

## Improving the efficiency of Luna moped by using Variomatic clutch transmission

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**Abstract:-** Nowadays, automakers have invested in new technologies in order to improve the efficiency of their products. Variomatic clutch transmission provides Luna moped with the ability to change the gear ratio continuously, which can then improve not only ride quality such as acceleration performance but also fuel-efficiency. However, to take advantage of the ability, a control system that can precisely neglect the gear system requirement. In this work study the performance of a two wheeler vehicle by using Variomatic clutch system is done. Study the working of Variomatic clutch transmission system in two wheeler vehicles to increase its speed and improve its efficiency by reducing drawbacks.

**Keywords:-** Automobiles, two wheeler, transmission system, control system, efficiency, Luna, Variomatic clutch transmission.

### I. INTRODUCTION

One of the main choices of a buyer nowadays at a time of buying a vehicle is transmission system used in the vehicle type of engine, and also the manufacturer of vehicle. There are many types of transmission in the world among them three are very famous:-

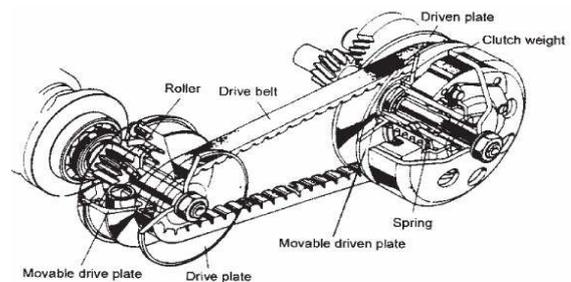
1. Manual transmission
2. Automatic transmission
3. Continues variable transmission (Variomatic clutch transmission)

But automatic transmission and Variomatic clutch transmission provides better handling compared to manual transmission where the driver don't need to shift the clutch manually using a gear knob. Therefore, a lot of buyer nowadays chose a car with automatic transmission and Variomatic clutch transmission compared to the car with manual transmission. Variomatic clutch transmission system is mostly used in different vehicles. It can work to keep engine at optimum power range and simply raises and lowers the engine speed as needed.

**Variomatic Clutch Transmission (VCT)** is the steeple, fully automatic transmission of the Dutch car manufacturer DAF, originally developed by Hub van Doorne: this consists of a "V" shaped drive belt and two pulleys, each of two cones, whose effective diameter can be changed so that the "V" belt runs nearer the spindle or nearer the rim, depending on the separation of the cones. These are synchronized so that the belt always remains at the same optimal tension

### II. HISTORY

It was the first commercially successful continuously variable transmission. In theory, this always produces the optimum torque. The Variomatic



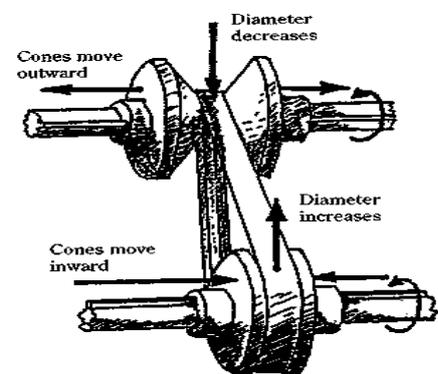
was introduced by DAF in 1958, also putting an automatic gear box in the Netherlands for the first time. The Variomatic was introduced on the DAF 600.

### III. HOW VARIOMATIC CLUTCH TRANSMISSIONS WORK.

- The purpose of Variomatic clutch transmissions-to vary the transmission ratio continuously.
- Variomatic clutch transmission vary the radius of the contact point between two rotating objects, thus the tangential velocity;
- Hydrostatic Variomatic clutch transmissions vary the fluid flow with variable displacement pumps into hydrostatic motors.
- Variomatic clutch transmission improves efficiency by allowing the engine to operate always in its optimum R.P.M., whatever the vehicle's speed.

**OPERATION:** Differential: With the DAF 600 - 55 each rear wheel was propelled individually by a pair of conical drums and drive belt with the effect of a limited slip differential. If a drive wheel on slippery road revs up, the other wheel can still transfer the full torque. This results in unusually good traction characteristics, which were also a reason for successes of the DAFs in rallies. There were several disadvantages that accompanied the lack of a true differential gear. Although each belt could settle into its optimum position, thus allowing for wheel speed variation, the system was slow to operate and depended on the pulleys being turned. This led to rapid tire wear and placed stress on other transmission components.

