STUDY ON THE CONTROL TECHNOLOGY OF LARGE–LOAD TIME CONSTANT ACCELERATOR MAGNET POWER SUPPLY *

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Abstract

With the increasing application of power supply to industrial system, digital control system has become the mainstream of modern industrial control system. Today's digital power supply control method mainly reflected in when load time constant is large, interference or load change, the power output is prone to overshoot or adjust the time is long, so the tracking and adjustment features cannot be met simultaneously. Therefore, this paper will study the power supply digital control technology for large - load time constant and the independent control method of tracking and regulating.

THE CLOSED LOOP ALGORITHM

Today's digital power supply control method generally uses the traditional digital PID control algorithm, but poor dynamic performance of traditional PID algorithm, mainly reflected in when load time constant is large, there is interference or load change.

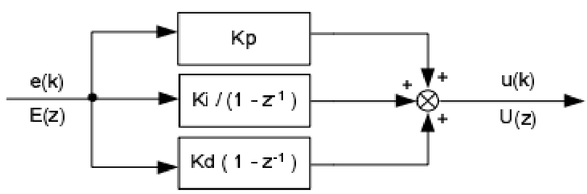


Figure 1: PID algorithm block diagram

$$u_p(k) = K_p e(k)$$

$$u_i(k) = K_i \sum_{j=0}^{k} e(j)$$

$$u_i(k) = K_d[e(k) - e(k-1)]$$

RST CONTROLLER DESIGN

BEPCII quadrupole power supply load:

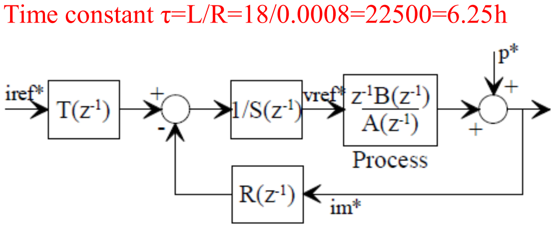
Resistance (Ω)	0.266
Inductance (H)	0.14

Time constant τ=L/R=0.14/0.266 = 525ms

LHC diode load:

Resistance (mΩ)	0.8
Inductance (H)	18

Time constant τ=L/R=18/0.0008=22500=6.25h



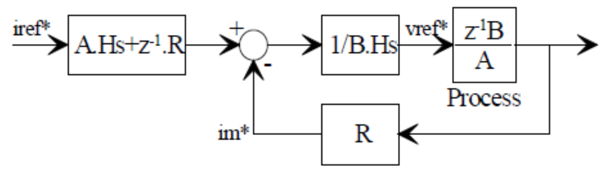


Figure 2: RST controller block diagram

The tracking transfer function is:

$$\frac{r(k)}{y(k)} = \frac{z^{-d} \cdot B \cdot T}{A \cdot S + R \cdot B \cdot z^{-d}}$$

And the regulation transfer function is:

$$\frac{y(k)}{P} = \frac{A \cdot S}{A \cdot S + R \cdot B \cdot z^{-d}}$$

The RST controller makes it possible to obtain the desired tracking behaviour (following the reference) independent of the desired regulation behaviour (rejection of a disturbance).

SIMULATION

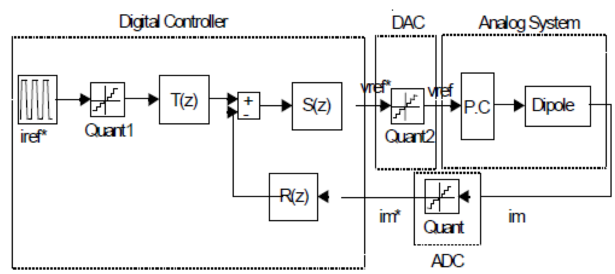


Figure 3: The MATLAB simulation diagram

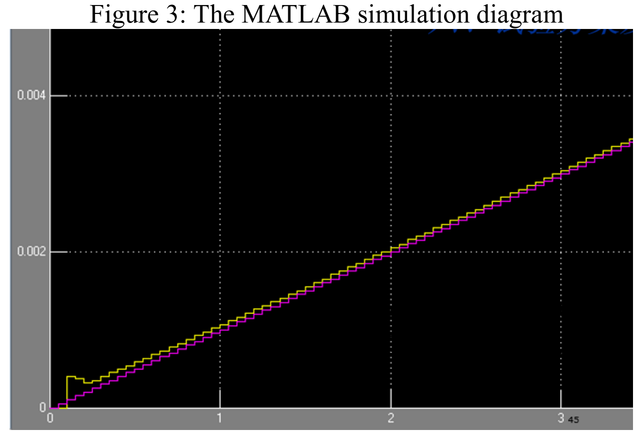


Figure 4: The simulation results

CONCLUSION

As a result of the tests completed to date, the digital loop using RST controller seems to fulfil all the performance requirements of the LHC (no overshoot, static or lagging error below 1ppm). The robustness of the algorithm avoids the use of more complex adaptive control. The following research mainly focuses on the parameter calculation of RST algorithm.

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