Journal of Engineering Research and Reports

20(10): 15-21, 2021; Article no.JERR.70845
ISSN: 2582-2926

Development of Optimal Design and Circular Broach Modular Design of Disc Cutters with the Development of a Parametric Model

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JERR/2021/v20i1017384
Editor(s):
(1) Dr. Djordje cica, university of banja luka, Bosnia and Herzegovina.
Reviewers:
(1) P.s.manoharan, thiagarajar college of engineering, India.
(2) B.saravanan, vsvn polytechnic college, India.
Complete Peer review History: https://www.sdiarticle4.com/review-history/70845

Original Research Article

Received 08 May 2021
Accepted 12 July 2021
Published 15 July 2021

ABSTRACT

Cutting tool is one of the most important instruments in production. It is used for machining of different components on machine tools. A material is cut into a chip to incur the desired work piece surface currently used in engineering various cutting tools. The directions of development of structures of metal cutting tools are: higher precision of dimensional and geometrical parameters, the use of new tool materials, cost, and quick. The cutting tools are not only affected by the design of machine, technology of manufacturing of products, but also impact the constructive forms of machine parts. The emergence of mechanical spine, thanks to the pull method. Spine broach can provide high-performance processing spine bore with the required accuracy. The development of heavy machine tools required the creation of new designs of large instruments. The use of mechanical automatic lines also required design tools with high dimensional stability capable of handling the items within the specified tolerance for a certain time. Instruments were developed in the process of renewing the cutting edge of the cutting tools with automatic adjustment; setting up

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tools on the size of the machine is a device for automatic replacement of worn tool in the process line of the Computer-Aided Manufacturing CAM of the cutting tool special requirements. Equipment must operate with high level efficiency, so to reduce the loss of time resetting of the need to minimal. A cutting tool requires knowledge of the theoretical foundations of design and calculation tools using CAD.

Keywords: Cutting tool; computer aided manufacturing; hydraulic hybrid system; matlab simulink.

1. INTRODUCTION

In several practices, especially those where high power densities are required, hydraulic hybrid systems can use as and serve as more efficient alternative to those driven by electric motors. Hydraulic engineering can be used to transfer maximum level of energy compared to the same sized electric Systems, which are mostly required a long period of time which batteries have to be charged. Hydraulic systems often have a longer running life span than Battery-powered systems. Like electric hybrid car, that has gas, diesel engine and battery, hydraulic hybrid Vehicle (HHV) includes a diesel engine and a Hydraulic power system, laboratory testing shows fuel economy over conventional United States Parcel Hydraulic hybrid technology has two Power sources that move the vehicle: a diesel combustion engine and hydraulic element. This technology replaces a conventional drive train with a [1] Hydraulic one, which eliminates the need for a mechanical transmission and Drive line. This vehicle can save energy from the hydraulic system, after the vehicle engine is off. This allow the vehicle to start with the energy saved, rather than relying on the engine to move the vehicle [2] to sustained fuel economy of a military vehicle or traditional vehicles, the Hydraulic hybrid technology is applied in a way it can benefit ancillary vehicle functions and enhance the mission usefulness of the vehicle are investigated as the Purpose of this project.

