INTELLIGENT NEURAL NETWORK FOR MODELLING AND CONTROL OF AN AUTOMOTIVE AIR CONDITIONING SYSTEM

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ABSTRACT

Air Conditioning (AC) System in the automotive is to provide the thermal comfort during the driving journey. Thermalcomfort plays an essential role in nowadays sophisticated modern vehicle.Monitoring and automatic control of air conditioning systems are important to ensure drive comfort are met during the journey, therefore, this research aims to study the Modeling of AC System of Automotive by using Intelligent Neural Network to achieve the desired cooling comfort. Intelligent Neural Network by neuro controller will be introduced to the automotive for the vehicle to control the air conditioning system and the goalof this project is to improve and maintain the occupant comfort level within car cabin with introduces various disturbances and at the same time achieve as an energy efficient vehicle.The objective of the project is to design a self-tuning neuro controller for the variable speed compressor of the Automotive Air Conditioning (AAC) system within Matlab-SIMULINK environment. In this research, Recursive Least Squares (RLS) system identification techniques were used to estimate the non-linear or dynamic model of the AAC system. The input and output data used to estimate the dynamic model of AAC system were obtained experimentally in the lab. The validity of the models was investigated based on mean square error (MSE) and correlation tests. From the parameter optimization and simulation, the optimum neural network structure of AAC system was obtained. Three types of controllers, namely PID, NARMA-L2 and NARMA-L2-PID were proposed in this research. The overall comparison of three conventional and neuro controllers was presented and discussed in this research. From the simulation results, it can be seen that the proposed hybrid NARMA-L2-PID controller has performed the best amongst all in term of the time response and the effective performance of the system as compared to the heuristic tuned- PID and NARMA L2 controllers.

ABSTRAK

Sistem penyaman udara (AC) dalam automotif adalah penting untuk memberi keselesaan dalam kenderaan. Pemantauan dan kawalan automatik sistem penyaman udara adalah penting untuk memastikan keselesaan memandu, oleh itu, kajian ini bertujuan untuk mengkaji pemodelan sistem AC automotif dengan menggunakan kaedah pengenalan sistem rangkaian neural pintar untuk mencapai keselesaan penyejukan yang dikehendaki. Rangkaian neural pintar oleh pengawal neuro akan diperkenalkan untuk mengawal sistem penyaman udara automotif. Matlamat projek ini adalah untuk meningkatkan dan mengekalkan tahap keselesaan penumpang dalam kabin kereta walaupun pelbagai gangguan diperkenalkan dan pada masa yang sama mengekalkan tahap kecekapan tenaga yang baik. Objektif projek ini adalah untuk merekabentuk pengawal neuro talaan sendiri untuk pemampat kelajuan yang berubah-ubah daripada sistem penyaman udara automotif (AAC) dalam persekitaran Matlab-SIMULINK. Dalam kajian ini, teknik pengenalan Pendaraban Kuasa Dua Terendah (RLS) telah digunakan untuk menganggar model bukan linear sistem ini. Data masukan dan keluaran yang digunakan untuk menganggarkan model dinamik sistem AAC telah diperolehi secara eksperimen di dalam makmal. Kesahihan model telah dikaji berdasarkan Min Ralat Kuasa Dua (MSE) dan ujian korelasi. Dari pengoptimuman parameter dan simulasi, struktur rangkaian neural yang optimum sistem AAC telah diperolehi. Tiga jenis pengawal, iaitu PID, NARMA-L2 dan NARMA-L2-PID telah dicadangkan dalam kajian ini. Perbandingan ketiga-tiga pengawal telah dibentangkan dan dibincangkan dalam kajian ini. Dari keputusan kajian mendapati sistem pengawal hibrid NARMA-L2-PID yang dicadangkan telah menunjukkan prestasi yang baik dengan memberi respons terbaik dan sistem prestasi yang berkesan berbanding dengan penalaan heuristik pengawal PID dan pengawal NARMA-L2.