

## Angle Synchronization of Two Motors on Parallel Link Joint Type Based on Disturbance Observer

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Parallel link joint type is a joint which has one degree of freedom (DoF) with more than one actuator mounted. The use of more than one actuator will produce greater joint torque. However, if both the actuators move not synchronously, it will cause the burdening effect to each other and cause damage to the actuators are used. To avoid the burdening effect, required a system to synchronize the movement of the actuators. PID control are used in each actuator to make harmonious movement between two actuators. Giving different load to each joint will cause the response of PID control becomes unequal so movement between two actuators are not same. In this research, disturbance observer is used at each actuator in order to make changes of dynamic model of each actuator because loading effect can be minimized. The result showed that the level of similarity between the two actuator response that calculate by using root mean square error (RMSE) when run without load and using the PID controller without disturbance observer is  $0.45^\circ$ . When using the disturbance observer is  $0.44^\circ$ . Whereas when one actuator is given a load and the other actuator freely, using a PID controller without disturbance observer is  $3.94^\circ$  and when using the disturbance observer is  $3.04^\circ$ .

Figure 1 shows the diagram system of disturbance observer. PID control contained in close loop actuator block. The amount of disturbance ( $d$ ) can be eliminated by estimating the  $d_{est}$ . Low pass filter (LPF) is used to ensure that the disturbance that estimated is not affected by noise and to avoid algebraic loops.

Figure 2 shows the result of the system when using a disturbance observer and does not use the disturbance observer. Similarity level of the response system when using disturbance observer look higher than not using disturbance observer.

Based on the result achieved, angle synchronization of two motors using disturbance observer produce a better response on two motors that used.

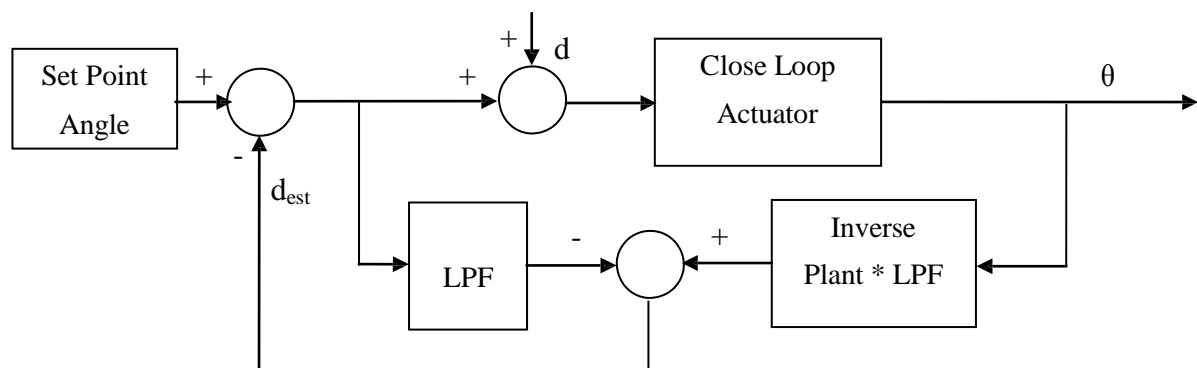
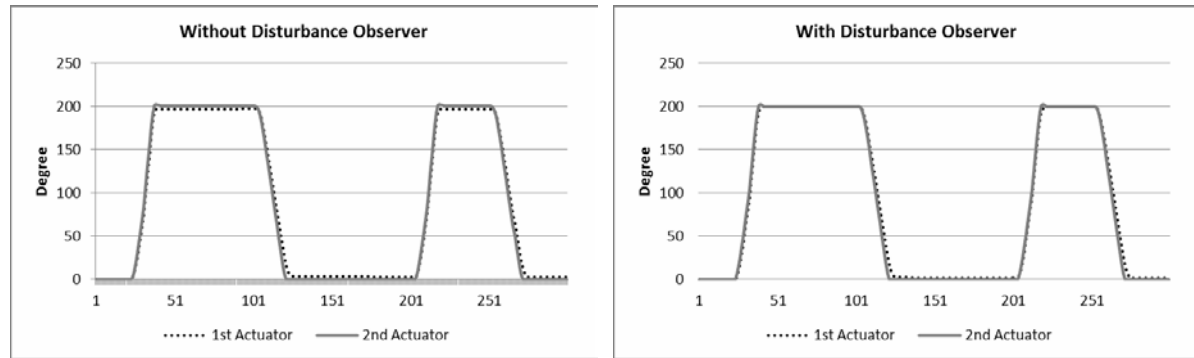


Figure 1. Diagram Block System



**Figure 2.** Output Response

## REFERENCES

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