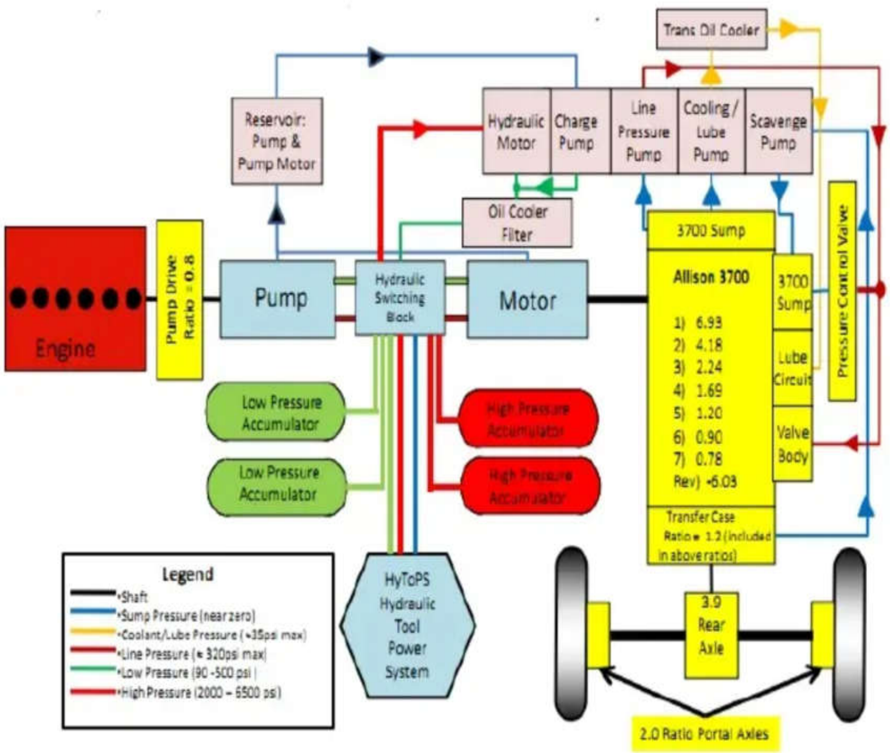

Fig. 1. Show the configuration of block diagram of the hydraulic hybrid vehicle

2. METHODOLOGY

2.1 Hydraulic Hybrid Vehicles, showing the Two Main Configurations: Parallel and Series

A hybrid vehicle combines two or more sources of power, hybrid technology is widely known as the most effective ways of solving the energy Problem. Heavy vehicles such as city buses have characteristics of high stop-and-go duty cycles and maximum force of flow in braking energy, which will be efficient for storage and reuse of the braking [1]. The additional power source can be electrical, chemical, hydraulic, flywheel operated or any other form of power storage and production [3]. In many hybrid options, the battery and the cell both have the high energy and are well suited for light vehicle. An ultra- capacitor (UC) [4] has higher power density than a battery because their operation does not apply a chemical reaction, but the high cost and lower dependability confine their application [1,5,6] as an important method of hybrid technology, hydraulic hybrid vehicles (HHV) now draw the attention of world-wide research. The first hydraulic hybrid diesel fuel city-delivery vehicle shows fuel saving by 60 to 70% and cut-down carbon discharge more than 40% in initial laboratory testing. The EPA estimated that the technology has the potential to save 1,000 gallons/year for each Urban-Delivery Vehicle [7]. In hydraulic hybrid vehicle, the hydraulic power helps the established internal combustion engine by supplying extra torque to shaft [4] The hydraulic hybrid system storage battery and hydraulic centrifugal have the potency for amending fuel saving through controlling the engine to an optimal lay-out and usage of restoring halting when slowing down When the vehicle stops, the energy come from the wheel pump liquid from low pressing storage into high pressing depot. As soon as the vehicle starts moving, the accumulator energy moves the vehicle. According to EPA Officials, this process recovers and reuses more than 70% of the energy that is unused on braking, this minimizes the brake wear by 75% and considerably savings [8,7].

2.2 Parallel

In parallel hydraulic hybrid vehicle (P HHV) uses a conventional mechanical drive train. The engine shaft is directly connected to a transmission to provide power to each wheel. The clutch is between the engine and pump/motors, so the engine can be decoupled completely from the load and powered entirely by hydraulic if enough energy is contained in the accumulator. Which reserve the engine to be off when not in use and on when the accumulator is low. Optimal engine management cannot be obtained since the engine speed is released to the wheel speed by the transmission gear ratio [9,10,11].

