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Analysis on the application of control algorithm in computer software

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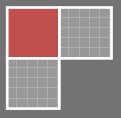
ABSTRACT

With the rapid development of modernization, computer software is more and more used in industry. Higher and higher automation requirements are made by producers and developers. In modern industry field, all kinds of computer control devices and process monitors are broadly used, which results in the problem that the traditional computer industry control software failed to satisfy clients. The application of traditional computer control algorithm in control software also faces the problem that the source program must be revised once the monitoring target changes. As a result, development cycle and maintenance cost increase while production efficiency of enterprises and develop efficiency of users decrease, and the control algorithm cannot be fully used in computer. This research proposes the analysis on the application of control algorithm in computer software, namely configuration inspection software. In the software platform and development environment of automatic monitor layer, configuration inspection software could provide plenty of flexible ways and better interface for user, and is easy to use. This method can solve the problems in traditional industry control and the control algorithm can be applied in practical production more conveniently and effectively. At the same time, control algorithm can be perfectly combined with computer software to improve the production efficiency, reduce production costs and accelerate the development of enterprises.

KEYWORDS

Control algorithm; Computer control technology; Configuration inspection software; PID.



INTRODUCTION

With the speeding-up production rate, expanding scale and rapid development of computer control technology, the application of computer control technology in production field has improved the production efficiency of enterprises and the development efficiency of developers in some degrees. In the development and application of industry control technology, computer (including IPC) has obvious advantages over the previous system[1]. Computer has rich software resources and hardware resources, software has great interoperability, and computer control system is easy to learn and use. Still there are many inevitable problems, such as revision of source program after monitoring target changed will decrease the efficiency and increase the maintenance costs. This research analyzed the application of control algorithm in configuration inspection software (SCADA) for its powerful interface display, friendly user interface and simple operation and other advantages. In addition, this software has excellent openness and diverse functional modules, which can tackle the problems in traditional computer control software and give full rein to control algorithm and computer in practical production.

INTRODUCTION OF COMPUTER CONTROL SYSTEM

Principle of Smith predictive control algorithm

In the control of industrial production, many control objects have pure delay property, and the delay time τ will reduce the system stability and dynamic capability and result in overshoot and sustained oscillation. If the ratio of pure delay time τ to time constant T_c is larger than 0.5, that is $\tau / T_c \geq 0.5$, regular PID will have difficulties to adapt, resulting in severe overshoot and less stability[2]. Otherwise, Smith predictive control algorithm can well resolve pure delay problem by certain compensation.

For single loop control system shown as Figure 1, parameter D(s) in traditional pure lag control system is the transfer function of regulator and is mainly used to correct $W_p(s)$ part. Parameter $W_p(s)e^{-\tau s}$ is the transfer function of the object, the transfer function of pure delay is not concluded in $W_p(s)$ objects, and parameter $e^{-\tau s}$ is the transfer function of pure delay object.

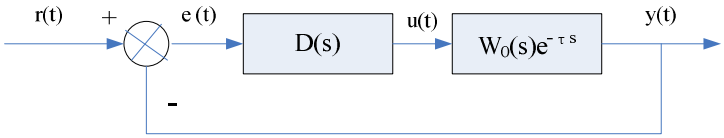


Figure 1 : Control system of pure lag component

Principle of Smith predictive control algorithm is to merge $W_p(s)e^{-\tau s}$ with D(s) as compensation part to compensate for pure lag of control target. This compensation part is usually called predictor, its transfer function is: $W_p(s)(1-e^{-\tau s})$, τ is pure lag time. Compensated system diagram is as shown in Figure 2:

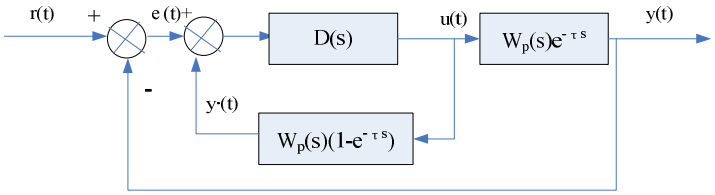


Figure 2 : Control system with Smith predictor

(1) Transfer function of pure lag compensator is $D'(s)$:

$$D'(s) = \frac{D(s)}{1 + D(s)W_p(S)(1 - e^{-\tau s})} \quad \textbf{(1)}$$

(2) Closed loop transfer function of compensated system is:

$$\Phi(s) = \frac{D'(s)W_p(s)e^{-\tau s}}{1 + D'(s)W_p(s)e^{-\tau s}} = \frac{D(s)W_p(s)}{1 + D(s)W_p(s)}e^{-\tau s} \quad \textbf{(2)}$$

Compensated close loop system is much more stable because lag parameter is out of the close circuit and its control performance reduces lag performance.

Digital filtering

Digital filtering is a processing procedure during which the signals in a certain frequency band are filtered through a series of treatment by some algorithm. As a result, there are less interference signals in the new signal and the truth of the signal is improved. Up to now, some digital filtering methods in common use are: limiting filtering method, median filtering method, mean filtering method and continuity filtering method and so on.

