IDENTIFYING THE FLOW PROCESSES IN HYDRAULIC CONVERTER AS PUMP WITH VARIABLE FLOW

[1]Aron-Adrian Petric*, [1]Gheorghe-Alexandru Radu, [1]Bogdan-Comanica Danila, [1]Sebastian Radu, [1]Ionut Tudor Soare

[1]Transilvania University of Brasov

KEYWORDS - Hydraulic-hybrid, Propulsion system, Hydraulics

ABSTRACT - Hydraulic Converter is an alternative to conventional pumps with variable flow which is affected by variable efficiency and constructive complexity. The objective of the paper is implementation of hydraulic converter, as pump with variable flow applied to hydraulic-hybrid propulsion system adapted for hybrid vehicle.

Hydraulic hybrid propulsion system has in his structure, components made from relatively simple and well-tuned processes of common materials with relatively low cost compared with other components of hybrid vehicles. Hydraulic-hybrid vehicle is very efficient in recovering hydraulic energy, storage and conversion to mechanical energy. A disadvantage of the hydraulic hybrid propulsion systems is bound to efficiency less than mechanical transmissions. For this reason it is investigating ways to increase hydraulic efficiency, for example hydraulic pumps and motors with variable flow whose efficiency is high. Functional features of hydraulic systems enable optimized solutions for primary energy sources. One direction is hydraulic converter.

Accessed work is done in a simulation of the operation of a hydraulic converter which generates the necessary of hydraulic energy to hydraulic-hybrid propulsion system and then are compared with variable flow hydraulic pump efficiency to that of hydraulic converter. The method of analysis used in the simulation achieve hydraulic converter is AMESIM. The analysis in this paper is the hydraulic converter. The work presents the flow processes in hydraulic converter for various constructive variants and operating modes.

INTRODUCTION

Constantinescu power transmission mechanism, which the author called it “the converter”, stirred great interest on the world of field specialists and mainly for automotive industry, towards the end of year 1923. There is a mechanical and a hydraulic converter.

Gogu Constantinescu states that problem is not the “brutal” gear box and some upgrades of the mechanism with infinite gear ratios, but between a highly efficient such as the manual gear box run by the mental effort of an intelligent driver and an automatic power transmission mechanism that can achieve at least what an intelligent driver with a manual gear box or even better performances.

Finally the new class of mechanisms, the Constantinescu’s convertor, which is a device used to transmit power automatically from the internal combustion engine or any other primary engine which outputs a limited torque on the secondary shaft; torque and rotational speed of the secondary shaft varying between large limits.

THE CONVERTER WITH HYDRAULIC FLUID RESERVOIR AND A RATCHET ACTUATING MECHANISM

This type of converter is important to speak about because of the construction and simplicity that it involves. We can notice that the pressure from the hydraulic system is the highest in the hydraulic motor, reasons why we had chosen for the graphic representation of the hydraulic pressure the pressure from the hydraulic motor. In this case vital to improve performances was to reduce the pressure in the hydraulic system, which we tried in the previous model, or, in this case to eliminate the hydraulic motor.

