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WEDM Tension Control Simulation Based on Matlab

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Abstract :*The dynamicequations and simulation model ofWEDMtensioncontrol based on cam mechanismare established.Using ofsimulationtechniquesto imitate different types ofprofile curvessignal, thensimulatetension control with the signals.Analysis the simulation results .This methodcould design the profile of cam and reduce thecost .*

Key words:*cam mechanism; tension control; Matlab/Simulink*

I. Introduction:

WEDM (Wire cut Electrical Discharge Machining), it is based on the galvanic corrosion of cutting liquid medium small gap pulse discharge material[1]. In the actual processing, due to the discharge electrode wire by working force, electrostatic force, electromagnetic force and friction in the process of working, etc, the value of tension is fluctuating, as result itaffectsthe precision,So it is important to keep the tension of wirein a certain.However, the dynamic characteristics of the electrode wire is very complex, andthe vibration of electrode wire is main reason causes the deterioration of the machining accuracy and surface quality. Currently there are Dong Xiaodong of Harbin Institute of Technology proposed wire system that realizes the constant tension control and constant speed control; Harbin Institute of Technology proposed by Zhang Zhiyong came up withtheFast-cutting Wire Electrical Discharge Machiningwireconstant tension control; Liu ZhiLongofXihua University proposed bilateral constant tension tensioning mechanism.Based on the characteristics of the wire tension, the paper proposes tension control system.

II. Cammechanismtension system

Cam mechanism has ease of use and flexibility, the use of a cam mechanism or in combination with other forms of organization, it can achieve almost all the kinds ofmovement styles in reliable、accurate and with compact structures. By studying the cam mechanism,design a WEDM tension system. The structure diagram is shown in Figure 1.The tension Sensor5 measures the size of the wire tension through the controller processing system in response to the control cam 910, conditioning system wire tension variation, and the choice of the cam profile curve 910 is critical to the entire system.

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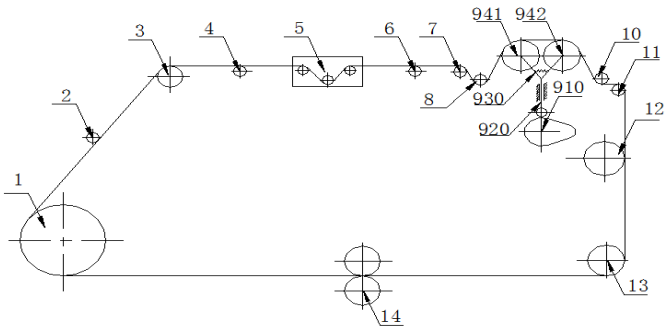

1-wire cylinder 2,4,6,8,10-guide wheel3,7,11,12,13,14-pulley5-Tension Sensor 910-cam 920-guide bar 930-swing link 941,942-cam pulley

Figure1Structure diagram cam tension control system

III. Dynamics model of cammechanism

Usually cam mechanism can be simplified to two-dimensional dynamic model [7], and then you can get similar results in the actual project. In actual forces the wire is extremely complicated. Generally the diameter wireofWEDMis 0.18mm, the elastic modulus of molybdenum wire is 3.2×10^{11}Pa[3]. In this paper, wire and cam mechanism can be simplified, that the wire vibrates around the equilibrium position in up and down motion, thereby simplifying the kinematic model of spring-damping.

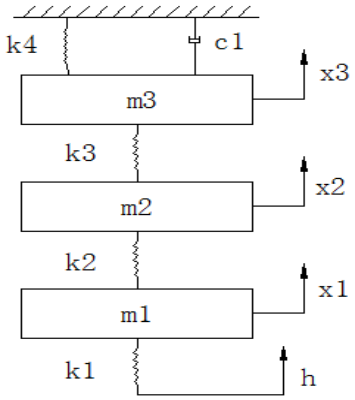

Figure2Cam mechanism dynamics model

Suppose the camshaft has a large rigidity, the vibration is not considered, in accordance with an equivalent lumped mass, which is equivalent to three degrees of freedom dynamic model system[8], shown in Figure 2, wherein the cam 910 is equivalent m1 lumpedmass, m2 for the guide bar 920 equivalent lumped mass, m3 for cam pulley 941 and942 equivalent lumped mass; k1 is the contact stiffnessof 910 camcontact with920 the guide bar, k2 is the tensile stiffness of the guide bar 920, k3 is the bending stiffness of swing link930, k4 is equivalent spring stiffness; h is movement of cam 910 acts on the guide bar 920 displacement in theory. System equivalent mass and equivalent stiffness of the elements to obtain the following kinetic equation:

$$m_1\ddot{x_1} = -k_1\big(x_1 - h(t)\big) + k_2(x_2 - x_1) \quad (1)$$

$$m_2\ddot{x_2} = -k_2(x_2 - x_1) + k_3(x_3 - x_2) (2)$$

$$m_3\ddot{x_3} = -k_3(x_3 - x_2) - k_4x_3 - c_1\dot{x_3} (3)$$

IV. Simulink simulation process

Inmatlab,simulink is used to modelsimulate and analyze dynamic multi-dimensional system of interactive tools. Through Simulink model can get information of detailed dynamic model and theexchanging information

between thecomponentsandthe subsystems. Using thesimulink system set up the model by the formula (1), (2), (3) non-linear differential equations. Simulation flow chart shown in Figure 3.