Median filtering method is to take samples on a parameter continuously for N times (N is usually odd numbers), arrange the samples according to size, and take the median as sampling value. Hypothetically, sampling values are y_1, y_2, y_3, and $y_1 \le y_2 \le y_3$, then y_2 is the most effective signal[3]. Median filtering can reduce pulse interference and gain great results in slowly varying application. Arithmetic mean filtering method is usually used to filter random interference signals but it also results in low sensitivity. Recursive mean filtering is to regard the sampling statistics as a queue with a fixed length N, add new sample data at the end of this queue and drop the first sample data, then calculate the arithmetic mean of these N data in the queue, its expression is:

$$\bar{y} = \frac{1}{N}\sum_{i=0}^{N-1} y_{n-i} \quad \textbf{(3)}$$

Different digital filters have different advantages in practical production, so it is important to adopt proper digital filter to get best results. Mean filtering method is more suitable for periodic interference, median filtering method and limit filtering method is more suitable for occasional pulse interference, continuity filtering method is more used in high frequency signal or low frequency signal, and weighted mean filtering method is mainly used for large pure time delay control object.

Digital PID control

In practical project, the most commonly used control rules of regulator are proportional control, integral control and differential control, which is called PID control or PID regulation. In modern production field, industrial automatic level is a major factor to compare modernization level of different industries. There are many kinds of PID control, PID controller and intelligent PID controller (instrument) which are widely applied in practical project operations. It has become one of the major technologies for industrial control to obtain various PID controllers with simple structure, reliable stability, easy adjustment and so on.

Supposing that Figure 3 shows the diagram of the PID regulator, with its relationship of input to output is proportional-integral-differential, namely:

$$U_{(s)} = K_p E(s) + K_i \frac{E(s)}{s} + K_d s E(s) \quad \textbf{(4)}$$

If the transfer function is shown as Formula 2-5:

$$D(s) = \frac{U(s)}{E(s)} = K_p + k_i \frac{1}{s} + k_d s \quad \textbf{(5)}$$

Among formula 5, T_i is integration time constant, T_d is differentiating time constant, K_p is proportional coefficient, $K_i = \frac{K_p}{T_i}$ is integral coefficient, $K_d = K_p K_d$ is called differentiating coefficient.

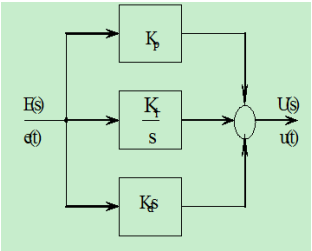


Figure 3 : PID regulator diagram

Adding integration into integral separate PID control algorithm will generate large overshoot. While connecting a series inertial first-order system to PID control output will play the role of incomplete differentiation PID controller, and many problems will be resolved. Thus, using integral separate algorithm in improved system will reduce overshoot while keeping integral effect. The effect of standard PID control algorithm in unit step input and output is as shown in Figure 4, and the effect of incomplete differentiation PID algorithm in unit step input and output is as shown in Figure 5:

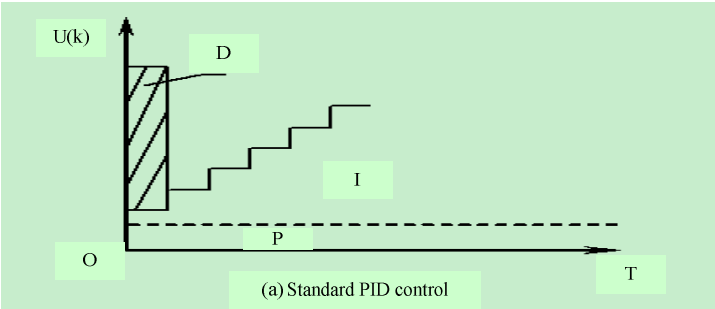


Figure 4 : Standard PID control

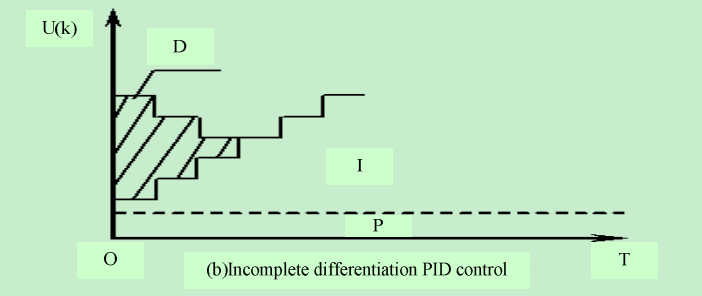


Figure 5 : Incomplete differentiation PID control

Figure 4 shows that standard PID control algorithm only shows differentiation effect in the first sampling period and the effect is strong. Figure 5 shows that incomplete differentiation PID control algorithm shows differentiation effect in longer time, that is to say incomplete differentiation PID control has better control effects.

