

Claims

1. A method for, in particular, continuously determining a current glucose value
5 in a transport fluid, in particular blood, of an organism, comprising the steps of
- a) determining (S1) a measurement series using a sensor device, comprising
at least two measured values for a tissue glucose value that are spaced apart
in time in the tissue surrounding the transport fluid,
 - 10 b) determining (S2) the tissue glucose value using the determined series of
measurements based on a measurement model in the form of a linear or non-
linear function, with the measurement model measuring values of the sensor
device measuring tissue glucose values taking into account at least one
measurement noise value are assigned,
 - 15 c) providing (S3) at least one state transition model, with the at least one state
transition model being used to assign at least one glucose value in the
transport fluid to the determined tissue glucose values, taking into account at
least one process noise value, and
 - 20 d) estimating (S4) the current glucose value in the transport fluid based on an
approximation of at least one provided state transition model and the
determined tissue glucose value using at least one Kalman filter in the case
of a measurement model in the form of a linear function or at least one
extended Kalman filter Case of a measurement model in the form of a non-
linear function
wherein several state transition models are provided, which are changed
25 depending on the course over time of the estimated current glucose value, in
particular its rate of change over time.
2. The method according to claim 1, characterized in that at least two state
30 transition models are provided, one on a constant glucose concentration, one based
on a constant change in glucose concentration and/or one based on a weighted sum
of previous glucose concentrations.

3. The method according to any one of claims 1 or 2, characterized in that measured values determined are filtered by means of at least one filter function, errors, in particular measurement errors, of the sensor device being suppressed by means of the at least one filter function.

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4. The method according to any one of claims 1-3, characterized in that the at least one measurement noise value is adjusted, in particular regularly.

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5. The method as claimed in claim 4, characterized in that, in order to adapt the at least one measurement noise value, the variance of the measurement noise is determined using a random sample of measured values, in particular it is estimated.

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6. The method according to claim 5, characterized in that a statistical test, in particular a Kolmogorov-Smirnov-test, is used to check whether the null hypothesis – the sample follows a mean-free Gaussian distribution with the determined variance of the measurement noise – is not rejected.

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7. The method according to claim 6, characterized in that the variance of the measurement noise is determined for at least one further sample of measured values as long as the null hypothesis is rejected.

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8. The method according to claim 3, characterized in that measured values are checked for outliers using the at least one filter function and measured values that were determined as outliers are discarded, in particular using an NIS test.

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9. The method as claimed in claim 8, characterized in that the measured values are checked using the at least one filter function to determine whether they are above or below specified limit values before they are discarded.

10. The method according to claim 9, characterized in that a current measured value that was not determined as an outlier is nevertheless rejected as a measurement error if at least a predetermined number, in particular two chronologically consecutive earlier measured values, were previously rejected as measurement errors .

11. The method according to any one of claims 1-10, characterized in that the state transition model comprises a diffusion model for time-dependent modelling of the diffusion process of glucose from the transport fluid into the surrounding tissue.

5 12. The method according to any one of claims 1-11, characterized in that several earlier measured values are filtered, in particular by means of a Kalman Fixed Interval Smoother.

10 13. The method according to claim 12, characterized in that when the Kalman Fixed Interval Smoother is used, it is run through forwards and backwards, with Kalman filtering being used in the forward pass and an RTS filter being used in the backward pass and/or of an MBF filter.

15 14. The method as claimed in any of claims 1-13, characterized in that the trend in blood sugar concentration is classified using a number of categories, in particular using at least seven categories.

20 15. Device for in particular continuously determining a current glucose value in a transport fluid, in particular blood, of an organism, in particular for carrying out a method according to any one of claims 1-14, comprising
a sensor device, in particular for measuring fluorescence in the transport fluid surrounding tissue by means of a probe, in particular a polymer-optical fiber probe, designed to determine a series of measurements, comprising at least two measured values spaced apart in time for a tissue glucose value in the tissue surrounding the
25 transport fluid,
a provision device, designed to provide at least one state transition model, with the at least one state transition model being used to assign at least one glucose value in the transport fluid to the determined tissue glucose values, taking into account at least one process noise value, and to provide a measurement model in the form of
30 a linear or non-linear function, whereby measured values of the sensor device are assigned to tissue glucose values by means of the measurement model, taking into account at least one measurement noise value, and
an evaluation device, designed to determine the tissue glucose value using the determined series of measurements based on the measurement model and to

estimate the current glucose value in the transport fluid based on an approximation of at least one provided state transition model and the determined tissue glucose value using at least one Kalman filter in the case of a measurement model in form of a linear function or at least an extended Kalman filter in the case of a measurement model in the form of a non-linear function.

16. Evaluation device for, in particular, continuously determining a current glucose value in a transport fluid, in particular blood, of an organism, comprising at least one interface for connecting a sensor device for providing a series of measurements, comprising at least two measured values at different times for a tissue glucose value in the tissue surrounding the transport fluid, at least one memory for storing at least one state transition model, wherein the at least one state transition model is used to assign the tissue glucose values determined by the at least one state transition model to at least one glucose value in the transport fluid to, taking into account at least one process noise value and for storing a measurement model in the form of a linear or non-linear function, with the measurement model being used to assign measured values of the sensor device to tissue glucose values, taking into account at least one measurement noise value, and a computing device, designed to determine the tissue glucose value using the determined series of measurements based on the stored measurement model and for estimating the current glucose value in the transport fluid based on an approximation of at least one provided state transition model and the determined tissue glucose value using at least one Kalman filter in the case of a measurement model in the form of a linear function or at least one extended Kalman filter in the case of a measurement model in the form of a non-linear function.

17. Non-transitory, computer-readable medium for storing instructions which, executed on a computer, cause a method for, in particular, continuous determination of a current glucose value in a transport fluid, in particular blood, of an organism to be carried out, preferably suitable for carrying out a method according to any one of claims 1- 14, comprising the steps of

- a) Determining by means of a sensor device a series of measurements comprising at least two time-spaced measured values for a tissue glucose value in the tissue surrounding the transport fluid,
- 5 b) determining the tissue glucose value using the determined series of measurements based on a measurement model in the form of a linear or non-linear function, with the measurement model being used to assign measured values of the sensor device to tissue glucose values, taking into account at least one measurement noise value,
- 10 c) providing at least one state transition model, with the at least one state transition model using the determined tissue glucose at least one glucose value in the transport fluid is assigned to glucose values, taking into account at least one process noise value, and
- 15 d) estimating the current glucose value in the transport fluid based on an approximation of at least one provided state transition model and the determined tissue glucose value using at least one Kalman filter in the case of a measurement model in the form of a linear function or at least one extended Kalman filter in the case of a measurement model in the form of a non-linear function.