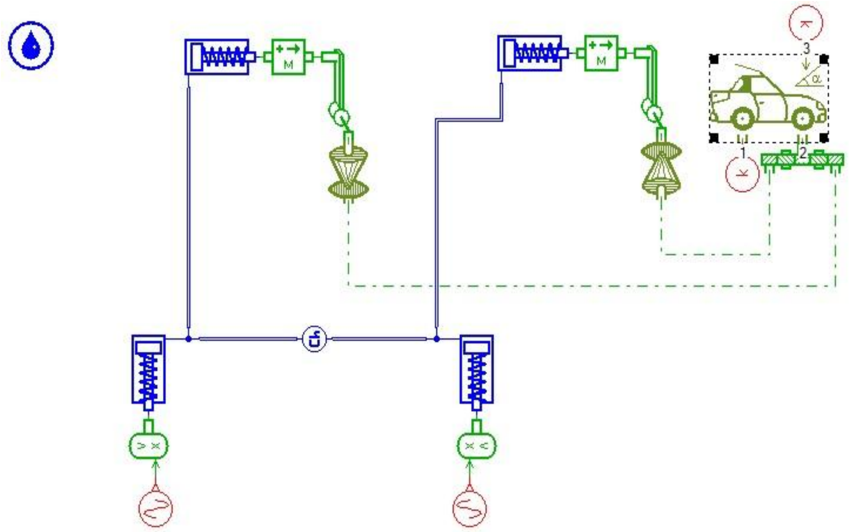

Figure 1 The hydraulic converter with reservoir and one-way mechanisms

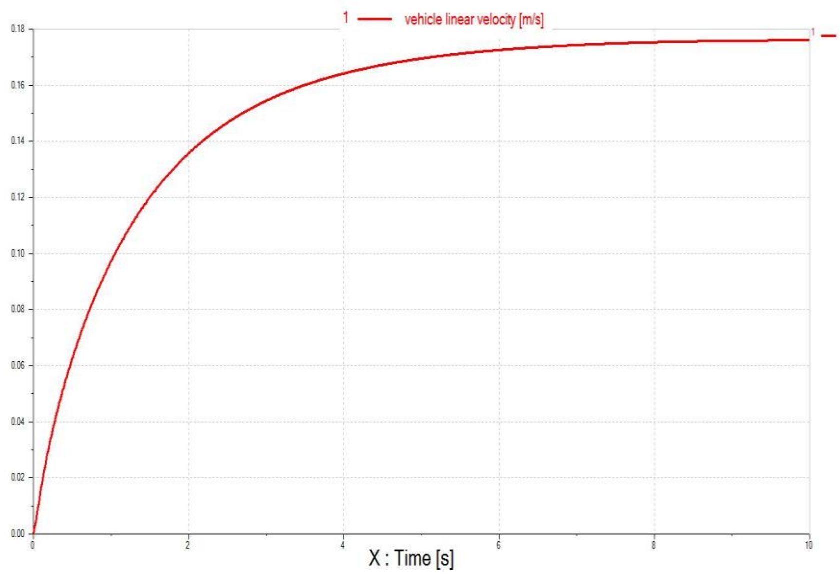

Figure 2 Velocity of the reservoir converter with one-way mechanism

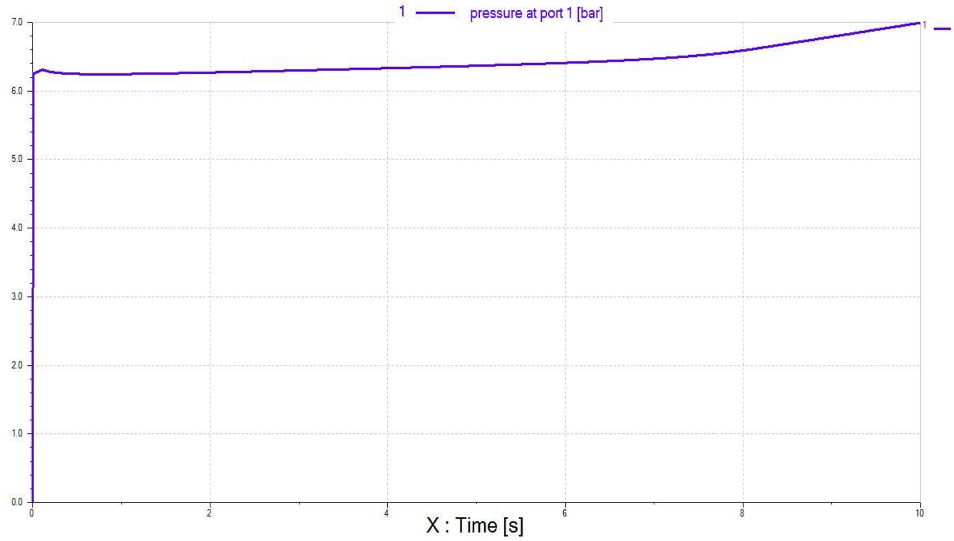

Figure 3 Pressure of the reservoir converter with one-way mechanism

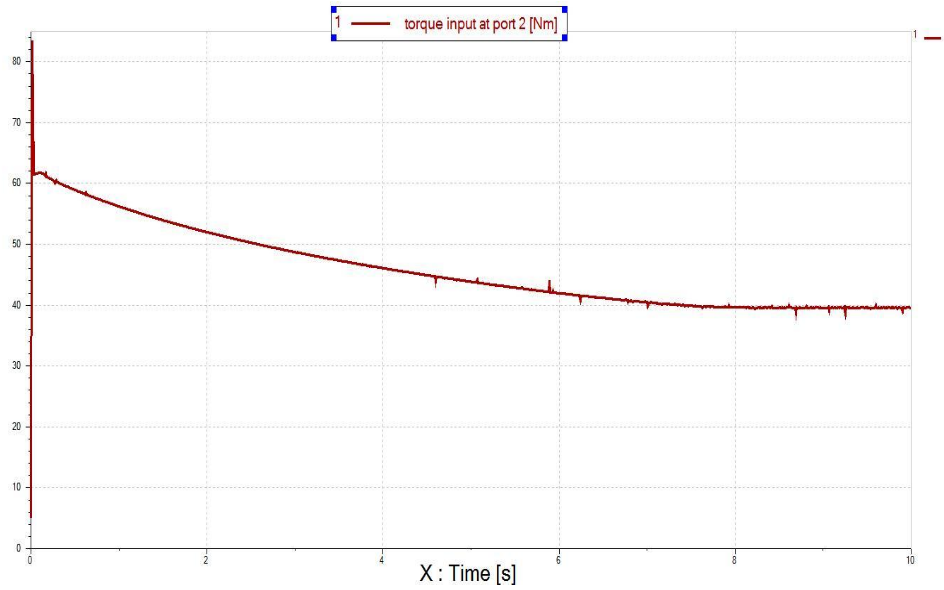

Figure 4 Torque of the reservoir converter with one-way mechanism

One can observe that the velocity of this raw setup of the converter is very small, the value maximum 0.18m/s is very small for a dynamical characteristic for vehicle in a time of 10 seconds. A good thing is the linear uprising behavior of the velocity, which in many case we had a sinusoidal behavior of the parameters, including pressure and acceleration.

