Journal of applied science and engineering innovation Vol.1 No.2 2014
ISSN (Print): 2331-9062
ISSN (Online): 2331-9070

Simulation analysis of the conveyor chain system based on MATLAB

Juntian Zhao[a], Yu Liu[b], Shunzeng Wang[b], Shengyang Hu[b]

LAN Zhou University of Technology, Lanzhou, 730050, PR China
[a]zhaojt@live.cn, [b]liuyu7541577@163.com

Abstract. In the aluminium ingot casting machine conveyor chain system, the vibration of the production process caused by the transport chain crawl and polygon effect produces water ripple, which directly affect the quality of the products. So this article combined with the MATLAB simulation technology to analyze the signal which affect the conveyor chain stability. And using its powerful graphics functions and mathematical functions to further improve the stability of conveyor chain provides reference.

Keywords. MATLAB, Aluminium ingot casting machine, Conveyor chain system

Introduction

Aluminum ingot casting machine is a key equipment which produces ordinary remelting ingots, and the basic structure is a chain conveyor. Now it is urgent to improve the stability of the conveyor chain system. Zeng chang Zhou and Veikos.N attempted to using computer analysis the conveyor chain system [1-2]. With the rapid development of electrical drive each related fields, digitalization has become the development trend of the current transmission technology, Yong lin Wang and I.Troedsson have used other software analyzed the conveyor chain control system [4-5]. In this paper, by means of MATLAB software to set up its signal mathematical model and to analyze its stability [3,6].

An order inertia Virtual Experiment System

The typical linear time-invariant system can be summarized as proportional component part, the integral part, the differential part, the inertia part, the oscillation part and delay part, and so on. It should be noted that it is representative of a typical part of a particular mathematical model, and not necessarily a specific component.

Because the lagging that the conveyor chain system have, so regard it as the first -order inertia system. The input signal mutation can not immediately output. Its transfer function is

$$G(s)=K/(Ts+1) \tag{1}$$

T is the inertia time constant, and represents the system inertia. K is the system input change magnification.

When the model parameters change, the changes to the open loop time domain corresponding situation is as follows.

(1)When T=1, L=1, K=1, K=4, K=0.2, Their images are t-y, t-y1, t-y2, as shown in figure 1.

Figure 1 shows that when the bigger numerical of K, the more quickly the system response. At the same time, the physical meaning of the amplification coefficient K is the system input change magnification. When K is a parameter indicates the input control signal to output the stronger signal. For a controlled variable, there may be several input variables affect them, so it should choose the larger variable amplification factor K as a moderator, the other input variables as the amount of interference in the system. The larger the *K* indicates that the channel adjustment ability stronger, and the larger the *K*, the greater the influence of the disturbance of output variables. The controller structure of the simulation is shown in figure 2.

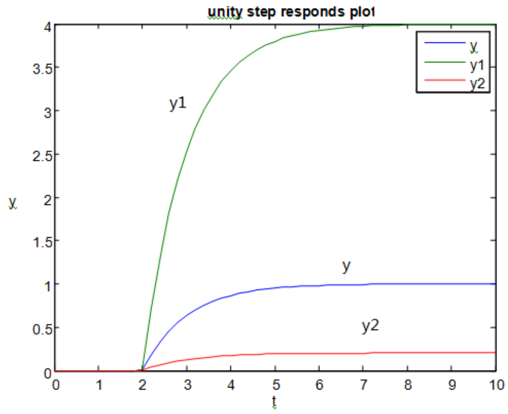


Fig.1 The simulation waveform parameter of the *K* changes

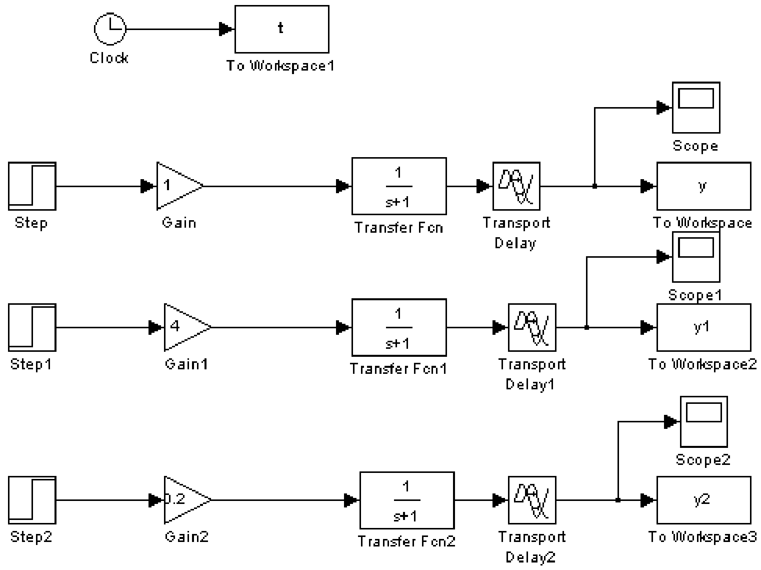


Fig.2 Simulation controller structure

(2) When *K*=1, *L*=1, *T*=1, *T*=4, *T*=0.2, their images are t-y, t-y1, t-y2, as shown in figure 3.

