CLAIMS

1. A method comprising:

obtaining individual patient data of a neural status of a patient;

obtaining a therapeutic brain network response map of a treatment; and

predicting an efficacy of the treatment for the patient based on a comparison of the data of the neural status and the brain network response map, wherein predicting the efficacy of the treatment comprises providing the individual patient data and the therapeutic brain network response map as inputs to a statistical prediction model for the treatment and predicting the efficacy of the treatment using the statistical prediction model,

wherein the statistical prediction model comprises convolution kernels configured to extract features from the individual patient data of the neural status and the therapeutic brain network response map.

2. The method of claim 1, wherein the features comprise an overlap area between the individual patient data and the brain network response map.

3. The method of claim 1, wherein values in the convolution kernels are learned during a training of the statistical prediction model for the treatment.

4. The method of claim 1, further comprising repeatedly multiplying each convolution kernel with the individual patient data and the therapeutic brain network response map, and storing results as pixels in a plurality of feature maps.

5. The method of claim 4, wherein the statistical prediction model further comprises a deep convolutional neural network comprises stacked convolution, rectified linear unit, and pooling layers configured to extract further features from the feature maps.

6. The method of claim 5, further comprising predicting the efficacy based on the further features from the feature maps.

7. The method of claim 1, further comprising predicting parameters for the treatment using the statistical prediction model.

8. The method of claim 1, wherein the treatment comprises vagus nerve stimulation and the neural status comprises a seizure.

9. The method of claim 8, wherein the individual patient data of the neural status comprises data of epileptiform spike or seizure network image indicative of brain regions in a seizure generation and propagation and pathways between these regions.

10. The method of claim 1, wherein obtaining the individual patient data of the neural status comprises using an electroencephalogram (EEG) or magnetoencephalogram (MEG), and wherein obtaining the therapeutic brain network response map comprises using functional magnetic resonance imaging (fMRI), positron emission tomography (PET), and/or single-photon emission computed tomography (SPECT).

11. The method of claim 1, wherein obtaining the individual patient data of the neural status comprises using group averaged spikes and source localization, using spike ICA analysis and source localization, using seizure network analysis, or combinations thereof.

12. The method of claim 11, wherein obtaining the individual patient data comprises projecting data onto a brain space, identifying brain regions that are involved in the neural status, calculating pathways between seizure brain regions, or combinations thereof.

13. The method of claim 1, wherein the therapeutic brain network response map corresponds to a brain response to the treatment using a certain set of parameters.

14. A system comprising:
at least one processor; and

computer readable media encoded with instructions that, when executed by the at least one processor, cause the system to:

provide image data of a neural status of a patient and a therapeutic brain network response map as inputs to a statistical prediction model for a treatment; and

predict an efficacy of the treatment using the statistical prediction model, wherein the statistical prediction model comprises convolution kernels configured to extract features from the individual patient data of the neural status and the therapeutic brain network response map.

15. The system of claim 14, wherein values in the convolution kernels are learned during a training of the statistical prediction model for the treatment.

16. The system of claim 14, wherein the instructions further cause the system to repeatedly multiply each convolution kernel with the individual patient data and the therapeutic brain network response map, and store results as pixels in a plurality of feature maps.

17. The system of claim 16, wherein the statistical prediction model further comprises a deep convolutional neural network comprises stacked convolution, rectified linear, and pool layers configured to extract further features from the feature maps.

18. The system of claim 17, wherein the instructions further cause the system to predict the efficacy based on the further features from the feature maps.

19. The system of claim 14, wherein the instructions further cause the system to predict parameters for the treatment using the statistical prediction model.

20. The system of claim 14, wherein the treatment comprises vagus nerve stimulation and the neural status comprises a seizure.

21. The system of claim 20, wherein the data of the neural status comprises data of an epilepsy source image indicative of a seizure origin.

22. The system of claim 14, further comprising an electroencephalogram (EEG) system coupled to the at least one processor or a magnetoencephalogram (MEG) system coupled to the at least one processor and configured to provide the image data, and a functional magnetic resonance imaging (fMRI) system coupled to the at least one processor and configured to provide the therapeutic brain network map.