**Gear ratio:-** The final drive has two pulleys with moveable conical drums. The distance between the drums is controlled by the engine vacuum in the inlet manifold and engine RPM, through centrifugal weights inside the drums. Between the two pulleys runs a drive belt. As a result of change in the distance of the conical drums in pulleys, the diameters and so also the reduction ratio changes continuously.



### IV. USE OF VARIOMATIC CLUTCH TRANSMISSION

- Many small tractors for home and garden use have simple rubber belt Variomatic clutch transmissions.
- Some combine harvesters have Variomatic clutch transmissions. The Variomatic clutch transmission allows the forward speed of the combine to be adjusted independently of the engine speed.
- Variomatic clutch transmissions have been used in aircraft electrical power generating systems since the 1950s and in SCCA Formula 500 race cars since the early 1970s.
- Some drill presses and milling machines contain a pulley-based Variomatic clutch transmission where the output shaft has a pair of manually-adjustable conical pulley halves through which a wide drive belt from the motor loops.
- This gap width thus adjusts the gearing ratio between the motor's fixed pulley and the output shaft's variable pulley.

## **KINETIC LUNA:**

Kinetic Luna is the brand which is credited with heralding the advent of personalized transportation in India. Way back in 1972, when Luna was launched, it brought an era which is still progressing.

### **Body detail of Luna:**

The moped has stylish body lining and appealing colors which helps end users to make Kinetic Luna their choice. Salient features of Kinetic Luna include Kick start, Rugged boxed steel body in black and shiny chrome, light weight, easy to handle and pedal kick starts.



### **Control:**

Since its inception, Luna has been known for the convenient ride and negligible maintenance cost. It served as a ubiquitous mode of transportation in rural Indian hinterland. Over the years, the Luna has undergone changes so as to keep pace with the changing times. Its strong chassis, decompression lever for easy pedal start, larger fuel tank etc. have made the moped more user friendly.

### **Engine**

Kinetic Luna TFR has 59.57 cc engines that produce maximum output of 1.67 HP @4500 + 500 rpm and maximum torque of 2.9 Nm @ 3000 rpm. Kinetic Luna Super has 59.57 cc engine which churns maximum output of 2.94 HP @ 6000 + 250 rpm and maximum torque of 4.2 Nm @ 4000 rpm.

## **V. TYPES OF VARIOMATIC CLUTCH TRANSMISSION:**

- The first patent for a friction-based belt Variomatic clutch transmission.
- Zenith Motorcycles built a V2 engine motorcycle with the Gradual-Gear.
- Rudge-Whitworth built the Rudge Multigear.
- Van's Variomatic clutch transmission, the DAF 600, was produced in 1958.
- The Ford CTX was developed by Ford, Van Doorne, and Fiat, with work on the transmission starting in 1976.
- Nissan's n-Variomatic clutch transmission based on the Fuji heavy industries Variomatic clutch transmission.
- Honda City Variomatic clutch transmission.
- Power Split Transmission (PST).
- Identical ZF Variomatic clutch transmission.
- Chain-driven Variomatic clutch transmission also known as the CFT30.

## VI. ADVANTAGES

- The main advantage of Variomatic clutch transmissions is that they allow an engine to run at its ideal rpm regardless of the speed of the vehicle.
- Automotive Variomatic clutch transmission's generally attempt to balance both of these functions by shooting for efficiency when the driver is only applying light to moderate amounts of accelerator.
- Engines do not develop constant power at all speeds; they have specific speeds where torque (pulling power), horsepower (speed power) or fuel efficiency is at their highest levels.

