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ETROLLEY AN ELECTRIC PUSH TO VEHICLES

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Abstract
This is a concept realized were a fuel driven vehicle or an electric vehicle is attached with a trolley which will carry its own weight, luggage and push the vehicle as a hybrid. The trolley fixed in the rear of the vehicle carries a battery and hub motor to drive its own wheels. The battery can be charged from a wall plug to deliver a mileage defined by the battery and the motor. It can be operated in hybrid by charging the battery from the electrical of the vehicle. This charging could be a feeble one to boost the mileage of fuel driven vehicle. In idling condition, the engine charges the battery till fuel charge. During fuel run of the vehicle, the motor is powered up to assist the engine which is Parallel Hybrid mode. Brakes applied put the motor in series operation or parallel operation in generator mode loading the wheels to charge the battery.

Keywords: IC Engine, Trolley, Sidecar, Parallel Hybrid EV, Regenerative Braking, BLDC Motor.

INTRODUCTION

Conventionally Hybrid Electric Vehicles (HEV) and Electric Assisted Vehicles (EAV) are the ones integrated with electric drive on the driven wheels. These are for personal utilities and not ready for commercial logistics. eTrolley is a concept which features fuel driven vehicle to form a convertible. eTrolley is an attachment to vehicle as a luggage carrier. It has single BLDC Hub Motor wheel. The motor is driven on a Battery placed in the trolley. Trolley has enough space to load. Its battery is chargeable from a wall plug and is facilitated with charging from vehicle power source. Vehicle charging is a feeble one and gets activated during engine idling and when no other electrical equipment is powered. This does not load the engine resulting in consumption of fuel for the purpose. This is called survival power by bringing in Governor action [1]. Energy delivered to the battery is stored till it is used by the trolley motor [2]. The trolley is enough powerful to push the vehicle and also carry a load of 100Kg. This can be used as electric vehicle when run without load. This is detachable trolley to use vehicle for personal utility.

When it comes to applications the concept can be fabricated according to user specific eTrolley. This can be proposed with three applications. Electric Trolley as Luggage Carrier, Electric Trolley as Side Car, Electric Trolley as Ambulance and Mobile EV charging station are described.

CONCEPT

A Trolley dragged by a vehicle definitely delivers load on the vehicle engine resulting in increase of fuel burn. This also reduces free run range which is due to added friction by the trolley. An effort in releasing this load from the engine will compensate its weight from the drag. Above that once there is push from the energy delivered by trolley wheel, the vehicle fuel burn reduces. Energy delivery of the trolley wheel depends on the vehicle speed. At each speed and load experienced by the trolley motor is tuned to reach the speed of vehicle. This can be monitored through the current delivered to the wheels to coup up to

the speed of vehicle. Once the wheel speed reaches vehicle speed the motor current increases indicating load is carried by the trolley and starts pushing the vehicle. As it reaches vehicle speed current draw by the motor starts decreasing. Controller is designed to tune the load current. Motor controller is tuned to reach zero current which delivers assistance to the vehicle. During braking the motor is switched to operate as regenerative braking [3].

ELECTRIC TROLLEY AS LUGGAGE CARRIER

A Chassis with hub motor fixed to it is a mechanical frame carrying a cabin. Hub Motor is BLDC driven by a battery seated in the lower part of the cabin. Upper part of cabin is for carrying load. This is made of light weight material and the frame made of hollow pipes to reduce overall weight of the trolley.

Fig.1 Trolley having a stand and hook to sling on the vehicle back

Fig.1 is only an illustration of the proposed eTrolley. The actual may be much smaller and shaped to sling on to a vehicle chassis. This carries a hub motor of the capacity 600W to carry 100 Kg of weight in the trolley. This can reach a maximum speed of 40Km/H.

ELECTRIC TROLLEY AS SIDE CAR

This is a chassis built over BLDC Hub Motor. The chassis is designed to carry a bucket seat with front glass to protect the rider from dust.

Fig.2 Electric trolley as side car

Fig.2 is a side car framed to attach on the side of the vehicle. Its BLDC Hub Motor is powered to assist the vehicle. The 600W motor carries 100Kg load weight. Its chassis is a simple frame made of round

pipes to make the trolley less in weight. This can reach a maximum speed of 45Km/H.

ELECTRIC TROLLEY AS AMBULANCE

This is a chassis carrying a cabin with top opening door. Front glass protects from dust, rain and wind. The cabin carries a bed to lay the patient. A rack on top takes the medical equipment to support the patient.

Fig.3 Ambulance Electric Trolley

Fig.3 indicates the ambulance electric trolley. This is on a 600W BLDC motor with a carrying capacity of 100Kg. This can reach a maximum speed of 35 Km/H on electric drive. It is a heavy structure on one wheel taking a side support of vehicle as in sidecar.

MOBILE EV CHARGING STATION

This a futuristic step towards rendering services to the Electric Vehicles. Battery life is limited and within that time battery delivers lesser run per charge. This is an attempt to prepare for the situation knocking at the doors of EV users.

