A DDS based clock drift correction method of underwater electromagnetic acquisition system

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Abstract

The most important task of the seabed electromagnetic data acquisition station is to discretize and sample the marine geophysical field signal according to the set working parameters. The system controller of the station generates the working sequence of data acquisition according to the system clock. In addition, the system needs to record the underwater real clock of the corresponding collected data for later data processing and inversion. The system real-time clock is generated by the counting and accumulation of second pulse (SP) signal, and the accuracy of SP depends on the clock stability of system clock source, such as atomic clock or crystal oscillator. The change of ambient temperature is the main factor affecting the clock accuracy of the system. When the ambient temperature changes, the output frequency of the clock source also changes, which leads to the advance or delay of the counting overflow point of the pulse counter relative to the standard clock. If the temperature characteristic of the clock source is measured first, then the overflow count of the pulse counter can be adjusted, the influence of temperature change on the output frequency can be compensated, as a result, the clock synchronization accuracy can be improved. However, when the output frequency of the clock source is low, the method of compensating the output frequency simply by changing the preset number of the counter will produce large errors. In this case, it is necessary to accurately adjust the output frequency and phase. Therefore, we use direct digital synthesizer (DDS) to realize the above assumption. In this process, the output frequency error curve of the clock source is fitted according to the discrete data point measured in the temperature characteristic experiment, then the curve is stored in the system memory area in the form of look-up table. Micro controller (MCU) of the system performs curve interpolation calculation according to real-time temperature and generates frequency control word (FCW). DDS adjusts the output frequency and phase of the clock source according to the FCW, Finally, the corrected clock is output after processing such as amplification and filtering.

A DDS based clock drift correction method of underwater electromagnetic acquisition system

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Abstract: The most important task of the seabed electromagnetic data acquisition station is to discretize and sample the marine geophysical field signal according to the set working parameters. The system controller of the station generates the working sequence of data acquisition according to the system clock. In addition, the system needs to record the underwater real clock of the corresponding collected data for later data processing and inversion. The system real-time clock is generated by the counting and accumulation of second pulse (SP) signal, and the accuracy of SP depends on the clock stability of system clock source, such as atomic clock or crystal oscillator. The change of ambient temperature is the main factor affecting the clock accuracy of the system. When the ambient temperature changes, the output frequency of the clock source also changes, which leads to the advance or delay of the counting overflow point of the pulse counter relative to the standard clock (Fig 1).

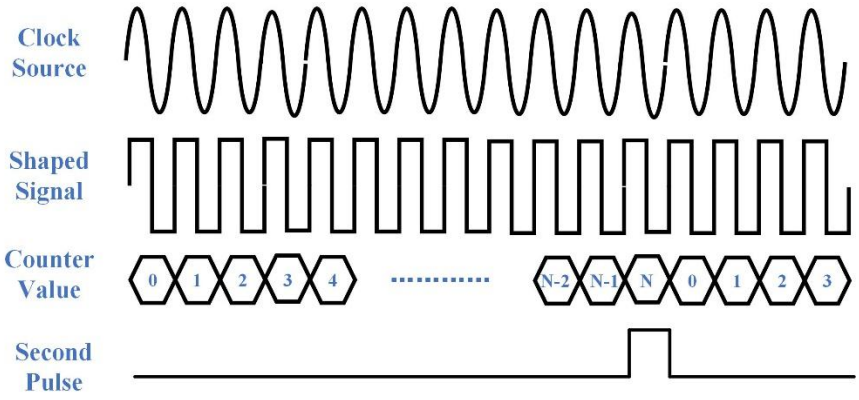

Figure 1 Schematic diagram of standard SP generation principle

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the system performs curve interpolation calculation according to real-time temperature and generates frequency control word (FCW). DDS adjusts the output frequency and phase of the clock source according to the FCW, Finally, the corrected clock is output after processing such as amplification and filtering(Fig 2).

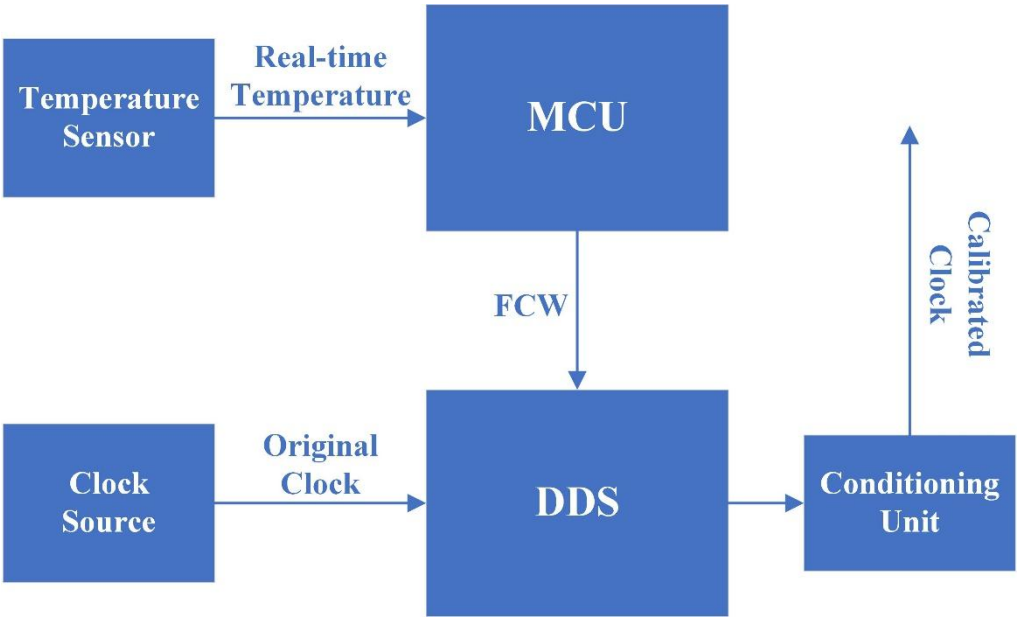

Figure 2 Schematic diagram of real-time temperature compensation based on DDS

Keywords: underwater electromagnetic acquisition system; Clock synchronization; DDS