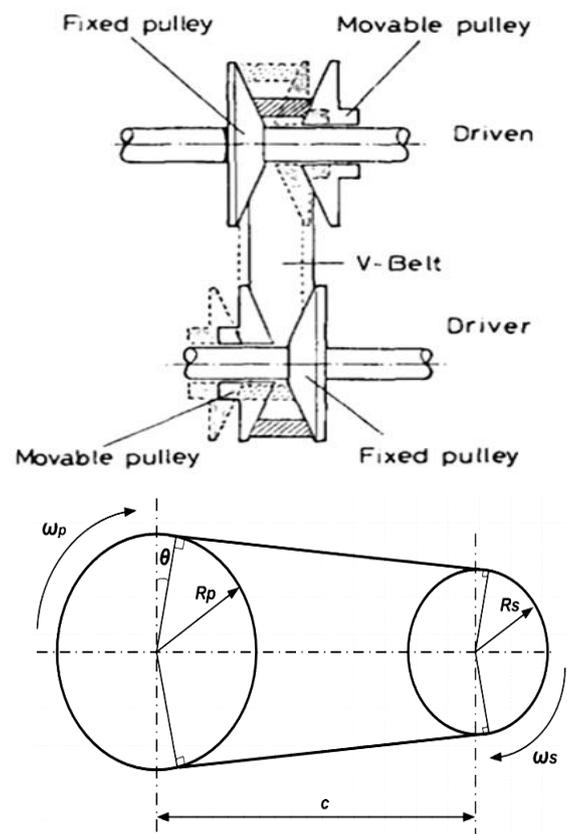
## VII. DISADVANTAGES

- VARIOMATIC CLUTCH TRANSMISSION torque-handling capability is limited by the strength of their transmission medium (usually a belt or chain), and by their ability to withstand friction wear between torque source and transmission medium.
- Some Variomatic clutch transmissions transmit torque in only one direction, rendering them useless for regenerative or engine-assisted vehicle braking; all braking would need to be provided by disc brakes, or similar dissipative systems.
- The Variomatic clutch transmission's biggest problem has been user acceptance.

## VIII. LITERATURE REVIEW

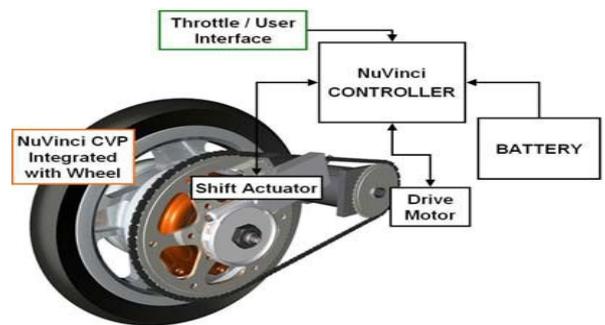
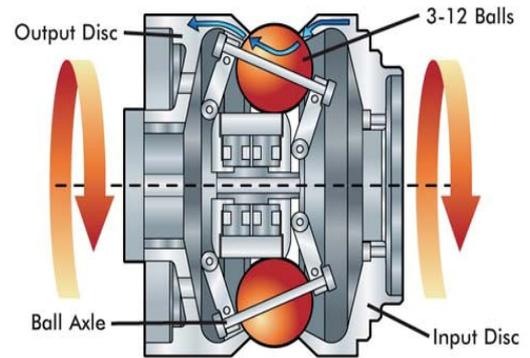
**Nur Cholis & Sugeng Ariyono** had designed a single acting pulley actuator Variomatic clutch transmission which utilizes combinations of DC motor system, gear reducers and power cam mechanisms to actuate primary movable pulley sheaves on the transmission shaft. Since the methods of controlling these are similar, this paper only discusses the primary part. The servomotor regulates the axial movement of primary movable pulley sheaves to shift the rubber v-belt placed between the sheaves, and change the belt-pulley contact radius.

Therefore, we can say that it is an integral part of the V-belt Variomatic clutch transmission system design to obtain an accurate relationship between the axial force and torque load for given speed ratios. After this study they have conclude that simulation results has significantly improved the performance of the conventional PD controller to complete 75.08 rotation of cam from lower gear ratio to top gear ratio is less then 6.79sec,in term of percentage overshoot and steady state error both perform well for the Single Acting Pulley actuator Variomatic clutch transmission system utilizes.



