequencing cycles; and

generating, based on the final temporal output set, the base call predictions for one or more sequencing cycles in the third window of sequencing cycles,

wherein an output layer processes the final temporal output set and produces a final output for the third window of sequencing cycles, wherein the base call predictions are generated based on the final output.

14. The artificial intelligence-based method of claim 10, wherein respective temporal convolution layers in the sequence of temporal convolution layers of the temporal network have different counts of convolution filters, wherein the first temporal convolution layer has M convolution filters, and wherein M is an integer greater than four.

15. The artificial intelligence-based method of claim 10, wherein respective temporal convolution layers in the sequence of temporal convolution layers of the temporal network have a same count of convolution filters, wherein the same count is M, and wherein M is an integer greater than four.

16. The artificial intelligence-based method of claim 15, wherein the convolution filters in the temporal network use one-dimensional (1D) convolutions.

17. The artificial intelligence-based method of claim 1, wherein the compression network uses 1x1 convolutions to control a number of compressed spatial outputs in a compressed spatial output set, wherein the compression network has N convolution filters, and wherein N is an integer equal to or less than four.

18. The artificial intelligence-based method of claim 1, further including using data identifying unreliable analytes to remove portions of compressed spatial outputs in a compressed spatial output set corresponding to the unreliable analytes, and generating a compressed, filtered spatial output set to substitute the compressed spatial output set and generate base call predictions only for those analytes that are not the unreliable analytes.