UNIVERSITI PUTRA MALAYSIA

SIMULATED REAL TIME CONTROLLER FOR TUNING ALGORITHM USING MODIFIED HILL CLIMBING APPROACH

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By

AHMED ABDULELAH AHMED

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

JULY 2014

DEDICATIONS

This work is dedicated to

dad and mom, without you I am nothing

brother and sister, I love you

my beloved wife, my light

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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Faculty: Engineering

Many techniques and inventions in the field of automatic control keeps going forwards, especially that the introduction of modern computing provided a huge ground for innovation in this field. Intelligent control was one of the direct beneficiaries of the computer systems advancements. That led to new ways to tackle old problems like model inaccuracies and inconsistencies. Often, it is necessary to calibrate a certain parameters of a control system due to plant parameters fluctuation over time.

In this research, an intelligent algorithmic tuning technique suitable for real-time system tuning based on hill climbing optimization algorithm and model reference adaptive control system (MRAC) technique is proposed. Although all adaptive control tuning methodologies depend partially or completely on online plant system identification, the proposed method uses only the model that is used to design the original controller, leading to simplified calculations that require neither high processing power nor long processing time, as opposed to identification techniques calculations. The main principle in the tuning process is to compare the output of the plant with a desired reference signal within an acceptable error margin.

In order to investigate the ability of the proposed tuning method to deal with different system complexities, simulations of three different case studies were conducted. In each case study, different possibilities to generate the desired reference signal is discussed along with how much the complexity of the system would affect the end result. Also, in each case study a discussion contrasts the limitations and conditions needed to be identified to use the proposed method. The proposed design performed very well, improving

overshoot and response speeds in example systems depending on reference response generation method.

The results showed that using different methods to generate the reference response gives system designer flexibility over favouring a specific response characteristics or an overall decent response. The simulation results illustrates that the method schemes proposed in this study show a viable and versatile solution to deal with controller tuning for systems with model inaccuracies as well as controller real time calibration problem.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

SIMUL ATED REAL-TIME CONTROLLER FOR TUNING ALGORITHM USING MODIFIED HILL CLIMBING APPROACH

Oleh

AHMED ABDULELAH AHMED

JULAI 2014

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Fakulti: Kejuruteraan

Banyak teknik dan penciptaan dalam bidang kawalan automatik terus berkembang terutama dengan pengenalan pengkomputeran moden yang telah menyediakan ruang yang luas untuk inovasi dalam bidang ini. Kawalan pintar adalah salah satu daripada penerima manfaat hasil kemajuan sistem komputer. Ini telah membawa kepada cara baru untuk mengatasi masalah sedia ada seperti model yang tidak tepat dan tidak konsisten. Kebiasaannya, kalibrasi parameter bagi sistem kawalan perlu dilakukan kerana parameter loji yang berubah-ubah dari semasa ke semasa.

Dalam kajian ini, teknik penalaan algoritma pintar yang sesuai untuk penalaan sistem masa nyata berdasarkan algoritma pengoptimuman mendaki bukit dan model rujukan suai sistem kawalan(MRAC) dicadangkan. Walaupun semua metodologi penalaan kawalan suai bergantung sebahagian atau sepenuhnya pada talian pengenalan sistem loji, kaedah yang dicadangkan hanya menggunakan model untuk rekabentuk pengawal asal, bertujuan memudahkan pengiraan yang tidak memerlukan kuasa pemprosesan tinggi dan memendekkan masa pemprosesan yang bertentangan dengan pengiraan teknik pengenalan. Prinsip utama dalam proses penalaan adalah untuk membandingkan pengeluaran loji dengan isyarat rujukan yang diingini dalam margin ralat yang boleh diterima.

Untuk mengenalpasti keupayaan kaedah penalaan yang dicadangkan dalam menangani sistem dengan kompleksiti yang berbeza, simulasi tiga kajian kes yang berbeza telah dijalankan. Dalam setiap kajian kes, kemungkinan yang berbeza untuk menjana isyarat rujukan yang dikehendaki dibincangkan bersama berdasarkan kompleksiti sistem yang akan memberi kesan kepada hasil akhir. Selain itu, dalam setiap kajian kes perbincangan perbezaan had

dan syarat perlu dikenalpasti untuk menggunakan kaedah yang dicadangkan. Reka bentuk yang dicadangkan berupaya dengan baik, meningkatkan terlajak dan kelajuan tindak balas dalam sistem contoh.

Hasil kajian menunjukkan bahawa menggunakan kaedah yang berlainan untuk menjana tindak balas rujukan memberikan fleksibiliti kepada pereka system lebih memihak kepada ciri-ciri tindak balas tertentu atau tindak balas yang baik secara keseluruhan. Keputusan simulasi menunjukkan bahawa skim kaedah yang dicadangkan dalam kajian ini sebagai penyelesaian yang berdaya maju dan serba boleh untuk menangani penalaan pengawal untuk sistem dengan ketidaktepatan model serta pengawal masa sebenar masalah penentukuran.

ACKNOWLEDGEMENTS

I would like to express my deep gratitude to my supervisor **Dr. Azura Bt. Che Soh** for helping and supporting me during my journey in pursuing a Master's degree. Her insightful guidance and support was the leading force that got me to carry on completing this research. I cannot imagine myself getting a better supervisor for my study.

Besides my advisor, I would like to thank my co-supervisors: **Prof. Madya Dr. Samsul Bahari b. Mohd. Noor** and **Dr. Mohd. Khair b. Hassan** for helping me clear many troubles out of my way with their knowledgeable reviewing and critique.

I would also like to thank the laboratories staff at Universiti Putra Malaysia for assisting me during my research.

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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TABLE OF CONTENTS