

CLAIMS

1. A system, comprising:

a spatial convolution network configured to process a window of per-cycle sequencing image sets for a series of sequencing cycles of a sequencing run on a cycle-by-cycle basis by separately convolving respective per-cycle sequencing image sets in the window of per-cycle sequencing image sets through respective sequences of spatial convolution layers to generate respective per-cycle spatial feature map sets for respective sequencing cycles in the series of sequencing cycles;

wherein the respective sequences of spatial convolution layers have respective sequences of spatial convolution filter banks, wherein trained coefficients of spatial convolution filters in spatial convolution filter banks of the respective sequences of spatial convolution filter banks vary between sequences of spatial convolution layers in the respective sequences of spatial convolution layers;

a temporal convolution network configured to process the per-cycle spatial feature map sets on a groupwise basis by convolving on respective overlapping groups of per-cycle spatial feature map sets in the per-cycle spatial feature map sets using respective temporal convolution filter banks of a first temporal convolution layer to generate respective per-group temporal feature map sets for the respective overlapping groups of per-cycle spatial feature map sets; and

wherein trained coefficients of temporal convolution filters in the respective temporal convolution filter banks vary between temporal convolution filter banks in the respective temporal convolution filter banks.

2. The system of claim 1, wherein the spatial convolution filters use intra-cycle segregated convolutions.

3. The system of claim 1, wherein the temporal convolution filters use inter-cycle combinatory convolutions.

4. The system of claim 1, further configured to comprise a compression network that separately convolves the respective per-cycle spatial feature map sets through respective compression convolution layers to generate respective per-cycle compressed spatial feature map sets for the respective sequencing cycles.

5. The system of claim 4, wherein trained coefficients of compression convolution filters in the respective compression convolution layers vary between compression convolution layers in the respective compression convolution layers.

6. The system of claim 5, wherein the temporal convolution network is further configured to process the per-group temporal feature map sets on the groupwise basis by convolving on respective overlapping groups of per-group temporal feature map sets in the per-group temporal feature map sets using respective temporal convolution filter banks of a second temporal convolution layer to generate respective further per-group temporal feature map sets for the respective overlapping groups of per-group temporal feature map sets.
7. The system of claim 6, further configured to comprise an output network that processes a final temporal feature map set generated by a final temporal convolution layer to generate a final output.
8. The system of claim 7, further configured to produce base call predication for one or more sequencing cycles in the series of sequencing cycles based on the final output.
9. A system, comprising:
 - a spatial convolution network configured to process a window of per-cycle sequencing image sets for a series of sequencing cycles of a sequencing run on a cycle-by-cycle basis by separately convolving respective per-cycle sequencing image sets in the window of per-cycle sequencing image sets through respective sequences of spatial convolution layers to generate respective per-cycle spatial feature map sets for respective sequencing cycles in the series of sequencing cycles;
 - a temporal convolution network configured to process the per-cycle spatial feature map sets on a groupwise basis by convolving on respective overlapping groups of per-cycle spatial feature map sets in the per-cycle spatial feature map sets using respective temporal convolution filter banks to generate respective per-group temporal feature map sets for the respective overlapping groups of per-cycle spatial feature map sets; and
 - wherein trained coefficients of temporal convolution filters in the respective temporal convolution filter banks vary between temporal convolution filter banks in the respective temporal convolution filter banks.
10. The system of claim 9, wherein the respective sequences of spatial convolution layers have respective sequences of spatial convolution filter banks, wherein trained coefficients of spatial convolution filters in spatial convolution filter banks of the respective sequences of spatial convolution filter banks are shared between sequences of spatial convolution layers in the respective sequences of spatial convolution layers.

11. The system of claim 9, further configured to comprise a compression network that separately convolves the respective per-cycle spatial feature map sets through respective compression convolution layers to generate respective per-cycle compressed spatial feature map sets for the respective sequencing cycles, wherein trained coefficients of compression convolution filters in the respective compression convolution layers vary between compression convolution layers in the respective compression convolution layers.

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

processing, through spatial convolution network, a window of per-cycle sequencing image sets for a series of sequencing cycles of a sequencing run on a cycle-by-cycle basis by separately convolving respective per-cycle sequencing image sets in the window of per-cycle sequencing image sets through respective sequences of spatial convolution layers, and generating respective per-cycle spatial feature map sets for respective sequencing cycles in the series of sequencing cycles;

wherein the respective sequences of spatial convolution layers have respective sequences of spatial convolution filter banks, wherein trained coefficients of spatial convolution filters in spatial convolution filter banks of the respective sequences of spatial convolution filter banks vary between sequences of spatial convolution layers in the respective sequences of spatial convolution layers;

processing, through a temporal convolution network, the per-cycle spatial feature map sets on a groupwise basis by convolving on respective overlapping groups of per-cycle spatial feature map sets in the per-cycle spatial feature map sets using respective temporal convolution filter banks of a first temporal convolution layer, and generating respective per-group temporal feature map sets for the respective overlapping groups of per-cycle spatial feature map sets; and

wherein trained coefficients of temporal convolution filters in the respective temporal convolution filter banks vary between temporal convolution filter banks in the respective temporal convolution filter banks.

13. The artificial intelligence-based method of claim 12, further including separately convolving the respective per-cycle spatial feature map sets through respective compression convolution layers of a compression network and generating respective per-cycle compressed spatial feature map sets for the respective sequencing cycles.

14. The artificial intelligence-based method of claim 13, wherein trained coefficients of compression convolution filters in the respective compression convolution layers vary between compression convolution layers in the respective compression convolution layers.

15. The artificial intelligence-based method of claim 14, further including processing, through the temporal convolution network, the per-group temporal feature map sets on the groupwise basis by convolving on respective overlapping groups of per-group temporal feature map sets in the per-group temporal feature map sets using respective temporal convolution filter banks of a second temporal convolution layer, and generating respective further per-group temporal feature map sets for the respective overlapping groups of per-group temporal feature map sets.

16. The artificial intelligence-based method of claim 15, further including processing, through an output network, a final temporal feature map set generated by a final temporal convolution layer, and generating a final output.

17. The artificial intelligence-based method of claim 16, further including producing base call predications for one or more sequencing cycles in the series of sequencing cycles based on the final output.

18. A system, comprising:

a spatial convolution network configured to apply respective sequences of spatial convolution layers to respective per-cycle sequencing images in a window of per-cycle sequencing images; and

wherein the respective sequences of spatial convolution layers have respective sequences of spatial convolution filter banks that differ from one sequence of spatial convolution layers to another sequence of spatial convolution layers.

19. A system, comprising:

a temporal convolution network configured with a first temporal convolution layer configured to apply respective sets of temporal convolution filters to respective sliding windows of spatial feature maps; and

wherein the respective sets of temporal convolution filters in the first temporal convolution layer have temporal convolution filters that differ from one set of temporal convolution filters to another set of temporal convolution filters.

20. The system of claim 19, wherein the temporal convolution network is configured with a second temporal convolution layer that succeeds the first temporal convolution layer, wherein the second convolution layer is configured to apply respective sets of temporal convolution filters to respective sliding windows of temporal feature maps, and wherein the respective sets of temporal convolution filters in the second temporal convolution layer have temporal convolution

filters that differ from one set of temporal convolution filters to another set of temporal convolution filters.