2.3 Series

In a series hydraulic hybrid vehicle (SHH), the mechanical drive train is removed, and the vehicle is powered by a hydrostatic drive. The shaft, which is connected to a hydraulic pump, also connected to the energy storage. [12] A series hydraulic hybrid vehicle increase fuel economy of a commercial car, and it provides independent wheel torque control. [13] There are many rules-based on controller system for 3.5 ton SHH V, with this control strategy, the SHH V offers a fuel economy improvement of 35% to 43% in comparison to the conventional vehicle. [14] The operating method of series hybrid hydraulic vehicle is based on hydraulic transformer to transmit it regenerated energy voltage. The model result shows that series was better than parallel in terms of braking of hydraulic transformer with considering the line outcome [15]. Series hybrid hydraulic and electric system (SHH ES) model was introduced for heavy-duty. The torque command scheme based on blurry logical system was suggested to reach a better result while reducing fuel intake. Applied successfully DP optimal control technique for the SHH V system. The optimal trajectories have been studied and adopted to establish implementable rule-based control strategy [16]. The procedure of vehicle transmission can accommodate grip usage in the drive measurement to befit the vehicle, the turn up, driver and the surroundings it has an important outcome on the dependability, fuel intake, ease of application, road safety and transport. The outlook of the transmission can add to the operation in which vehicle is efficient and fuel saving. The scheme we are talking about is array between second and seventh gear because the change from first to second gear is not possible when the vehicle is moving in transmission model shifting control that comprise one out of seven-speed drivetrain proportion is taken as an input, and it outputs the vehicle speed, vehicle [17] Distance, driver pedal position, current gear ratio, fuel consumption, simulation time, Motor pressure, motor displacement, motor speed and efficiency as outputs to a Compass workspace. The best scheme used for gear changing automatic transmission is build up depending on the right usage in deciding the algorithm for the best fuel saving since the transmission is no Longer driven by the internal combustion engine, the instantaneous fuel consumption cannot be computed from outputs of the contagion. The command scheme build up is to research and discover the right usable measure that can optimize fuel saving.

3. SHIFTING CRITERIA AND ANALYZE THE SHIFTING STRATEGY FOR THE TRANSMISSION

The design of a controller requires certain performance criteria to be established as objectives. The aim of the controller was to allow the gear change time that will reduce fuel intake for hydraulic hybrid truck. Unlike conventional vehicles, this truck's drive wheels are not directly attached to the internal combustion engine. Thus, the torque and the speed controlled severally from the drive speed. The IC engine must allow power to a storage sceheme, the rate at which the power is consumed does not need to match the rate of power production. When enough power has been saved, the internal combustion engine can be powered off until the stored power has dropped to some renewal level. At this time, it would have recharged the storage system. The aim of reducing fuel intake cannot depend on the engine torque and speed to prompt driving status. First, the analysis of the truck model shows that higher efficiency of the motor is obtained in a higher gear of the transmission. Therefore, the transmission should be in the highest possible gear as long as the torque demand can be met while driving. The analysis of data produced by the South west Research Institute s-function "black box model" of the hydraulic drive, the Fig. 2 display with high effectiveness for the motor displacement. Therefore, the controller should strive to keep the hydraulic Motor working near full displacement. Fig. 3-2 shows that high acceleration requires higher torque, thus requiring a lower gear. However, taking this plot into Account, the transmission should up shift to get higher motor displacement as long as the torque requirement can be satisfied. So, the highest possible gear criterion is made for this controller.

