

[CLAIMS]

[Claim 1]

A method for training a neuron network using a processor in communication with a memory, comprising:

determining features of a signal using the neuron network;

determining an uncertainty measure of the features for classifying the signal;

reconstructing the signal from the features using a decoder neuron network to produce a reconstructed signal;

comparing the reconstructed signal with the signal to produce a reconstruction error;

combining the uncertainty measure with the reconstruction error to produce a rank of the signal for a necessity of a manual labeling;

labeling the signal according to the rank to produce the labeled signal; and

training the neuron network and the decoder neuron network using the labeled signal.

[Claim 2]

The method of claim 1, wherein the labeling comprises:

transmitting a labeling request to an annotation device if the rank indicates the necessity of the manual labeling process.

[Claim 3]

The method of claim 1, wherein the determining features are performed by using an encoder neural network.

[Claim 4]

The method of claim 1, wherein the signal is an electroencephalogram (EEG) or an electrocardiogram (ECG).

[Claim 5]

The method of claim 1, wherein the reconstruction error is defined based on a Euclidean distance between the signal and the reconstructed signal.

[Claim 6]

The method of claim 1, wherein the rank is defined based on an addition of an entropy function and the reconstruction error.

[Claim 7]

An active learning system comprising:
a human machine interface;
a storage device including neural networks;
a memory;
a network interface controller connectable with a network being outside the system;
an imaging interface connectable with an imaging device; and
a processor configured to connect to the human machine interface, the storage device, the memory, the network interface controller and the imaging interface,
wherein the processor executes instructions for classifying a signal using the neural networks stored in the storage device, wherein the neural networks perform steps of:
determining features of the signal using the neuron network;
determining an uncertainty measure of the features for classifying the signal;

reconstructing the signal from the features using a decoder neuron network to produce a reconstructed signal;
comparing the reconstructed signal with the signal to produce a reconstruction error;
combining the uncertainty measure with the reconstruction error to produce a rank of the signal for a necessity of a manual labeling;
labeling the signal according to the rank to produce the labeled signal; and
training the neuron network and the decoder neuron network using the labeled signal.

[Claim 8]

The method of claim 7, wherein the labeling comprises:
transmitting a labeling request to an annotation device if the rank indicates the necessity of the manual labeling process.

[Claim 9]

The method of claim 7, wherein the determining features are performed by using an encoder neural network.

[Claim 10]

The method of claim 7, wherein the signal is an electroencephalogram (EEG) or an electrocardiogram (ECG).

[Claim 11]

The method of claim 7, wherein the reconstruction error is defined based on a Euclidean distance between the signal and the reconstructed signal.

[Claim 12]

The method of claim 7, wherein the rank is defined based on an addition of an entropy function and the reconstruction error.

[Claim 13]

A non-transitory computer-readable medium storing software comprising instructions executable by one or more computers which, upon such execution, cause the one or more computers to perform operations comprising:

- determining features of a signal using the neuron network;
- determining an uncertainty measure of the features for classifying the signal;
- reconstructing the signal from the features using a decoder neuron network to produce a reconstructed signal;
- comparing the reconstructed signal with the signal to produce a reconstruction error;
- combining the uncertainty measure with the reconstruction error to produce a rank of the signal for a necessity of a manual labeling;
- labeling the signal according to the rank to produce the labeled signal; and
- training the neuron network and the decoder neuron network using the labeled signal.

[Claim 14]

The method of claim 13, wherein the labeling comprises:

- transmitting a labeling request to an annotation device if the rank indicates the necessity of the manual labeling process.

[Claim 15]

The method of claim 13, wherein the determining features are performed by using an encoder neural network.

[Claim 16]

The method of claim 13, wherein the signal is an electroencephalogram (EEG) or an electrocardiogram (ECG).

[Claim 17]

The method of claim 13, wherein the reconstruction error is defined based on a Euclidean distance between the signal and the reconstructed signal.

[Claim 18]

The method of claim 13, wherein the rank is defined based on an addition of an entropy function and the reconstruction error.