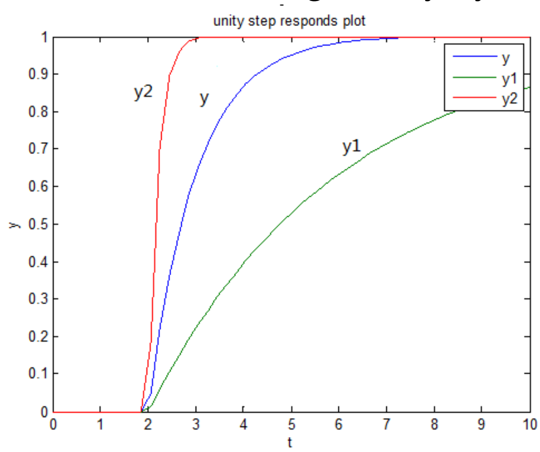


Fig.3 The simulation waveform parameter of the *T* changes

Figure 3 shows that when the smaller numerical of *T*, the more quickly the system response. The *T* is the dynamic parameter, and the greater the time constant *T* shows that the response of the system is stable. The system is stable means that the system is usually easy to control, but to adjust for a long time. The smaller the time constant *T*, and the system is difficult to control. Therefore, in the actual should select suitable time constant *T*. The controller structure of the simulation is shown in figure 4.

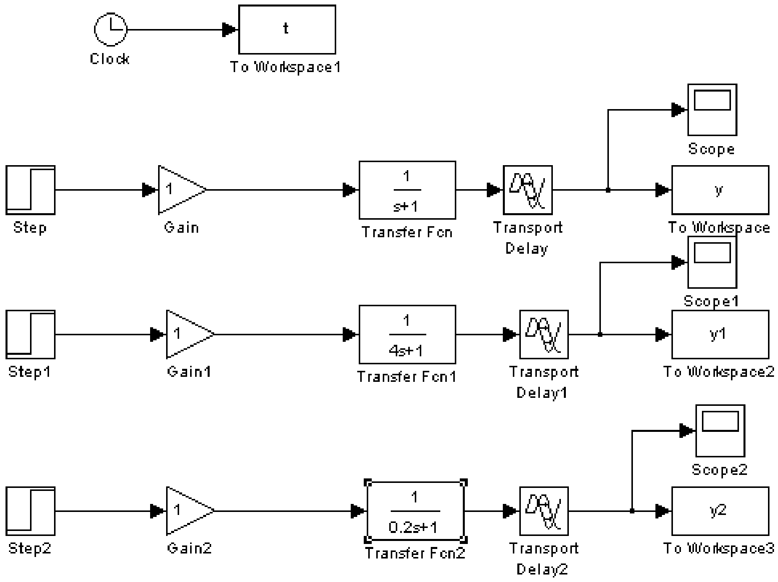


Fig.4 Simulation controller structure

(3) When *K*=1, *T*=1, *L*=1, *L*=4, *L*=0.2, their images were t-y, t-y1, t-y2, as shown in figure 5.

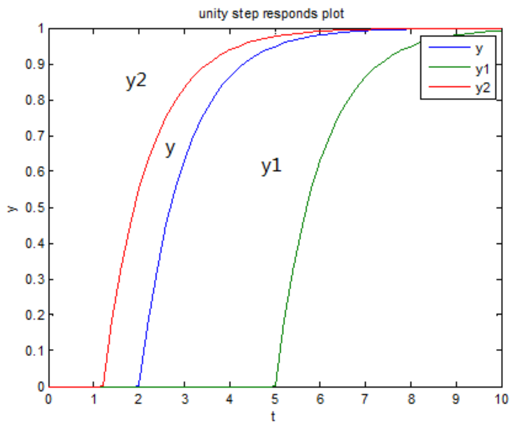


Fig. 5 The simulation waveform parameter of the *L* changes

Figure 5 shows that when the smaller numerical of *L*, the more quickly the system response. While there is time delay and capacity lags behind from the figure 5. Obviously, the time lag is detrimental to the control. It present in the measuring instruments in the time lag resulting controlled variable changes can not be reflected in a timely manner, and it will delay control and decision. The time lag which exists in the channel of actuator and the controlled, resulting regulator control action can not be put in place to increase the system's shock, and even make the system out of control. Only exists in the time lag of interference channel, the presence of the interference effect will be put off a period of time so that has no substantial impact to the system. So it should avoid and take the smaller value for *L*. The controller structure of the simulation is shown in figure 6.