The pressure diagram of this model is taken from the junction point of the pipe coming from the reservoir, the pipe coming from the actuation piston and the pipe going to the actuated piston which in its turn transmits the power to the mechanical arm. The mass between the piston and the mechanical arm is put to be able to connect the piston to the arm; it has a very small mass, which is to be neglected in order not to disturb the system.

As one can notice the pressure is very small also comparing to the pressured obtained in the previous versions of the converter. A value of maximum of 7 bars developed by the hydraulic system is very low for a sonic oscillating system. We can observe also from the pressure diagram that there is no oscillation of the pressure, meaning that the sonic phenomena does not occur, which explains the low pressure and the weak dynamic performances of the vehicle.

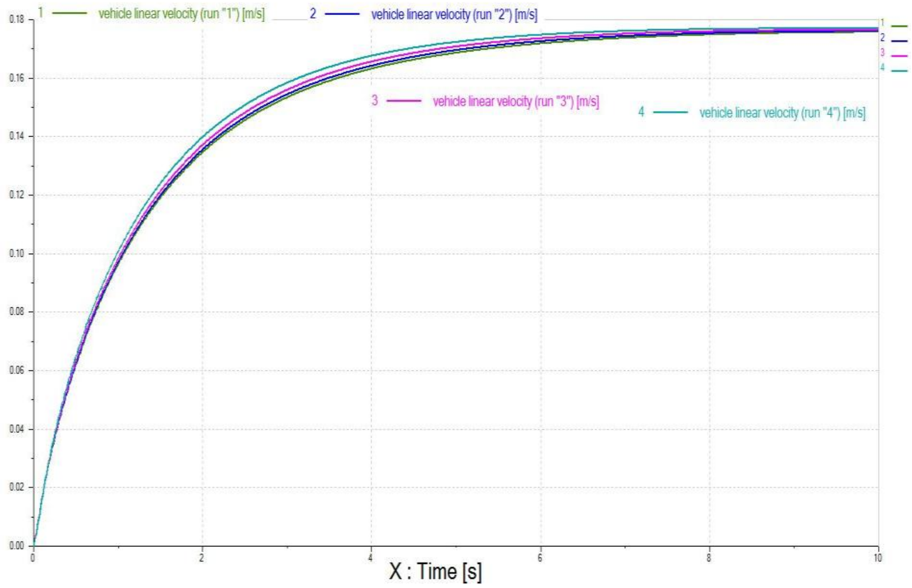

Figure 5 Velocity of the reservoir converter, batch of values for the volume of the chamber