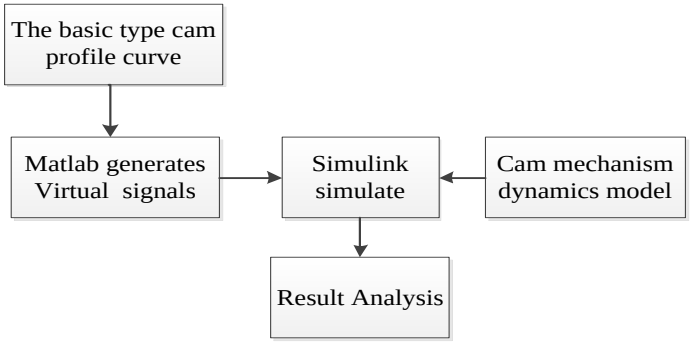

Figure3Simulationflow chart

Operations in simulink environment is as follows: Select new command in the file menu, according to the above equationsconstructs simulate model asfigure4. In order to achieve the movement of the cam mechanism h = h (t), using virtual signals. Firstly, create a functioninmatlabM-file editor (signalofh) ; then, choosethe form workspace module library modules in thesourcesmodule library in Simlulink Library Browser; Finally, input the appropriate command in matlab command window and it will add h variable to the workspace.

The basic type of cam curve are in three ways: double-stop curve,single-stopcurve, non-stop curve [6]. Construction virtual signalsof the three basic types of curves in matlab for simulation. x3 is a displacement signal under three curves in Figure 5, and curve 1 represents the simulation result of the non-stop curve ;curve 2 represents a single-stop curve; curve 3 represents a double-stop curve . The simulation shows that non-stop curve simulation results change dramatically, poor stability.Single-stop curve and double-stop curve have a more cyclical, showing similar features like sine curve, and the relationship between cycles (single-stop curve simulation period is twice double-stop curve simulation cycle.)

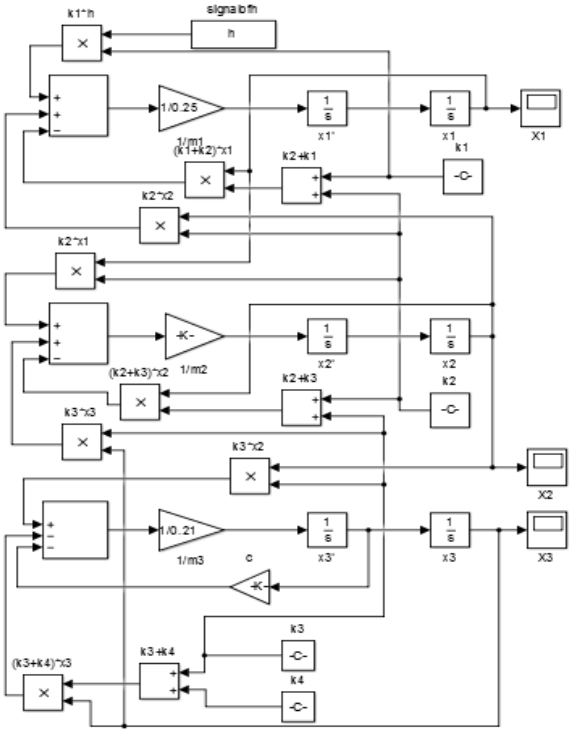

Figure 4System Simulation Model

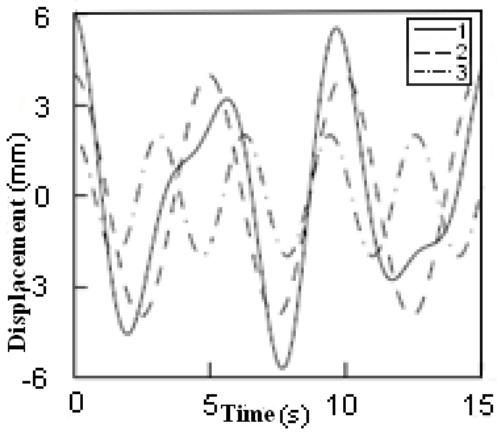

Figure 5Simulation results

V. Conclusion

In matlab / simulink, establishdynamicmodel simulation of cam mechanism using three basic cam curvevirtual signal. Generally requirements for wire tension control in 2-20N [5]. Set wire of WEDM total length 1-50m. The E = σ / ε, F = σ * A, then the simulationresult can adjust 0.3110-15.552N, it is a wide adjustment. Taking into account the diversity of the actual cam curve, this article uses three basic types of cam profile curve, has a certain universality. But in the actual design process, it is not enough,andneed further practical applications.

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