**Carter, Jeremy & McDaniel** has optimized Performance and Efficiency of Two-Wheeled vehicle by using Variomatic clutch transmission and stated that the power train of a simple electric vehicle is comprised of the power source device. Many electric vehicles operate in a direct-drive configuration, where the speed of the vehicle is directly linked to the speed of the drive motor. An electric vehicle power train is not unlike a conventional automotive internal combustion engine power train; that is, the individual components and complete system have different efficiencies and performance characteristics at different motor speeds and load conditions.

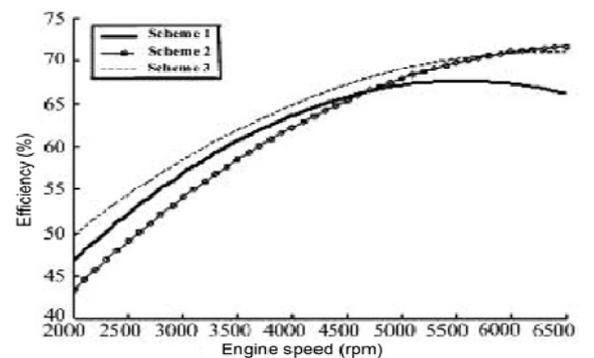
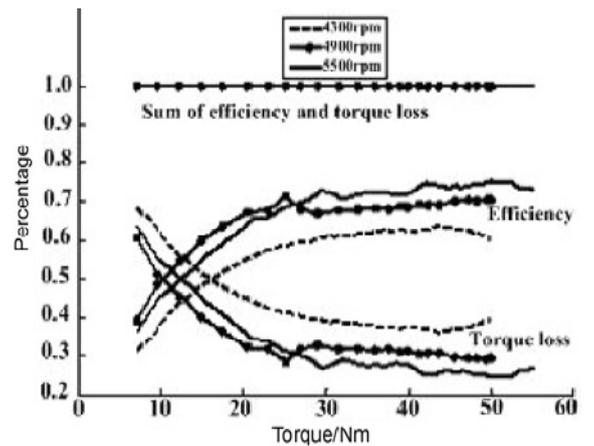
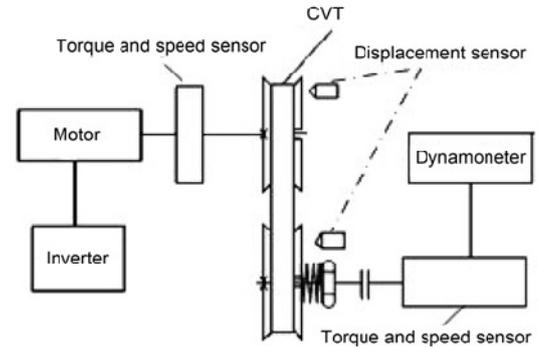
The test vehicle for this program was the 2006 model Currie IZIP1000 36 volt scooter. Both vehicles retained the stock motor and sprockets. Three control batteries were used for all tests. The final result of their conclusion was improvements in acceleration performance and hill climb capability. The 0-16kph and 0-19 kph times both yielded a 38% improvement with the CVP and control system. Additionally, the time to complete the hill climb test was reduced by 20%, and there was a 24% increase in average speed.



**D. Rockwood & N. Parks** stated a research on a continuously variable transmission for efficient urban transportation and started Finding solutions for efficient modes of urban transportation is becoming more pressing given concerns over fossil fuel depletion and climate change. Human powered vehicles can play a role in overall urban transport solutions. Of such vehicles, the bicycle has met with the most overall popularity given that it is fairly lightweight, man oeuvre- able, inexpensive, and efficient to operate. The invention of the bicycle has allowed the relatively efficient human locomotion to be implied. A 73 kg bicyclist expends approximately 292 calories travelling 1h at  $16 \text{ km h}^{-1}$ . Exercise is also beneficial to human health and wellbeing, and has shown to reduce costs in the health care industry and at the end then found that the experience of engine drive users promises to be enhanced over existing transmission solutions by being lighter, safer, and intuitive to use, and allow more efficient operation. In addition, those desiring to gather more information about their rides such as those on exercise regimens or those participating in cycling sports would benefit from the data harvesting and communications functions incorporated into the drive.

