# CLAIMS

1. Use of electrophysiological recordings of signals from at least two anatomical structures, wherein the signals are recorded from recording sites located in the anatomical structures, wherein the electrophysiological recordings comprise spatiotemporal fluctuations in the recorded extracellular potential, wherein the electrophysiological recordings are action potentials and/or local field potentials (LFPs) in the anatomical structures and represent a state of the central nervous system (CNS) at a specific time point for assessment of a state of the CNS of a subject and/or differentiation between states of the CNS of a subject at said specific time point, wherein the assessment comprises the steps of:

a) amplifying recorded action potentials and/or local field potentials;

b) digitizing recorded action potentials and/or local field potentials;

c) reducing the influence of current dipoles located far away from the recording site to obtain signals that are decoupled from other anatomical structures;

said assessment further comprising at least one of the following four steps

d1) high-pass filtering of the signals and amplitude thresholding at a predefined value above noise background for the identification of action potentials;

d2) obtaining at least one spike train from trains of action potentials generated from groups of neurons or individual cells;

e1) obtaining power spectral densities (PSDs) or cross-spectral densities for the LFPs;

e2) normalizing PSDs to noise background;

and said assessment further comprising the step of

f) assessing the state of the CNS based on the recorded spatiotemporal fluctuations defining a location in a predefined state space;

wherein the predefined state space is defined by a set of feature vectors.

2. The use according to claim 1, further comprising the step of:

e3) reducing noise and variability by averaging PSDs from different electrode pairs from the same anatomical structure.

3. The use according to claim 1 or 2, wherein the set of feature vectors of the predefined state space has been defined by features of signals obtained in electrophysiological recordings under at least two reference states.

4. The use according to claim 3, wherein a feature vector has been projected onto a subspace spanned by at least two of the reference states.

5. The use according to claim 1 or 2, wherein the set of feature vectors of the predefined state space has been defined by action potentials and/or local field potentials (LFPs) obtained in electrophysiological recordings under at least three reference states, wherein the action potentials and/or local field potentials (LFPs) have been subjected to the steps of:
a) amplifying recorded action potentials and/or local field potentials;
b) digitizing recorded action potentials and/or local field potentials;
c) reducing the influence of current dipoles located far away from the electrodes to obtain signals that are decoupled from other anatomical structures;
wherein said action potentials and/or local field potentials (LFPs) further have been subjected to at least one of the following five steps
d1) high-pass filtering of the signals and amplitude thresholding at a predefined value above noise background for the identification of action potentials;
d2) obtaining at least one spike train from trains of action potentials generated from groups of neurons or individual cells;
e1) obtaining power spectral densities (PSDs) or cross-spectral densities for the LFPs;
e2) normalizing PSDs to noise background;
e3) reducing noise and variability by averaging PSDs from different electrode pairs from the same anatomical structure.
and wherein the feature vectors have been transformed by a coefficient matrix obtained from principal component analysis (PCA) or related methods.

6. Use of electrophysiological recordings of signals from at least two anatomical structures, wherein the signals are recorded from recording sites located in the anatomical structures, wherein the electrophysiological recordings comprise spatiotemporal fluctuations in the recorded extracellular potential, wherein the electrophysiological recordings are action potentials and/or local field potentials

(LFPs) in the anatomical structures and represent the state of the central nervous system (CNS) at a specific timepoint for assessment of a state of the CNS of a subject and/or differentiation between states of the CNS of a subject at a specific time point, wherein the assessment comprises the steps of:
a') providing a stimulus to the CNS;
a) amplifying recorded action potentials and/or local field
potentials;
b) digitizing recorded action potentials and/or local field potentials;
c) reducing the influence of current dipoles located far away from the recording site to obtain signals that are decoupled from other anatomical structures;
said assessment further comprising at least one of the following four steps
d1 ) high-pass filtering of the signals and amplitude thresholding at a predefined value above noise
background for the identification of action potentials;
d2) obtaining at least one spike train from trains of action
potentials generated from groups of neurons or individual cells;
d3) creating peristimulus time histograms (PSTHs) from spike trains
e) creating evoked potentials (EPs) from the LFPs;
and said assessment further comprising the step of
f) assessing the state of the CNS based on the recorded spatiotemporal fluctuations defining a location in a predefined state space;
wherein the predefined state space is defined by a set of feature vectors.

7. The use according to claim 6, wherein the set of feature vectors of the predefined state space has been defined by features of signals obtained in electrophysiological recordings under at least two reference states.

8. The use according to claim 7, wherein a feature vector has been projected onto a subspace spanned by at least two of the reference states.

9. The use according to claim 6, wherein the set of feature vectors of the predefined state space has been defined by action potentials and/or local field potentials (LFPs) obtained in electrophysiological recordings under at least three reference states, wherein a stimulus has been provided to the CNS prior to the

electrophysiological recordings, wherein the action potentials and/or local field potentials (LFPs) have been subjected to the steps of:
a) amplifying recorded action potentials and/or local field
potentials;
b) digitizing recorded action potentials and/or local field potentials;
c) reducing the influence of current dipoles located far away from the electrodes to obtain signals that are decoupled from other anatomical structures;
wherein said action potentials and/or local field potentials (LFPs) further have been subjected to at least one of the following four steps
d1 ) high-pass filtering of the signals and amplitude thresholding at a predefined value above noise
background for the identification of action potentials;
d2) obtaining at least one spike train from trains of action potentials generated from groups of neurons or individual cells;
d3) creating peristimulus time histograms (PSTHs) from spike trains
e) creating evoked potentials (EPs) from the LFPs;
and wherein the feature vectors have been transformed by a coefficient matrix obtained from principal component analysis (PCA) or related methods.

