Increasing petroleum prices and environmental concerns have caused a demand for more fuel efficient vehicles. Hybrid vehicles provide a solution to this demand, and hydraulic hybrid vehicles are shown to have a cheaper cost of ownership compared to electric hybrid vehicles. A hybrid drivetrain with a hydraulic continuously variable transmission (CVT) is modeled to include efficiency information of the engine and hydraulic components. Since the expressions comprising the model can be set as functions of a control input, which is related to the swashplate angle of the hydraulic motor in the CVT, an optimization algorithm can determine a control input that maximizes the overall vehicle efficiency allowing the vehicle to increase its fuel economy. Simulations are conducted using two driving schedules: one to represent city driving and the other to represent highway driving. Based on the results of these simulations, the hybrid vehicle produces a 1.28% increase in fuel economy over a similar conventional vehicle in city driving and a 22.62% increase in fuel economy for highway driving.