

SUMMARY

ANALISIS DAN PERANCANGAN SISTEM PENGENDALI PADA INVERTED PENDULUM MENGGUNAKAN METODE FUZZY SLIDING MODE CONTROL

DESIGN AND ANALYSIS OF CONTROLLER SYSTEM ON INVERTED PENDULUM USING FUZZY SLIDING MODE CONTROL METHOD

Created by Rizan, Rifqi Izzatur

Subject : Fuzzy mathematics

Keyword : inverted pendulum ; logika fuzzy ; sistem pengendalian ; sliding mode control (SMC).

Description :

Permasalahan umum yang sering dihadapi dalam pengendalian suatu sistem nonlinear ialah munculnya gangguan tak pasti yang dapat berasal dari dalam ataupun dari luar sistem. Sliding Mode Control (SMC) merupakan salah satu algoritma kontrol yang bersifat sangat robust, sehingga mampu bekerja dengan baik pada sistem nonlinear yang mempunyai ketidakpastian model atau parameter. Namun dalam aplikasi praktis, pada SMC murni sering muncul chattering yang merupakan osilasi keluaran pengendali dengan frekuensi tinggi dan menyebabkan sistem menjadi tidak stabil. Untuk memperbaiki performansi sistem, SMC murni dimodifikasi dengan logika fuzzy yang bekerja secara kualitatif, sehingga disebut Fuzzy Sliding Mode Control (FSMC). Plant inverted pendulum yang merupakan benchmark untuk sistem nonlinear dan tidak stabil dipilih untuk menguji kemampuan metode FSMC. Pada Tugas Akhir ini, dirancang sistem pengendali FSMC pada inverted pendulum dan analisis terhadap performansi sistemnya, dengan cara membandingkan metode FSMC dengan metode fuzzy logic control (FLC) dan sliding mode control (SMC). Dari hasil Tugas Akhir ini diperoleh kesimpulan bahwa metode FSMC yang diuji memiliki beberapa kelebihan daripada metode FLC dan SMC, yaitu lebih sederhana dalam perancangannya, waktu respon lebih cepat, kesalahan lebih kecil saat mendapat gangguan bernilai besar, dan lebih robust terhadap berbagai ketidakpastian, baik gangguan eksternal maupun gangguan internal. Namun terdapat suatu kekurangan pada metode FSMC, yaitu dibutuhkan penalaan logika fuzzy, memiliki kesalahan yang lebih besar daripada FLC dan SMC saat diberi gangguan bernilai kecil atau gangguan yang bersifat kontinu.

Description Alt:

The general problem often faced in a nonlinear system control is the appearance of uncertainty disturbance that could come from inside or outside of the system. Sliding Mode Control (SMC) is one of the control algorithm that is very robust, so that it can work properly on nonlinear system that has model or parameter uncertainties. But in practice application, on pure SMC often exist chattering that is control output oscillation with high frequency and cause the system being unstable. To improve the system performance, pure SMC is modified with fuzzy logic that is working qualitatively, so that it is called as Fuzzy Sliding Mode Control (FSMC). Inverted pendulum plant which is a benchmark for nonlinear and unstable system is chosen to test the ability of FSMC method. In this Final Project, FSMC controller is designed on inverted pendulum and the analysis of its performance, by comparing FSMC method with Fuzzy Logic Control (FLC) method and SMC method. From the result of this Final Project, obtained a conclusion that tested FSMC method has several advantages than both FLC and SMC method, they are simpler in its design, faster response time, smaller error when taking big valued disturbance, and more robust toward various uncertainties, not only external disturbance but also the internal one. Nevertheless, there are few weakness of FSMC method, it needs fuzzy logic tuning, has bigger error than FLC and SMC when taking small valued disturbance or continuous disturbance.

Contributor : Dra. Mardijah, M.T.

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Contact Person :

Mr. Achmad (achmad@its.ac.id)

Mr. Taufik R (taujack@its.ac.id)

Mr. Agus Setiawan (setiawan04@its.ac.id)