

CLAIMS

Claim 1. A system, comprising:

a spatial convolution network component of a convolutional neural network configured to process a window of per-cycle sequencing image sets depicting clusters 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 depicting clusters 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 image sets depicting clusters depict intensity emissions generated as a result of nucleotide incorporation in clusters of associated analytes on a substrate during a sequencing cycle of a sequencing run;

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 component of the convolutional neural 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;

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; and

an output network, connected to the temporal convolution network component, that processes a final temporal feature map set generated by a final temporal convolution layer and generate a base call predictions based on the final temporal feature map set.

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

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

Claim 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.

Claim 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.

Claim 6. The system of claim 5, wherein the temporal convolution network component 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.

Claim 7. A system, comprising:
a spatial convolution network configured to process a window of per-cycle sequencing image sets depicting clusters 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 depicting clusters

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.

Claim 8. The system of claim 7, 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.

Claim 9. The system of claim 7, 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.

Claim 10. An artificial intelligence-based method of base calling, the method including:

processing, through spatial convolution network component of a convolutional neural network, a window of per-cycle sequencing image sets depicting clusters 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 depicting clusters 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 per-cycle sequencing image sets depicting clusters depict intensity emissions generated as a result of nucleotide incorporation in clusters of associated analytes on a substrate during a sequencing cycle of a sequencing run;

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 component of the convolutional neural 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;

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; and

calling bases from output of a final layer of the temporal convolution network component.

Claim 11. The artificial intelligence-based method of claim 10, 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.

Claim 12. The artificial intelligence-based method of claim 11, wherein trained coefficients of compression convolution filters in the respective compression convolution layers vary between compression convolution layers in the respective compression convolution layers.

Claim 13. The artificial intelligence-based method of claim 12, further including processing, through the temporal convolution network component, 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.