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DRIVING CYCLE DEVELOPMENT USING K-SHAPE AND CONVOLUTIONAL NEURAL NETWORK FOR ENERGY CONSUMPTION AND EMISSIONS ANALYSIS

ARUNKUMAR A/L SUBRAMANIAM

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Main Supervisor : **Associate Professor Ts. Salisa Abdul Rahman, Ph.D**

Co-Supervisor : **Siti Norbakyah Jabar, Ph.D**

School : **Faculty of Ocean Engineering Technology**

One of the key challenges in the automotive industry is enhancing fuel efficiency and reducing emissions while meeting regulatory requirements. Common issues include the lack of context-specific driving cycles, limitations of conventional clustering methods in capturing non-linear driving behaviours, inefficiencies in real-time system integration with Siemens Totally Integrated Automation (TIA) Portal, and delays from traditional data exchange methods, leading to inaccuracies in fuel consumption and emission analysis. This research focuses on integrating MATLAB scripts for fuel consumption and emission analysis with real-time execution in the Siemens TIA Portal. A major focus is on seamless integration strategies between MATLAB and Siemens environments during execution to enhance analysis efficiency. The study involves collecting driving cycle data for Ipoh City using MATLAB Mobile and DC-TRAD and constructing the Ipoh City driving cycle using the K-shape clustering technique, which identifies complex patterns more accurately than conventional clustering methods. Additionally, a convolutional neural network (CNN) algorithm is applied for effective and precise driving cycle development. The research includes a detailed analysis of execution cycle time, fuel consumption, and emissions across both MATLAB and Siemens environments. A significant improvement in execution performance is achieved, with model cycle times in the Siemens environment reduced

by over 90%, reaching a maximum of 100 milliseconds compared to 45 seconds in MATLAB. This substantial reduction in cycle time is accomplished without compromising accuracy, as the results from MATLAB are successfully replicated in the Siemens environment, leading to the selection of route 6 as the optimized route for the Ipoh City driving cycle. Addressing challenges related to computational power and system integration for real-time processing, this research outlines strategies to optimize MATLAB scripts for real-time deployment within Siemens systems. Ultimately, this integration aims to provide efficient and accurate solutions for analysing energy consumption and emissions in automotive applications, contributing valuable advancements to the field.

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PEMBANGUNAN KITARAN PEMANDUAN MENGGUNAKAN K-SHAPE DAN RANGKAIAN NEURAL KONVOLUSI UNTUK ANALISIS PENGUNAAN TENAGA DAN EMISI

ARUNKUMAR A/L SUBRAMANIAM

JUN 2025

Penyelia : Professor Madya Ts. Salisa Abdul Rahman, Ph.D

Penyelia Bersama : Siti Norbakyah Jabar, Ph.D

Pusat Pengajian : Fakulti Teknologi Kejuruteraan Kelautan

Salah satu cabaran utama industri automotif ialah meningkatkan kecekapan bahan api dan mengurangkan pelepasan gas sambil mematuhi peraturan pihak berkuasa. Isu yang timbul termasuk kekurangan kitaran pemanduan khusus konteks, keterbatasan kaedah pengelompokan konvensional dalam mengenal pasti tingkah laku pemanduan tidak linear, ketidakcekapan integrasi masa nyata dengan Siemens Totally Integrated Automation (TIA), serta kelewatan akibat kaedah pertukaran data tradisional yang menyebabkan ketidaktepatan analisis penggunaan bahan api dan pelepasan. Kajian ini memfokuskan integrasi skrip MATLAB untuk analisis penggunaan bahan api dan pelepasan gas dengan pelaksanaan sistem masa nyata dalam persekitaran Siemens TIA. Objektif utamanya adalah memastikan pertukaran data secara masa nyata antara MATLAB dan Siemens semasa pelaksanaan sistem bagi meningkatkan kecekapan analisis. Kajian melibatkan pengumpulan data kitaran pemanduan bandar Ipoh menggunakan MATLAB Mobile dan DC-TRAD serta pembinaan kitaran pemanduan menggunakan teknik pengelompokan K-Shape yang mampu mengenal pasti corak yang lebih kompleks dan tepat berbanding teknik konvensional. Selain itu, algoritma Rangkaian Neural Konvolusi (CNN) turut digunakan untuk pembangunan kitaran pemanduan yang lebih berkesan dan tepat. Analisis menyeluruh dijalankan melibatkan masa kitaran pelaksanaan, penggunaan bahan api dan pelepasan gas dalam

persekitaran MATLAB dan Siemens. Prestasi pelaksanaan menunjukkan peningkatan ketara, dengan masa kitaran model dalam Siemens dikurangkan lebih 90%, mencapai maksimum 100 milisaat berbanding 45 saat dalam MATLAB. Pengurangan ini dicapai tanpa menjejaskan ketepatan kerana keputusan daripada MATLAB berjaya dikekalkan dalam Siemens, menghasilkan laluan 6 sebagai laluan optimum bagi kitaran pemanduan bandar Ipoh. Memandangkan cabaran kuasa pengiraan dan integrasi masa nyata, kajian ini menekankan strategi pengoptimuman skrip MATLAB bagi pelaksanaan masa nyata dalam Siemens. Integrasi ini menawarkan penyelesaian cekap dan tepat bagi analisis penggunaan tenaga dan pelepasan dalam sistem automotif serta menyumbang kepada kemajuan bidang ini.