

OPTIMAL ANTI LOCK BRAKING SYSTEM WITH REGENERATIVE BRAKING  
IN HYBRID ELECTRIC VEHICLE

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To my beloved parents and brothers

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## **ABSTRACT**

Hybrid electric vehicle is an electric drive vehicle which is powered by internal combustion engines (ICE) and an electric motor. However, this vehicle has some problems such as driving range, recharge time and battery cost. On the other hand, one advantage of HEV is able to recover energy during the brake by converting kinetic energy into electric energy and use it immediately or stored when it is required. This process is called regenerative braking. Anti-lock-braking system (ABS) is a safety system which allows the wheels to maintain the friction between the tires and prevent the car from skidding especially on dry and slippery road surfaces. Change in vehicle weight, friction coefficient of the road and road inclination can affect the behavior of the braking system. Therefore, optimization of the ABS system is necessary. In this study, optimal anti-lock-braking system (ABS) with regenerative braking in a hybrid electric vehicle is surveyed. The methodology consists of the mathematical model of the vehicle, ICE and electric motor, control design for ABS system and simulation. Besides, MATLAB software is used for the simulation model.

## ABSTRAK

Hibrid kenderaan elektrik adalah memandu kenderaan elektrik yang dikuasakan oleh enjin pembakaran dalaman (ICE ) dan motor elektrik. Walau bagaimanapun , kenderaan ini mempunyai beberapa masalah seperti pelbagai memandu , masa aliran masuk dan kos bateri. Sebaliknya , satu kelebihan HEV adalah keupayaan untuk mendapatkan semula tenaga semasa brek dengan menukar tenaga kinetik kepada tenaga elektrik dan menggunakannya dengan serta-merta atau disimpan apabila ia diperlukan. Proses ini dipanggil brek regeneratif. Sistem anti -kunci brek - (ABS ) adalah sistem keselamatan yang membolehkan roda untuk mengekalkan geseran antara tayar dan menghalang kereta dari tergelincir terutamanya pada permukaan jalan kering dan licin. Perubahan berat kenderaan , pekali geseran jalan dan kecenderungan jalan boleh memberi kesan kepada tingkah laku sistem brek. Oleh itu , pengoptimuman sistem ABS itu perlu. Dalam kajian ini, sistem anti -kunci brek - optimum ( ABS) dengan brek regeneratif di dalam kenderaan elektrik hibrid yang dikaji. Metodologi ini terdiri daripada model matematik kenderaan, ICE dan motor elektrik , reka bentuk kawalan sistem ABS dan simulasi. Selain itu, perisian MATLAB digunakan untuk model penyelakuan.