

# ADVISOR Simulation of Electric Vehicle Performance on Various Driving Cycles

K.W. Chew, C.K. Koay, Y. R. Yong

**Abstract**—ADVISOR software is used to perform simulation on determining if the combination of ultracapacitor with lead acid battery in an Electric Vehicle (EV) would improve its overall performance. Two vehicle templates are developed to represent: 1) EV with only batteries (EVBT), and 2) EV with combination of batteries and ultracapacitors (EVBTUC). The performances of both vehicles running on the United States’ Environmental Protection Agency (EPA) Federal Test Procedure Driving Cycles are then compared.

**Index Terms**—ADVISOR, Electric Vehicle (EV), Lead Acid Battery, Ultracapacitor, EPA Federal Test Procedure.

## I. INTRODUCTION

THERE are several problems which are associated with the EV technology at the moment. The most prominent one revolves around the main energy source of the EV, which is the battery. In this paper, the battery type discussed is the lead acid battery.

The battery has a characteristic of slow charging and discharging of current. This particular characteristic leads to inefficiency in recapturing the regenerative power from the wheels of EV back into the battery pack. As a consequence, this inefficiency produces more heat to accumulate at the battery pack area and prolonged battery operation under such high temperature circumstances would shorten the battery’s lifespan.

Hence, it is proposed that the integration of ultracapacitor along with the Battery pack of the EV would improve:

- 1) The charging and discharging efficiencies of the EV;
- 2) The driving cost of the EV; and
- 3) The travel distance of the EV.

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K.W. Chew is with the Department of Electrical and Electronic Engineering, Faculty of Engineering and Science in University Tunku Abdul Rahman, Setapak (e-mail: [chewkw@utar.edu.my](mailto:chewkw@utar.edu.my)).

C.K. Koay a final year student pursuing Bachelor’s Degree in Mechatronics Engineering with Faculty of Engineering and Science in University Tunku Abdul Rahman, Setapak (e-mail: [koaychoongkhai@gmail.com](mailto:koaychoongkhai@gmail.com)).

Y. R. Yong is currently a postgraduate student from centre of vehicular technology (CVT), Universiti Tunku Abdul Rahman.

## II. RESEARCH METHODOLOGY

### A. ADVISOR



Fig. 1. ADVISOR in MATLAB Environment

The ADVISOR software is initially developed by the United States’ National Renewable Energy Laboratory (NREL) and subsequently released to the public. As of April 2014, ADVISOR is an open-source software available for download.

ADVISOR is a software used to perform comprehensive analysis of performances of a wide range of vehicles. By using ADVISOR, two vehicles are developed: 1) EV with only lead acid batteries (EVBT), and, 2) EV with combination of lead acid batteries and ultracapacitors (EVBTUC). Subsequently, both vehicles are then made to run on the EPA Federal Test Procedure driving cycles, and their performances compared.

### B. EPA Driving Cycles

The Federal Test Procedure was created by the United States’ EPA for fuel economy testing and emission certification of light-duty vehicles in the United States.

The rationale of choosing the EPA Federal Test Procedure is because it is a Transient Cycle as compared to the Modal Cycles such as the New European Driving Cycle (NEDC) and the Japanese 10-15 Mode Driving Cycle.

Transient Cycle gives better representation of real-life driving behavior as opposed to the straight acceleration and constant speed profiles of the Modal Cycle.

The EPA Federal Test Procedure Driving Cycles tested in this paper are:











