CLAIMS

What is claimed is:

1. A zero crossing point signal output method, comprising:

continuously receiving zero crossing point square wave signals input by a zero-crossing detection circuit, and periodically sampling each zero crossing point square wave signal at a predetermined sampling frequency;

acquiring a sampling number of each zero crossing point square wave signal in 1^{st} to M^{th} zero crossing point square wave signals to obtain sampling numbers of M zero crossing point square wave signals, calculating an average value of the sampling numbers of the M zero crossing point square wave signals to obtain an average sampling number S, and calculating a first zero crossing point interval T1 based on the average sampling number S and the predetermined sampling frequency; and setting a zero crossing point signal output interval as the first zero crossing point interval T1, where M is a predetermined value and is a positive integer greater than or equal to 1;

continuously outputting zero crossing point signals with an interval being the zero crossing point signal output interval; obtaining a sampling number of each zero crossing point square wave signal in $M+1^{th}$ to $M+N^{th}$ zero crossing point square wave signals to obtain sampling numbers of N zero crossing point square wave signals, calculating a difference value between each of the sampling numbers of the N zero crossing point square wave signals and the average sampling number S to obtain N sampling number difference values, and summing the N sampling number difference values to obtain an accumulated difference value Δs, where N is a predetermined value and is a positive integer greater than or equal to 1;

calculating, when Δs is not within a predetermined change range, a second zero crossing point interval T2 in accordance with a predetermined rule, and setting the zero crossing point signal output interval as the second zero crossing point interval T2; and when Δs is within the predetermined change range, keeping the zero crossing point signal output interval unchanged, wherein the predetermined change range is [-5,5]; and

continuously outputting zero crossing point signals with an interval being the zero crossing point signal output interval.

2. The method according to claim 1, wherein said continuously receiving the zero crossing point square wave signals input by the zero-crossing detection circuit, and

periodically sampling each zero crossing point square wave signal at the predetermined sampling frequency comprises:

continuously receiving the zero crossing point square wave signals input by the zero-crossing detection circuit, performing filtering on each of the received zero crossing point square wave signals to filter out high-frequency noise in each zero crossing point square wave signal, and periodically sampling each zero crossing point square wave signal at the predetermined sampling frequency.

3. The method according to claim 1, wherein said calculating, when Δs is not within the predetermined change range, the corrected zero crossing point interval T2 in accordance with the second predetermined rule comprises:

calculating $T2 = T1-\Delta t$ when Δs is smaller than a minimum value of the predetermined change range, and calculating $T2 = T1+ \Delta t$ when Δs is greater than a maximum value of the predetermined change range, wherein Δt is a predetermined correction value.

4. A computer readable storage medium, comprising computer instructions, wherein the computer instructions, when executed, implement the zero crossing point signal output method according to any one of claims 1 to 3.

5. A power line data transmitting method, comprising the zero crossing point signal output method according to any one of claims 1 to 3, and further comprising: subsequent to said continuously outputting the zero crossing point signals with the interval being the zero crossing point signal output interval T,

determining a 1st zero crossing point time t based on the zero crossing point signals, and determining a start time of transmitting a synchronization signal of a data packet to be transmitted based on the 1st zero crossing point time, wherein the start time of transmitting the synchronization signal of the data packet to be transmitted is t+t1, t+t1 is earlier than a 2nd zero crossing point time t+T, t+T is contained in a time period from a time point of transmitting a first synchronization bit signal to a time point of transmitting a last synchronization bit signal, and t1 is a first predetermined fixed value; and sequentially transmitting data bit signals of the data packet to be transmitted.

6. A computer readable storage medium comprising computer instructions, wherein the computer instructions, when executed, implement the power line data transmitting method according to claim 5.

7. A zero crossing point signal output apparatus, comprising:

a receiving module configured to continuously receive zero crossing point square wave signals input by a zero-crossing detection circuit;

a sampling module configured to periodically sample each zero crossing point square wave signal at a predetermined sampling frequency;

a calculating module configured to acquire a sampling number of each zero crossing point square wave signal in 1^{st} to M^{th} zero crossing point square wave signals to obtain sampling numbers of M zero crossing point square wave signals, calculate an average value of the sampling numbers of the M zero crossing point square wave signals to obtain an average sampling number S, and calculate a first zero crossing point interval T1 based on the average sampling number S and the predetermined sampling frequency; and set a zero crossing point signal output interval as the first zero crossing point interval T1, wherein M is a predetermined value and is a positive integer greater than or equal to 1; and

an outputting module configured to continuously output zero crossing point signals with an interval being the zero crossing point signal output interval,

wherein the calculating module is further configured to obtain a sampling number of each zero crossing point square wave signal in $M+1^{th}$ to $M+N^{th}$ zero crossing point square wave signals to obtain sampling numbers of N zero crossing point square wave signals, calculate a difference value between each of the sampling numbers of the N zero crossing point square wave signals and the average sampling number S to obtain N sampling number difference values, and sum the N sampling number difference values to obtain an accumulated difference value Δs, where N is a predetermined value and is a positive integer greater than or equal to 1; calculate, when Δs is not within a predetermined change range, a second zero crossing point interval T2 in accordance with a predetermined rule, and set the zero crossing point signal output interval as the second zero crossing point interval T2; and when Δs is within the predetermined change range, keep the zero crossing point signal output interval unchanged, wherein the predetermined change range is [-5,5].

8. The zero crossing point signal output apparatus according to claim 7, further comprising:

a filtering module configured to, subsequent to the receiving module continuously receiving the zero crossing point square wave signals input by the zero-crossing detection circuit, perform filtering on each of the received zero crossing point square wave signals to filter out high-frequency noise in each zero crossing point square wave signal.

9. The zero crossing point signal output apparatus according to claim 7, wherein the calculating module being configured to calculate, when Δs is not within the predetermined change range, the corrected zero crossing point interval T2 in accordance with the second predetermined rule comprises:

the calculating module being configured to calculate T2 = T1-Δt when Δs is smaller than a minimum value of the predetermined change range, and calculate T2 = T1+ Δt when Δs is greater than a maximum value of the predetermined change range, wherein Δt is a predetermined correction value.

10. A power line data transmitting device, comprising:

the zero crossing point signal output apparatus of any one of claims 7 to 9; and

a data outputting module configured to, subsequent to receiving the zero crossing point signals with the interval being the zero crossing point signal output interval which are continuously output by the outputting module, determine a 1st zero crossing point time t based on the zero crossing point signals, and determine a start time of transmitting a synchronization signal of a data packet to be transmitted based on the 1st zero crossing point time, wherein the start time of transmitting the synchronization signal of the data packet to be transmitted is t+t1, t+t1 is earlier than a 2nd zero crossing point time t+T, t+T is comprised in a time period from a time point of transmitting a first synchronization bit signal to a time point of transmitting a last synchronization bit signal, and t1 is a first predetermined fixed value; and sequentially transmit data bit signals of the data packet to be transmitted.