**C. Zhu, H. Liu, j. Tian, Q. Xiao and X. Du**  
 Efficiency experiments of CVTs are conducted on a specific test bench. A dynamometer is used to provide a load transmitted with a 200-Nm maximum torque capacity, while the power is provided by a variable-frequency motor with a 110 kW maximum power, as shown in Figure. Because speed loss contributes to less than 4% of the total power loss in most operating conditions for the CVT, only torque loss is considered in this study. Figure shows variation of efficiency and the torque loss as the load increases, with a constant input speed 4300 r/min, 4900 r/min, and 5500 r/min respectively. The trend tends to mitigation with respect to a load big enough. Moreover, given a constant torque, the efficiency grows with increasing input speed.

The power loss of a rubber V-belt CVT was analyzed, following the introduction of CVTs' working mechanism. The torque loss accounts for the majority of power loss in most operating conditions, which mainly consist of belt hysteresis loss and belt radial motion loss. The experiments of efficiency from different operation conditions and varied components of the clutch were done on a test bench. Results show that there is potential efficiency improvement by tuning engagement speed, shift speed, load condition, ratio range controlling, and parameters changing the component of CVTs. Moreover, by structural improvements in both driving and driven pulleys, and the development of high strength belt, the rubber belt CVT will finally be eligible for a wider automotive application.



## IX. CONCLUSION

At the end of this paper it has been concluded that continuous gear ratio plays a vital role in improving the efficiency of any vehicle. Today, half of the vehicle in the world runs with the help of Variomatic clutch transmission and it will increase in near future. Using Variomatic clutch transmission system in Luna moped may bring major changes in the vehicle. Removing the centrifugal clutch transmission system and implementation of Variomatic clutch transmission system is done and at the end study on specific dimension and readings is taken. After all this process done it has been observed that Luna moped has increase efficiency and improvement in model is seen. By using rubber belt there is a great advantages seen in the

Luna. Efficiency increases in Luna by using the runner belt as it gives more friction and slip less operation in Variomatic clutch transmission.

## X. REFERENCES

### **JOURNAL PAPERS**

1. Design of single acting pulley actuator continuously variable transmission by Nur Cholis, Sugeng Ariyono, Gigih Priyandoko.
2. Conversion of a heavy duty truck diesel engine with an innovative power Turbine connected to the crankshaft through a continuously variable transmission to operate compression ignition dual fuel diesel-LPG by Alberto Boretti.
3. A continuously variable transmission for efficient urban transportation D. Rockwood N.Parks, D.Garmir.
4. Experimental investigation on the efficiency of the pulley-drive cvt by c. zhu, h. liu, j. tian, q. xiao and x. du.
5. A review on belt and chain continuously variable transmissions Dynamics and control by Nilabh Srivastava, Imtiaz Haque.
6. Fuel consumption of a vehicle with power split CVT system by Giacomo Mantriota.
7. Design of Continuously Variable Transmission with Metal Pushing Belt and Variable Pulleys by E. Maleki Pour S. Golabi.
8. Use of a Variable Transmission to Optimize Performance and Efficiency of Two-Wheeled Light Electric Vehicles by Carter, Jeremy , McDaniel, Loren , Vasiliotis, Christophe

### **BOOK**

1. R.S. khurmi “Kinematics of machine” 4<sup>th</sup> edition, 2009, S. Chand publication.
2. A comparative study and application of continuously variable transmission to a single main rotor heavy lift helicopter by Sameer Hammer

### **WEBSITE**

1. Nissan Gloria Lineup. Nissan Official Website. 2003, Nissan Motors Corp. Tokyo, Japan. <http://www.nissan.co.jp/GLORIA/Y34/0112/LINEUP/index.html>.
2. [http://www.ritzsite.demon.nl/DAF/DAF\\_cars\\_p9.htm](http://www.ritzsite.demon.nl/DAF/DAF_cars_p9.htm)
3. [www.google.com](http://www.google.com)
4. [www.bikesandcars.com](http://www.bikesandcars.com)
5. [www.googleimage.com](http://www.googleimage.com)
6. [www.tvstwowheeler.com](http://www.tvstwowheeler.com).