By analyzing the simulation data of MATLAP above, it presents the following conclusion. For conveyor chain control system, the controlled object is often difficult to change and the controlled variable is fixed, but it can change or adjust the performance index *K*, *T* and *L* to improve control precision of the control system of conveyor chain. In the typical linear time-invariant systems, in order to improve the speed of system response to the abnormal signal, we should set a larger *K* value, the smaller L and T value.

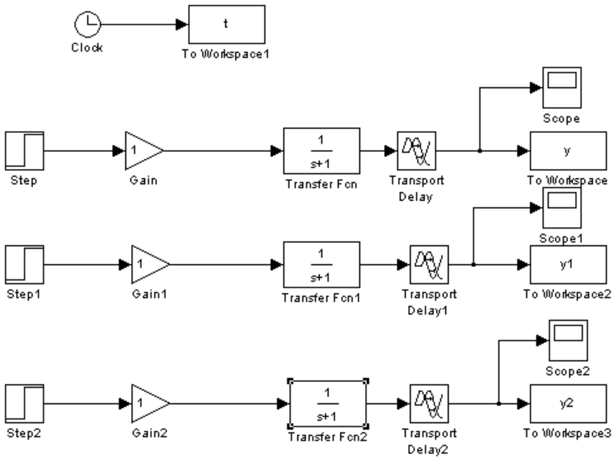


Fig.6 Simulation controller structure

The unit step response

When there is a larger interference factor of the aluminum ingot casting machine, input variables into the unit step signal. When the input signal is the unit step signal and under zero initial conditions, the Laplace transform of the inertia output is

$$C(s) = R(s)G(s) = \frac{K}{T_1 s + 1} * \frac{1}{T_2 s + 1} \tag{2}$$

When the T_1 = 1, T_2 = 1, L = 1, When K = 1, K = 4, K = 0.2. Their images are t-y, t-y1, t-y2, as shown in figure 7.

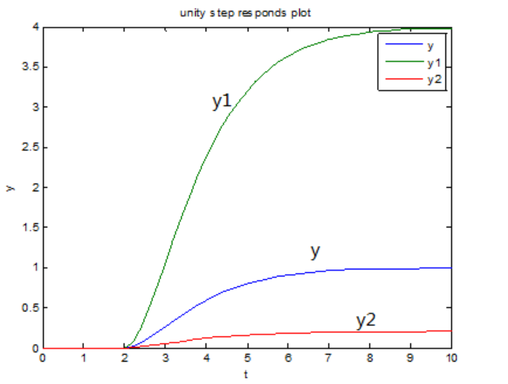


Fig.7 The simulation waveform parameter of the K changes

Figure 7 shows that when other values are same, the bigger numerical of K, the more quickly the system response. It presents the curves become slow contrast figure 1. It shows that in the case of other parameters constant, unit step signal only affect the system response speed. The change curve is basically the same. Similarly, when the T_1, T_2 and L change the curve changes similar to figure 3 and figure 5. The controller structure of the simulation is shown in figure 8.

Through analyzing the simulation data of MATLAP above, it presents the following conclusion.

Proportional control by adjusting the value of K, and it respond is more timely and short transition time to overcome the interference ability. Almost all the adjustment of law has scale effect. But the biggest drawback is it has residual error in adjustment process. Therefore, proportional control is suitable for not important system. PI control by adjusting the value of K and

T, due to the proportional action to adjust timely, fast reaction, integral action can overcome residual error. It applies to adjust the channel delay is small, load change is small, and do not allow residual error. PID adjustment taking advantages of three kinds of basic regulation law, and adjust K, T_1 and T_2 can get very good control effect. Applicable to the load change is big, and the control of high quality control requirements.

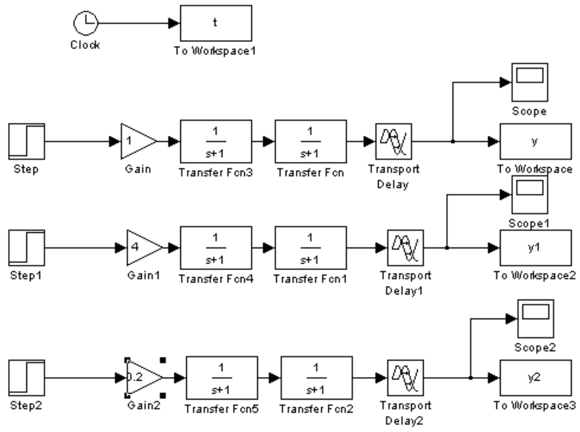
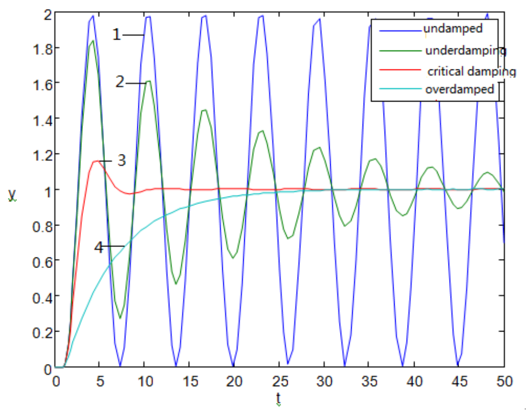