10. The use according to any one of the preceding claims, wherein each state of the CNS is identified as being one of at least three reference states.

11. The use according to any one of the preceding claims, wherein the action potentials and/or local field potentials have been obtained from an awake animal or human.

12. The use according to any one of the preceding claims, wherein the action potentials and/or local field potentials have been obtained from at least one anatomical structure located below the superficial structures of the brain.

13. The use according to any one of claims 1 to 12 for evaluating the effect of a treatment of a condition or disease, wherein the condition or disease is neurological and/or psychiatric.

14. The use according to claim 13, wherein the condition is Parkinson's disease.

15. The use according to claim 13, wherein the condition is schizophrenia.

16. The use according to claim 13, wherein the condition is a pain condition.

17. The use according to claim 13, wherein the condition is levodopa-induced dyskinesia.

18. A system for assessment of a state of the central nervous system (CNS) of a subject and/or differentiation between states of the central nervous system (CNS) of a subject at a specific time point based on electrophysiological recordings of signals from at least two anatomical structures, wherein the signals are recorded from recording sites located in the anatomical structures, wherein the electrophysiological recordings comprise spatiotemporal fluctuations in the recorded extracellular potential, wherein the electrophysiological recordings are action potentials and/or local field potentials (LFPs) in the anatomical structures and represent the state of the CNS at said specific time point, wherein the system comprises:
- means for amplifying recorded action potentials and/or local field potentials;
- means for digitizing recorded action potentials and/or local field potentials;
- means for reducing the influence of current dipoles located far away from the recording site to obtain signals that are decoupled from other anatomical structures;
said system further comprising at least one of the following four means
- means for high-pass filtering of the signals and amplitude thresholding at a predefined value above noise background for the identification of action potentials;
- means for obtaining at least one spike train from trains of action potentials generated from groups of neurons or individual cells; - means for obtaining power spectral densities (PSDs) or cross- spectral densities for the LFPs;
- means for normalizing PSDs to noise background;
and said system further comprising

means for assessing the state of the CNS based on the recorded spatiotemporal fluctuations defining a location in a predefined state space;
wherein the predefined state space is defined by a set of feature vectors.

19. The system according to claim 18, further comprising:
- means for reducing noise and variability by averaging PSDs from different electrode pairs from the same anatomical structure.

20. A system for assessment of a state of the central nervous system (CNS) of a subject and/or differentiation between states of the central nervous system (CNS) of a subject at a specific time point based on
electrophysiological recordings of signals from at least two anatomical structures, wherein the signals are recorded from recording sites located in the anatomical structures, wherein the electrophysiological recordings comprise spatiotemporal fluctuations in the recorded extracellular potential, wherein the electrophysiological recordings are action potentials and/or local field potentials (LFPs) in the anatomical structures and represent the state of the CNS at said specific timepoint, wherein the system comprises:
- means for amplifying recorded action potentials and/or local field potentials;
- means for digitizing recorded action potentials and/or local field potentials;
- means for reducing the influence of current dipoles located far away from the recording site to obtain signals that are decoupled from other anatomical structures;
said system further comprising at least one of the following four means
- means for high-pass filtering of the signals and amplitude thresholding at a predefined value above noise background for the identification of action potentials;
- means for obtaining at least one spike train from trains of action potentials generated from groups of neurons or individual cells;
- means for creating peristimulus time histograms (PSTHs) from spike trains;
- means for creating evoked potentials (EPs) from the LFPs.
and said system further comprising

means for assessing the state of the CNS based on the recorded spatiotemporal fluctuations defining a location in a predefined state space;
wherein the predefined state space is defined by a set of feature vectors.

21. The system according to any one of claims 20, further comprising
- means for providing a stimulus to the CNS.

22. The system according to any one of claim 18 to 21, further comprising:
- means defining the set of feature vectors of the predefined state space based on features of signals obtained in electrophysiological recordings under at least three reference states.

23. The system according to any one of claims 18 to 22, further comprising
- means for projecting a feature vector onto a subspace spanned by at least one of the reference states.

24. The system according to any one of claims 18 to 23, further comprising
- at least three electrodes.

25. The system according to claim 24, wherein each electrode has a diameter up to 100 µm and wherein each electrode is stiff enough to penetrate neuronal tissue and into the anatomical structure.

26. The system according to claim 24, wherein each electrode has a diameter up to 100 µm and wherein at least one electrode is flexible in at least one dimension.

27. The system according to any one of claims 18 to 26, further comprising
- a recording device being able to be connected to at least three
electrodes and having the ability to record action potentials and/or local field potentials in said anatomical structure, wherein the recorded
action potentials and/or local field potentials at one specific timepoint represent the state of the CNS at said specific timepoint.

28. The system according to any one of claims 17 to 27 for use in assessment of a state of the CNS and/or differentiation of at least two states of the CNS.

29. The system according to any one of claims 18 to 27 for use in evaluating the effect of a treatment of a condition or disease, wherein the condition or disease is neurological and/or psychiatric.

30. The use according to claim 29, wherein the condition is Parkinson's disease.

31. The use according to claim 29, wherein the condition is schizophrenia.

32. The use according to claim 29, wherein the condition is a pain condition.

33. The use according to claim 29, wherein the condition is levodopa-induced dyskinesia.