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Electronic Valve Control Team

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Front Matter

Executive Summary

Automotive consumers are demanding vehicles with more power, better gas mileage and lower emissions. These requirements have engineers looking for new technologies and designs to improve automotive combustion engines. Driving power and emission by-products are the results of the air and fuel mixture burned inside the combustion chamber. In production automobiles, the intake of the fuel air mixture and the output of exhaust gases are controlled by a mechanical valve system designed for nominal operating speeds and loads. This "set in stone" approach to valve control represents a compromise between the optimal valve settings for different engine speeds and loadings.

By controlling the valves electronically, air intake can be varied during operation to optimize power, fuel consumption and reduce emissions for all operating conditions. The EVCT (Electronic Valve Control Team) will analyze the valve control problem and engineer an electronically controlled solution for opening and closing intake valves. A single cylinder Briggs and Stratton engine will be modified to use the new electronic valve control design.

To properly design an electronic valve system to monitor, actuate and control the valves, the dynamics and forces within the engine and valve must be understood. The opening force for the valve will be measured and the valve will be weighed for inertia calculations and engine-valve system modeling. This engine-valve control system model and measured dynamic forces will be analyzed to derive requirements and specifications for the valve actuators, springs and accompanying control system.

Design and fabrication the valve actuation and control system will be completed using a simple design approach in order to limit modes of failure and cut manufacturing time. Concepts will be generated and screened until the concept with the most potential for successful implementation is selected. Using the concept and specification requirements, a valve control system will be designed using as many commercially available components as possible so that more time and effort can be used to design and manufacture new parts. The manufacturing facilities at the University of Utah will be used to fabricate the components not readily available for the valve actuation and control system.

Once the valve actuation components have been designed and fabricated, the control and monitoring circuitry and sensors will be interfaced to a computer system using a 16-bit D-link. The computer code for the control system will be written in Matlab Symulink because it provides accurate real time monitoring and control. Computer code for controlling the valve system will initially be developed using data from the engine-valve system model to emulate the original mechanical valve profile. Further refinements in the computer code to will be made, based on actual engine performance, in order to complete our team's goal of optimizing valve lift and duration for various operating speeds and loads.

Before modification, the Briggs and Stratton engine will be run on dynamometer and gas analyzer to establish baseline performance. Power output, fuel consumption and emissions will be recorded for idle and other engine speeds. Once the electronic valve control system is developed the same measurements will be repeated using the modified engine. Finally, an in depth analysis will be performed to compare the power output, fuel efficiency, and emissions of the electronically controlled valve system against the original engine valve mechanism.