APPLICATION OF CONTROL ALGORITHM IN CONFIGURATION INSPECTION SOFTWARE

Introduction of the function of configuration inspection software

Configuration inspection software is a kind of software usually used in data acquisition and process control, it can provide simple operation methods and developing methods for operation interface to users in various configuration modes (not program modes), tackling generality problem of control system. And all kinds of software modules in configuration inspection software are set up in advance, which can rapidly realize and complete every function requirement of monitoring layer as well as supporting computers and I/O products from different hardware vendors. Configuration inspection software can also be connected to industrial control computer and network system, provide interface of all kinds of software and hardware to control layer and management layer, and integrate system[5]. This research briefly introduces the following functions of configuration inspection software:

(1) Strong interface display configuration function. Industrial configuration inspection software is mainly used in Windows operating system in order to get beautiful interface by Windows graphical function and make it convenient and time-saving for operators to develop directly through various toolbars. In addition, there are many drawing tools for users to draw their own industrial interface and edit or modify it, which makes the design free and easy and the interface vivid and concise.

(2) Good openness. Openness is an important indicator to judge configuration inspection software. Parts of the entire system may not come from the same developer or manufacturer because of rapid social development and different functions division, “heterogeneity” is a feature of control system. Configuration inspection software can be connected with many communication protocols and support all kinds of hardware devices[6].

(3) Various functional modules. Various control functions can meet the users’ field requirement and measurement and control needs. Various functional modules can realize real-time monitoring and warning function, make functional statement, display history curve and real time curve. Well-designed user operational interface is easy to operate.

(4) Powerful database. Real-time database can store a lot of data materials such as analog data, discrete data, character data, and exchange data with external equipment.

(5) Reliable security system. Different users have different access authority, and operation system can be modified, which ensures the system secure.

(6) Powerful emulation function. It enables the system to run several functions at the same time and shorts the developing period.

Designing idea of configuration inspection software

Configuration inspection software usually consists of increasing and increasingly strong components such as graphical interface system, real time database system and third-party data interface, it generally adopts the object-oriented programs and designing ideas.

When making the figure, the main pictures of on-sited process can be simplified into three relatively simple objects, including line, shape needs to be filled, and text. There are various functions on the graphical interface, such as warning notice, confirming notice and copy notice, whose data can be decided according to configuration[7]. This enables engineers to set every picture freely with no limit on the number of the objects in each picture.

The part of communication and third-party program interface is a main symbol of a open system and an important means to realize interaction and long-distance data visit between configuration inspection software and third-party program. It has the following effects[8]:

(1) Connect host computer and slave computer in dual-computer redundant system;

(2) Connect computers in building distributed HMI/SCADA application;

(3) Realize communication function in application based on Internet or Browser/Server.

Some functions in communication component are relatively independent programs, they can be operated and used alone. And some functions are locked in other programs, they cannot be obviously operated and used.

CONCLUSION

This research comprehensively elaborated the reason, basic characteristic and function of configuration inspection software, and briefly introduced the principle and application of computer control algorithm. As configuration inspection software becoming the main system applied in modern production and manufacturing industries, both of the users and hardware producers can use the configuration inspection software as a main tool to collect information and integrate. This requires configuration inspection software having many functions to meet customers' needs and ensure special customers' request for redevelopment. Using configuration inspection software can solve technical problems and merge the technical design with control in optimizing process. Taking the final plan and its effect as well as technical design into consideration can resolve problems which may make control difficult, and this method attracts more and more attention.

In the background of rapid development of industrial control, configuration inspection software is more and more applied in project for its great inspection function and relatively simple operation. However, there are still some problems in configuration inspection software to be improved and resolved. At present, the functions of configuration inspection software are still limited on inspection layer and lack of control ability. And new control algorithms are created continuously owing to the rapid development of computer technology. But it still requires further research to merge these algorithm technologies with computer software technology in practical production, and figure out a simple way to operate.

REFERENCES

[1] Qi Wenxin, Zhou Xuewen; Design and application of distributed intelligent greenhouse computerized control system [J], Transactions of the Chinese Society of Agricultural Engineering, **20(1)**, 246-249 **(2004)**.

[2] Mu Shanxiang, Zhang Qijun; Development and application of gas engine computer control system[J], Small Internal Combustion Engine and Motorcycle, **42(4)**, 59-62 **(2013)**.

[3] Zhang Yuhua; Research application of control algorithm for configuration software[D], HoHai University, **(2008)**.

[4] Ruan Xuebin; Application of generalized predictive control to air-condition monitor and control system[J], CONTROL Engineering of China, **14(1)**, 18-20 **(2007)**.

[5] Tang Yongjian, Cheng Liming; Research application of control algorithm for configuration software[J], Computer CD Software and Applications, **(16)**, 92-93,100 **(2010)**.

[6] Shao Lianhe; The simulation and study of arithmetic of the PID control[J], Journal of Chengde Petroleum College, **(02)**, **(2009)**.

[7] K.H.Doan, J.L.Busath, D.H.Kellman; "The DIII-D neutral beam supervisory control and data acquisition workstation upgrade,"*Fusion Engineering*, **(2002)**.

[8] Zha Qiwen, Zhang Wu, Zeng Xuewen; A parallel TCP congestion control algorithm for multi-core systems in a high-speed network[J], Chinese High Technology Letters, **23(9)**, 894-900 **(2013)**.