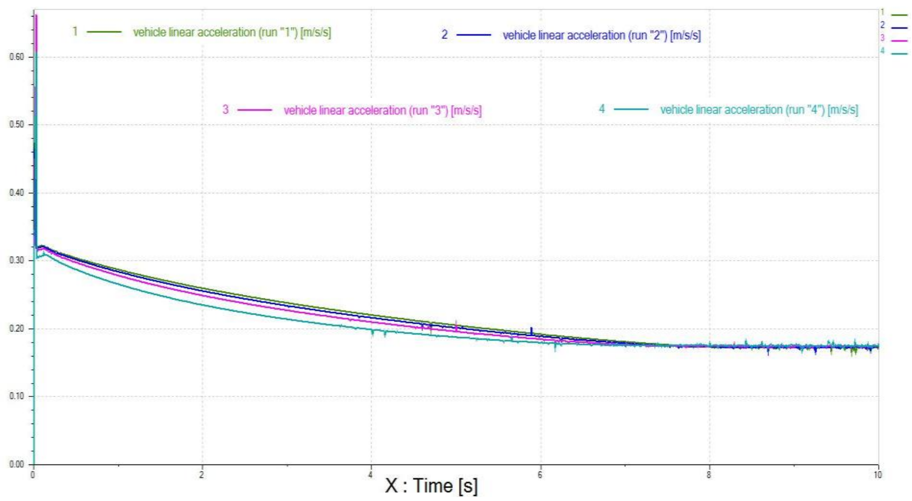

Figure 6 Acceleration of the reservoir converter, batch of values for the volume of the chamber

Easy to observe from these charts, that the influence of the volume of the pressure chamber, has very small importance upon the behavior of the converter. The velocity has no improvement compared to the previous chart. The acceleration of the vehicle is very small, of under 1m/s. The torque and pressure have no noticeable changes from the previous model either.

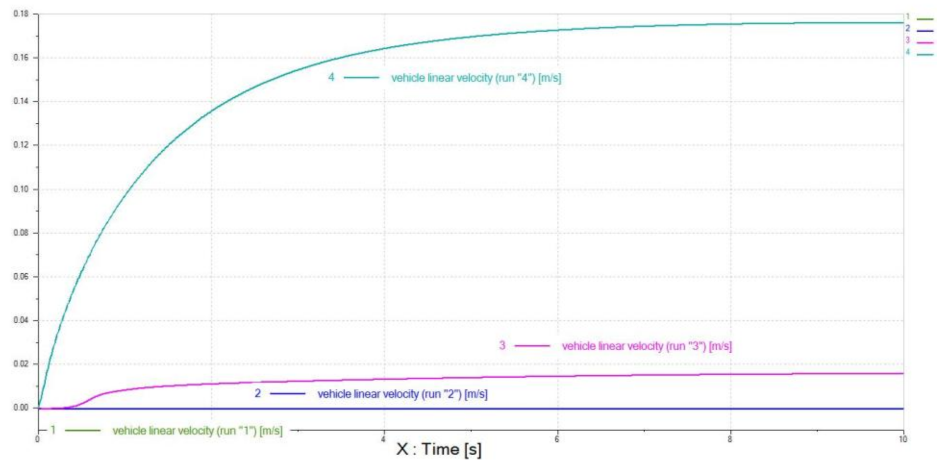

Figure 7 Velocity of the reservoir converter, batch of values for the frequencies

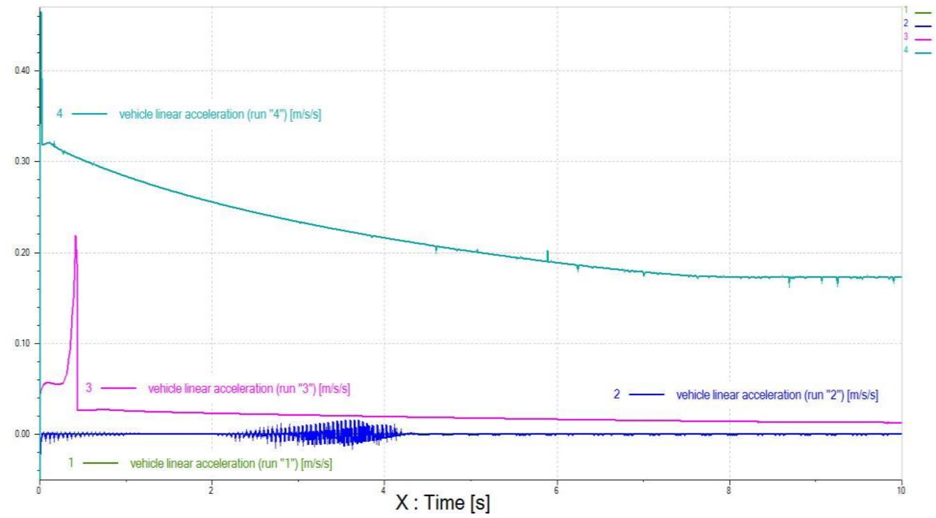

Figure 8 Acceleration of the reservoir converter, batch of values for the frequencies

These previous charts presented here are the result of simulation with batch of frequencies, in order to see the influence of the frequency on the dynamic performances of this converter. The values of the batch of frequencies are:

1. 10Hz. 2. 30Hz. 3. 50Hz. 4.100Hz.