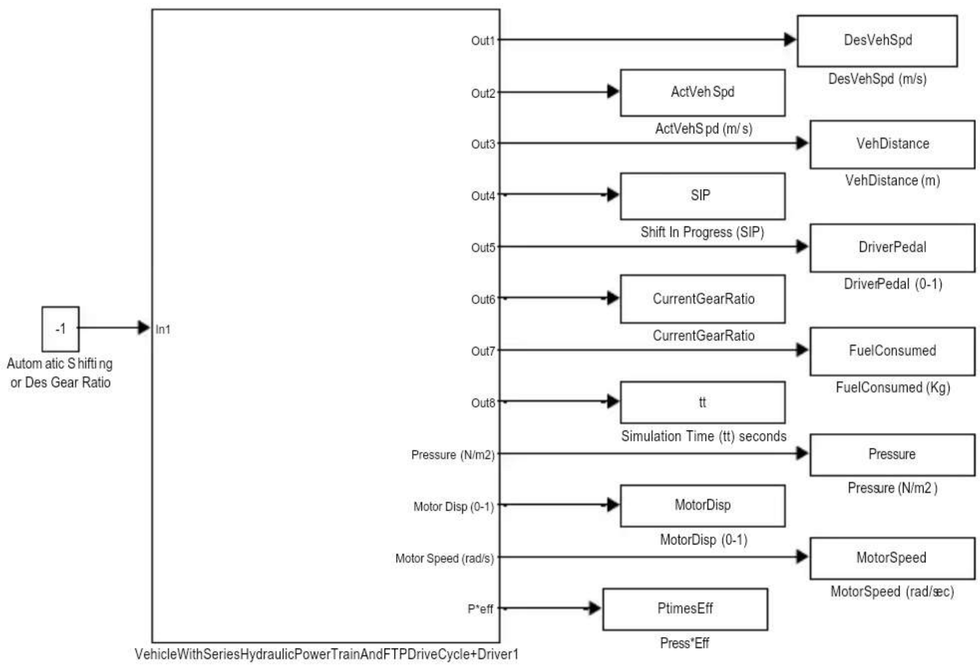

Fig. 2. Simulation block diagram of shifting strategy developed in Matlab/Simulink

4. DISCUSS THE SIMULATION RESULTS AND COMPARES THE RESULTS TO THE ORIGINAL SHIFTING MODEL SIMULATION

The model result are shown and discussed by equating it with the default gear shift schedule result include fuel consumption, tracking functioning, vehicle speed limit. The simulation runs in a 1369-second velocity-base EPA Federal Urban Driving Schedule (FUDS) with a discrete of 0.005-second sampling time.

4.1 Fuel Consumption

Fig. 4 shows that the total fuel consumption of the controller simulation is 3.7367kg, which is 5.22% less than the fuel consumption of the original shifting simulation of 3.9427kg, the number of gear in the controller simulation is 315, compared to 197 in the default simulation.

As the default shifting schedule of the original model does not include the 2 second dwell time criterion, the fuel consumption of the original model with 2-second dwell time will be more than 3.9427kg without dwell time.

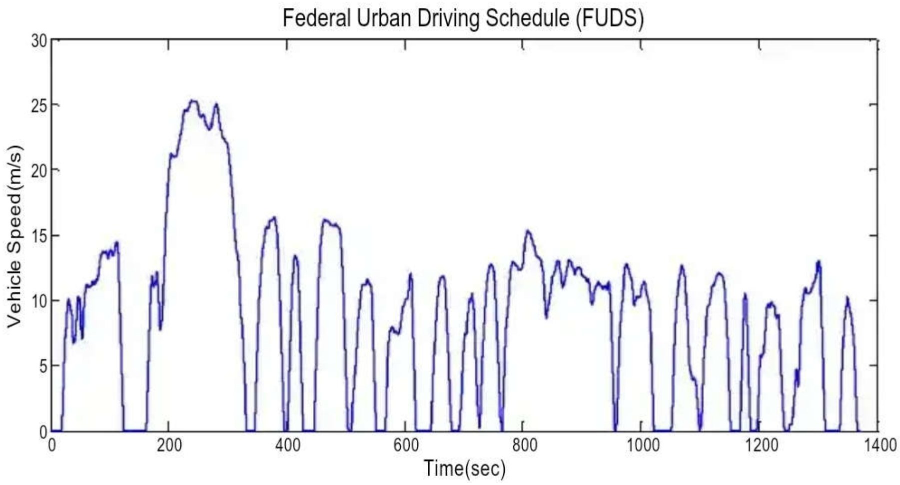

Fig. 3. EPA federal urban driving schedule (FUDS)