Fig.8 Simulation controller structure

With regard to aluminium ingot casting machine conveyor chain system .When the input signal is the unit step function, in order to improve the speed of system response to the abnormal signal, it should set a larger *K* value and the smaller *L* and *T* value.

The second order oscillation respond

To the second order oscillation respond, we discuss the undamped system, the under-damping system, the critical damping system, and the over-damped system characteristics as shown in Fig. 9.



1- undamped condition, 2- under-damping condition,3- critical damping condition, 4- over-damped condition.

Fig.9 The simulation waveform parameter changes

Figure 9 shows different parameters of different influence on the stability of the system. By analyzing the simulation data of MATLAP above, it presents the following conclusion.

(1) When the system is undamped state, the transient response is a periodic function of the oscillation amplitude.

(2) When the system is over-damped state, the second-order system unit step response is monotonically increasing, and there is no overshoot.

ISSN (Print): 2331-9062
ISSN (Online): 2331-9070

(3)The critical damping second-order system unit step response is monotonically increasing, and there is no overshoot. But it is obviously faster than the over-damped response.

(4)The under-damped second-order system unit step response curves overshoot, and oscillation damping is a trend. The system gives the corresponding dynamic indicators.

The controller structure of the simulation is shown in figure 10.

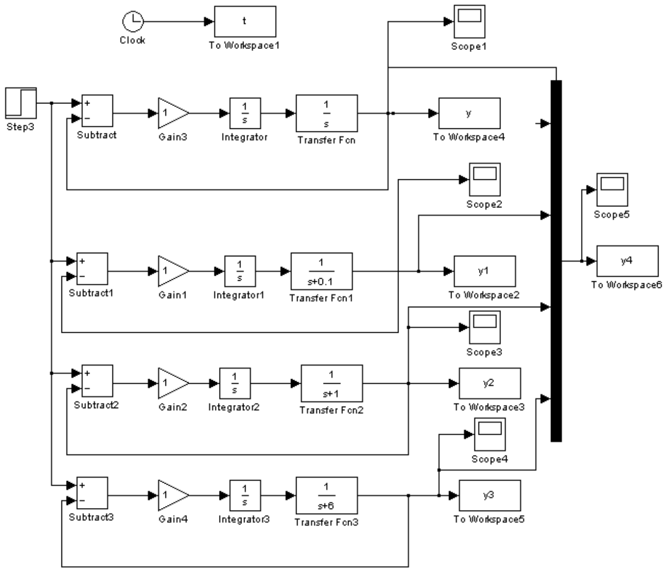


Fig.10 Simulation controller structure

Conclusions

With the help of MATLAB, it is more accurately simulate the signal which affect the aluminium ingot casting machine conveyor chain system stability, and provides the countermeasures. In order to improve the stability about the system of conveyor chain, General conveyor chain by PLC process control. The control content mainly includes speed adjustment, drive protection, overload protection and limit protection. In addition, in order to improve the speed of system response to the abnormal signal. It should set a larger K value and the smaller L and T value. But when the system has much control points, it should choose the computer control.

References

[1]Zeng chang Zhou,Asynchronous engine assembly line conveyor line, J.Automobile Technology. 24(1998)351-362.

[2] Veikos N, Freudenstein F,On the dynamic analysis of roller-chain drivers part theory,J. Mech DesSynASME. 46 (1992) 431–439.

[3]CHEN Huai-chen, WU Gao, MATLAB and its electronic signals Course, M. Electronic Industry Press, Beijing, 2002.

[4]WANG Yong-lin, LI Bin, Roller chain drive vibration characteristics of the study, J.Mechanical Science and Technology. 16 (1997)122-125.

[5] I Troedsson, L vedmar, A Dynamic Analysis of the Oscillations in a Chain Drive, J. Journal of Mechanical Design.123(2001)395-401.

[6]Chew M, Inertia effects of a roller-chain on impact intensity, J. Mech Transmissions and Automation Des.107 (1985)123–130.