Fig.4 Mobile EV charging station

Electric vehicles need wall plug power to get charged. A two wheeled chassis built over two BLDC hub motors with a cabin to seat 5KVA generator is built. The chassis is heavy load carrying a battery bank [4]. Two BLDC motors of 600W each are electronically differential controlled to push the vehicle. This can carry a weight in trolley upto 250Kg and take a maximum speed of 50Km/H.

FUZZY LOGIC ROLE AND REDUNDANCY

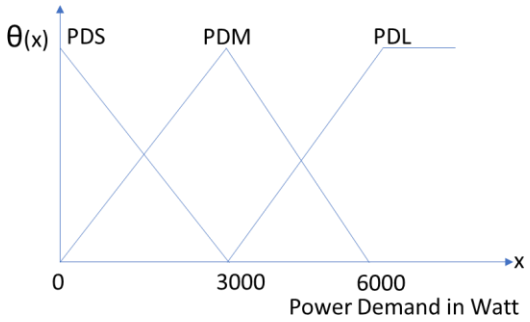
In Parallel operation of engine and Motor by sensing speed of the vehicle power delivery to hub motor is derived

FUZZY LOGIC OF PARALLEL HEV:

Power Demand:

PDS – Small Demand PDM – Medium Demand

PDL – Large Demand {PDS, PDM, PDL}



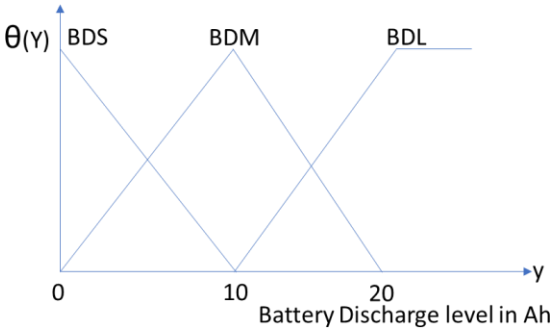
$\theta_{PDS}(x) = 3000 - x/3000 - 0$

$\theta_{PDM}(x) = x - 0/3000 - 0 \quad || \; \theta_{PDM}(x) = 6000 - x/6000 - 3000$

$\theta_{PDL}(x) = x - 3000/6000 - 3000$

Drive Battery Status:
BDS – Small Discharge BDM – Medium Discharge BDL – Large Discharge {BDS, BDM, BDL} Defining Battery discharge range, Membership Function of the input variables. We use Triangular Membership Functions.

Range for Speed (40 to 60):
BDS: 0 to 10 BDM: 0 to 20 BDL: 10 to 20

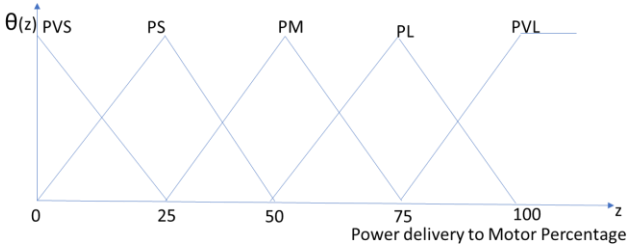


$\theta_{BDS}(y) = 10 - y/10 - 0$

$\theta_{BDM}(y) = y - 0/10 - 0 \quad || \; \theta_{BDM}(y) = 20 - y/20 - 10$

$\theta_{BDL}(y) = y - 10/20 - 10$

Membership function for Power delivery to Motor Percentage:
A power governing action takes place to deliver only the required power to the motors and effectively carry the wheel load.
PVS: 0 to 25 PS: 0 to 50 PM: 25 to 75 PL: 50 to 100 PVL: 75 to 100.



$\theta_{PVS}(z) = 25 - z/25 - 0$
$\theta_{PS}(z) = z - 0/25 - 0$ || $\theta_{PS}(z) = 50 - z/50 - 25$
$\theta_{PM}(z) = z - 25/50 - 25$ || $\theta_{PM}(z) = 75 - z/75 - 50$
$\theta_{PL}(z) = z - 50/75 - 50$ || $\theta_{PL}(z) = 100 - z/100 - 75$
$\theta_{PVL}(z) = z - 75/100 - 75$

RULE BASE FOR POWER DELIVERY TO MOTOR PERCENTAGE:

POWER \ BATTERY	BDS	BDM	BDL
PDS	PVS	PS	PM
PDM	PS	PM	PL
PDL	PM	PL	PVL

PERFORMANCE

Power delivery to the wheels is from Battery depends on the vehicle speed. Both the rotational sources are in parallel as per running conditions of the vehicle. The motor added on the trolley first kills friction with minimum expenditure of stored energy. Secondly this stored energy is derived by avoiding frictional losses due to braking [5]. These two energy captures serve smoothening the vehicle run and saving the fuel burn. Terrine conditions impeding the performance of the engine is avoided. This gives a better health and life to the engine since the engine experiences assistance to carry load [6]. Fuel consumption falls drastically.

CONCLUSION

Fuzzy logic caters a fast and accurate tuning of energy sources. Motors and the engine perform to give a better driving conditions, faster pick up and most importantly it saves huge amount of fuel being burnt for its own survival. Efficiency with respect to conventional vehicles is much higher.

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