As one can see the frequencies have a big influence on the performances of the vehicle, where the frequency of 10Hz is no were to see on the charts, only the one of 30 Hz starts to be noticeable on the chart. The 50Hz frequency has significant improvement compared to the previous two, but the main difference is the 100Hz frequency with which we obtain by far the best results. Unfortunately the speed of the vehicle does not increase and the maximum speed remains at way under the 1m/s mark, up to 0.18m/s. We cannot discuss about dynamic performances at this low values. We need to continue with the improvement of this converter in order to obtain comparable results to the other types of transmissions.

In the following setup of this converter still the frequency will be changed, but this time in the right sinusoidal signal source will have a frequency of 10Hz and in the left side will have a frequency of 100Hz.

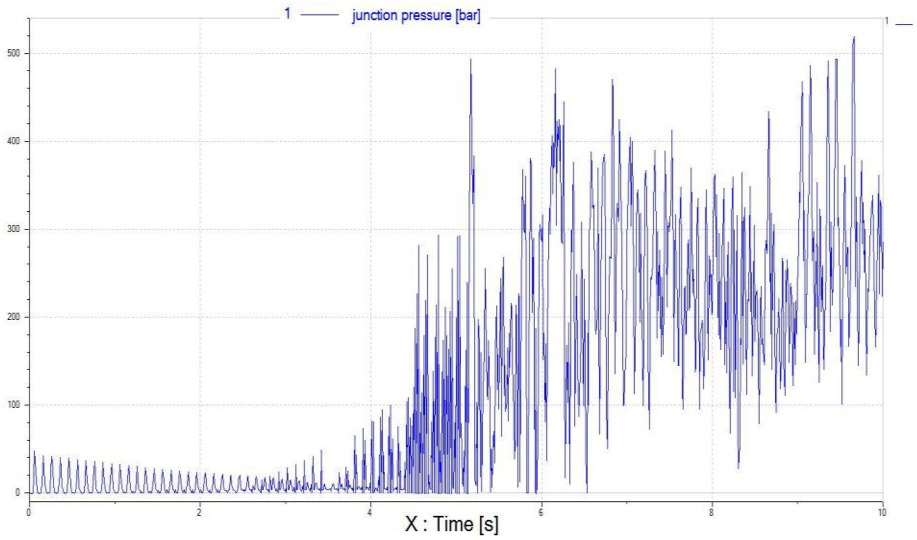

Figure 9 Pressure of the reservoir converter

The behavior of this converter has changed significantly after the modification of the frequencies, the left output of the signal source being different from the right one. We can clearly notice from the chart of the velocity evolution that the dynamic performances have been improved considerable. The velocity not only passing through the 1m/s mark, but even being able to achieve 18.5 m/s. The acceleration and the torque have a more interesting behavior they to have imprinted the sonic signature in their evolution. We can see that the acceleration reaches a maximum value of $13m/s^2$, oscillating between 0 and this value in less than 0.1 seconds. Also the torque has the has the same behavior as the acceleration, reaching a maximum value of 2000Nm and also oscillating between 0 and the maximum value in interval time less than 0.1 seconds.

Finally the pressure chart has a clear imprint of Gogu Constantinescu's Sonics theory, with an almost constant small oscillation of value until the forth second of the chart then big not constant oscillations of values, the chart reaching values of maximum 519 bars.

ACKNOWLEDGMENTS

This paper is supported by the Sectorial Operational Programme Human Resources Development (SOP HRD), financed from the European Social Found and by the Romanian Government under the contract number POSDRU/6/1.5/S/6. and POSDRU/88/1.5/S/59321.

REFERENCES

1. Pop, I. Ioan, Tratat de Teoria Sonicitatii, Ed. Performantica, 2006
2. Pop, I, Selecție de brevete, Ed. Performantica, 2007
3. www.sae.org
4. www.wikipedia.com
5. www.jackssmallengines.com
6. *** LMS AMESIM AMEhelp