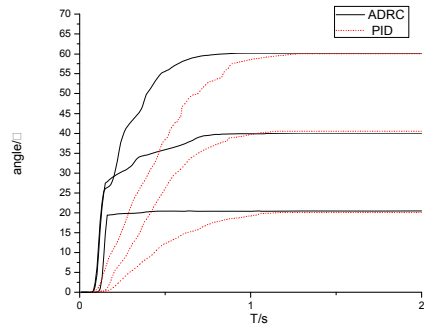

Figure 4.The step response comparison between ADRC and PID

As shown in Figure 4, the average steady-state error is less than 0.3°, and the average transition process time is about 0.6 s under the control of ADRC, while the average steady-state error is less than 0.4°, and the average transition process time is about 1s under the control of PID. Compared with PID, the average steady-state error reduces by 25% and the response time reduces by 40% adopting ADRC.

V.TWO FREEDOM DEGREE COMPOUND POSITION CONTROL

The spherical joint position control target is represented by attitude matrix T,The included angles between corresponding coordinate system axis X, Y, Z and fixed coordinate system are α, β, λ. The included angles α, β, λ only determine attitude matrix T.The system realizes the control target by ADRC. The control targets are α=8°, β =6°, λ =6°and α=24°, β =17°, λ =17°. Controller parameters are as follows:

ADRC 1： h =0.05, h_0 = 0.025, r_0 =6200, h_1 = 0.08, β_{01} =70, β_{02} =1350, β_{03} =2650, h_2 =0.14, β_0 =0.34, β_1 =190, β_2 =3.4,

ADRC 2： h =0.05, h_0 = 0.023, r_0 =6100, h_1 = 0.075, β_{01} =80, β_{02} =1450, β_{03} =2700, h_2 =0.13, β_0 =0.3, β_1 =170, β_2 =2.5,

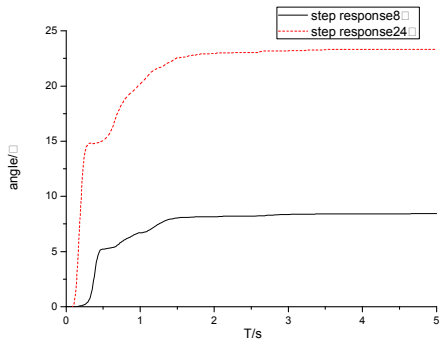

Figure 5. included angle of coordinate system axis x

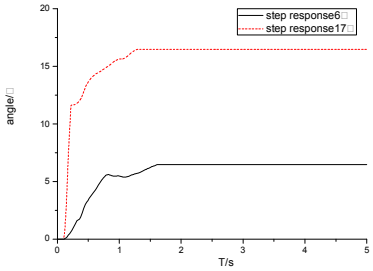

Figure 6. included angle of coordinate system axis y

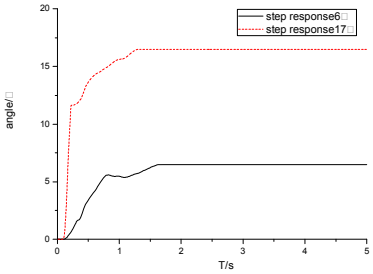

Figure 7. included angle of coordinate system axis z

As shown in Figure 5, 6 and 7, the steady-state time which reaches the target location is about 2s, the steady-state error is less than 0.5 °.It is shown that ADRC can achieve good spherical joint position control.

VI.CONCLUSIONS

As a new type of pneumatic actuator, pneumatic artificial muscle is taken seriously with good flexibility, but it has some disadvantages, such as linearity error, slow response speed and low repetition accuracy. In order to overcome the above shortcomings, this study adopts ADRC on spherical joint control experimental research and obtains ideal control effect that lays the foundation for multiple joint control.

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