

An artificial neural network (ANN) adaptive controller is designed and tested for an 8-cylinder camless internal combustion engine. The controller objective is to satisfy the desired cylinder air charge (CAC) which is equivalent to the driver's torque demand and minimize the pumping loss (PL) which is related to fuel economy. A challenging problem in the 8-cylinder engine is the estimation of the cylinder air charge which is essential for the adaptive controller operation. This problem is solved by implementing an intelligent Kalman filter based cylinder air charge estimator. Input-output data at a speed  $S = 1500$  RPM was generated for the 8-cylinder engine and used to train an ANN model for the engine. Based on the thermodynamics and ANN engine models an adaptive feedback controller is designed. The controller provides the intake valve lift (IVL) and closing timing (IVC) that satisfy the desired CAC by inverting the engine ANN model. The error between the cylinder air charge measurement from the cylinder air charge estimator and its predicted value from the ANN is utilized to update the controller's parameters recursively. The adaptation scheme keeps good CAC tracking performance over the long time horizon when the engine parts degrade, speed changes and in the presence of modeling errors.