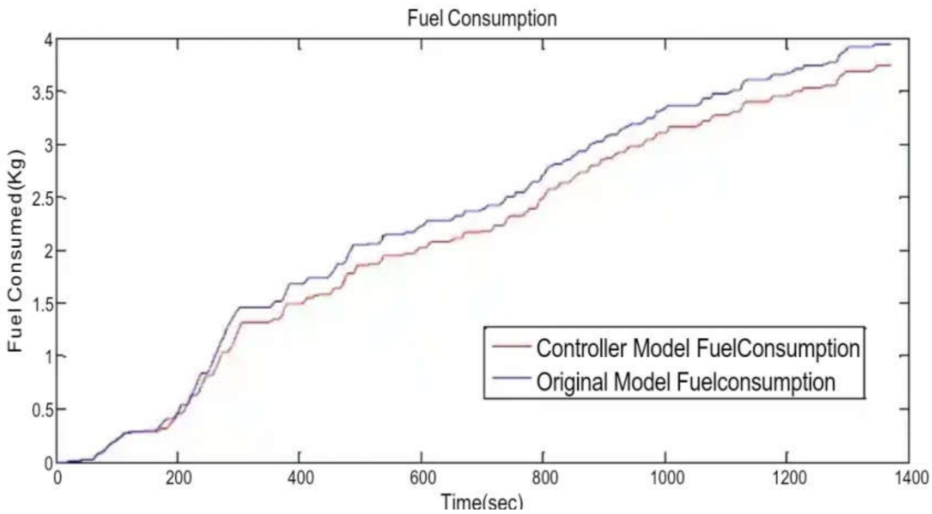

Fig. 4. Fuel consumption simulation result comparison: fuel consumption (kg) vs time (seconds)

4.2 Tracking Functioning

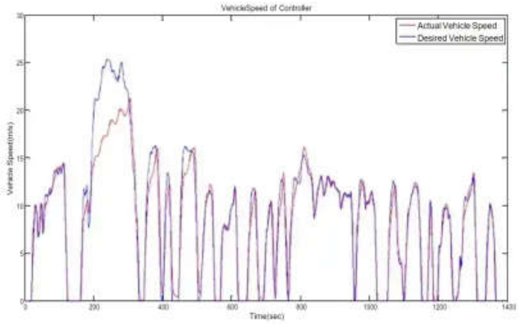

Fig. 5. controller model simulation result: actual and desire vehicle speed (m/s) vs. time (second)

4.3 Vehicle Speed Limit

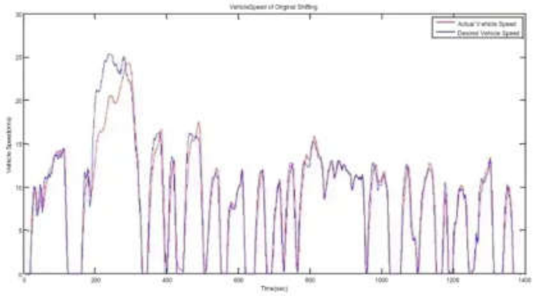

Fig. 6. original model simulation results: actual and desired vehicle speed (m/s) vs. time (second)

The combine time-based plots of actual vehicle speed (m/s) and desired vehicle speed (m/s) are depicted in Fig. 4 and Fig. 5. One exception occurs between 200 seconds and 300 seconds with a 8m/s peak value difference during the high-acceleration and high-speed period around 17m/s to 25m/s. this difference can be seen clearly from Fig. 6 which shows the error of the actual vehicle speed from both original and controller model when compared to the desired vehicle speed. The vehicle speed stays not more than 3m/s except for the period between 200 seconds and 300 seconds as mentioned before. The FUDS is used for light-duty vehicle test. Therefore the most aggressive acceleration rates might not be realistic for heavy-duty truck which account for the peak error of vehicle speed between 200 and 300 seconds.

5. SUMMARY

This paper proposes a fuel-economy optimization gear shifting strategy for a seven-speed automatic gear used on the hydraulic hybrid vehicle so as to increase fuel saving. This scheme is propose with a possible gear standard for as long as the torque demand is fulfilled aside from braking operation and torque requirement position. The strategy take various measures into account like motor displacement, better operation and fuel saving. The optimization is basis on the two area of the existing Simulink truck frame work. One Approach is based on the hydraulic motor working conditions, such as motor displacement, and the other is based on the driver's intention, which is interpreted as the driver pedal position. This controller is able to recognize the driver's intention to Change the speed and incorporate it into gear shifting decision making. Saving and functioning the analyze the result in Federal Urban Driving Cycle.

6. CONCLUSION

The simulation results show that the SIMULINK optimal gear shifting Controller model is able to increase the fuel economy by 5.22% with a 3

.73kg fuel intake compared to default changing time an also can keep the hydraulic motor by 3000RPM maximum speed when driving. The frame-work operate substantially in covering 4.68 percent distance. Difference between the actual and desired total driving distance which is less than the 5% designed standard.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/70845