LUCRĂRI REPREZENTATIVE

LR_1: Irimescu Adrian, **Mihon Liviu**, Padure Gelu, *Automotive transmission efficiency measurement using a chassis dynamometer*, International Journal of Automotive Technology, Volume: 12, Issue: 4, ISSN 1229-9138, pag.555-559, 2011, **FI=1,523**, WOS:000292313400011

LR_2: Ioan Hiticaș, Daniel Marin, **Mihon Liviu**, *Modelling and operational testing of pulse-width modulation at injection time for a spark-ignition engine*, Technical Gazette, ISSN 1330-3651, vol. 20(1), pag.147-153, 2013, **FI=0,678**, WOS:000315409300021

LR_3: Irimescu Adrian, Iorga Danila, **Mihon Liviu**, Henţiu Radu, *Emissions Model for Spark Ignition Engines Fueled with Gasoline-Bioethanol Blends*, Journal of Environment Protection and Ecology, ISSN 1311-5065, vol 13(1), pag.9-16, 2012, **FI=0,634**, WOS:000302843500002

LR_4: Marin Daniel, Hiticaș Ioan-Dumitru, **Mihon Liviu**, *Fuzzy Logic Control Applied on SI Engine Concerning the Injection Time Evolution*, 13th IEEE International Symposium on Computational Intelligence and Informatics (CINTI), Budapest, Hungary, ISSN: 2380-8586, pag.279-284, 2012, WOS:000319991600047

LR_5: **Mihon Liviu,** Iorga Dănilă, Swoboda Walter, Hiticaș Ioan, Henţiu Radu, *Improving performance of a Diesel-gas engine*, CONAT 20102021 paper, Brașov, 2010

LR_6: Lontiș, Nicolae-Stelian, **Mihon, Nicolae-Liviu**, Vetreș, Ion, *Numerical simulation study of a hybrid road vehicle regarding fuel economy and ambient emission delivery*, INGINERIA AUTOMOBILULUI, ISSN 1842-4074, vol 43, pag.10-15, 2017, WOS:000409240700004

LR_7: **Mihon Liviu**, Negoiţescu Arina, Tokar Adriana, Ostoia Daniel, *Dynamical behaviour of a powertrain*, MVT_20121018 paper, Timișoara, 2012

LR_8: Hiticaș Ioan, Marin Daniel, Mihon Liviu, Resiga Emanuel, Iorga Dănilă, *Parameters control of a spark ignition engine through programmable ECU for specific regimes*, 7th IEEE International Symposium on Applied Computational Intelligence and Informatics (SACI), ISBN 978-1-4673-1014-7, pag. 399-404, Timișoara, 2012

LR_9: **Mihon Nicolae Liviu**, Lontiș Nicolae Stelian, Deac Sorin, *The behaviour of a vehicle's suspension on a dynamic testing conditions* , International Conference on Applied Sciences ICAS 2017, IOP Conf.Series: Materials Science and Engineering paper, 294 (2018), Hunedoara, 2017

LR_10: **Mihon Nicolae Liviu**, Lontiș Nicolae Stelian, *Modeling and analysis of a vehicle suspension*, AMMA 2018 paper, ISBN 978-3-319-944008-1, Cluj Napoca, 2018

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1229−9138/2011/059−11

AUTOMOTIVE TRANSMISSION EFFICIENCY MEASUREMENT USING A CHASSIS DYNAMOMETER

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ABSTRACT−Automotive transmission efficiency measurements are usually performed on purpose-built rigs. A simple model was developed for calculating the overall transmission efficiency of passenger cars by using a chassis dynamometer. Wheel power and engine output were measured, and these values were used for calculations. The proposed method can only be employed for vehicles with manual drive because it requires constant speed measurements. Two case studies were investigated, with front-wheel and rear-wheel drive passenger cars. The results obtained from using the proposed model are in good agreement with data provided in the literature.

KEY WORDS : Transmission efficiency, Wheel power, Vehicle dynamics, Chassis dynamometer

1. INTRODUCTION

A portion of the power produced by internal combustion engines is lost due to friction in the vehicle's transmission. As a result, the overall powertrain efficiency decreases. Even if considerable advancements were made in the field of automatic (Shinbori *et al.*, 2010; Kelling *et al.*, 2006) and continuous variable transmissions (CVT) (Saito and Miyamoto, 2010), (Ryu and Kim, 2008), manual drives would still be more efficient, with maximum ratings around 96 % (Schuster, 2000). Studies were conducted to evaluate the benefits of using different lubricants (Wienecke and Bartz, 2001; Kubo *et al.*, 1986), and hybrid (Cho *et al.*, 2006), epicyclic (Ciobotaru *et al.*, 2010) transmissions and models (Kim *et al.*, 2010) were developed for new powertrains.

The work developed in this paper aims to asses a simple method for calculating passenger car manual transmission efficiency based on an energy in – energy out approach, similar to the one described in (Schuster, 2000). A chassis dynamometer was used to measure engine output during acceleration and wheel power under steady state operation at full load. These values were used to calculate the overall transmission efficiency for a front- and a rear-wheel drive vehicle.

2. EXPERIMENTAL SETUP

Power measurements were performed on a MAHA LPS 3000 chassis dynamometer with the vehicle secured as shown in figure 1. The tester measures wheel power (P_w), and the software calculates engine output (P_e) by measuring drag power in the additional stage following full load operation. After the vehicle is accelerated at full throttle from 50 km/h up to the maximum engine speed, the clutch is disengaged and the transmission decelerates from the maximum speed down to 50 km/h, while the rig measures drag power. Measuring power with this method ensures increased accuracy of ±2% (Maha Standard Operating instructions and User's Manual).

The dynamometer's settings only allow for full load power measurements during acceleration for engine speed values greater than 1720 rev/min and 1930 rev/min for each of the vehicles with the 4[th] gear selected because the rig does not measure drag power below 50 km/h vehicle speed. For this reason, steady state measurements were considered, and engine power values for engine speeds below 2000 rev/min were calculated assuming a second degree polynomial drag power variation (figure 2). This drag power measured by the dynamometer is lost power due to friction and the

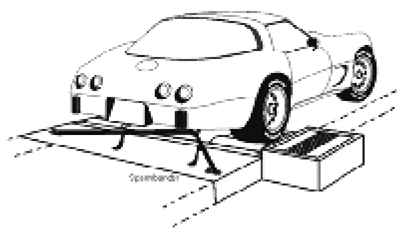

Figure 1. Chassis dynamometer setup (Maha Standard Operating instructions and User's Manual).

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MODELLING AND OPERATIONAL TESTING OF PULSE-WIDTH MODULATION AT INJECTION TIME FOR A SPARK-IGNITION ENGINE

Ioan Hiticas, Daniel Marin, Liviu Mihon

Original scientific paper

Nowadays, the computer control has to be taken into account in any field of study. Due to the advantage of its binary system, it can very quickly control the signals from devices. This paper is focused on the analysis of some studies carried out on the PWM (Pulse Width Modulation) technologies. The engines used nowadays are provided with an electronic injection system. During our research, we have made a connection between a few parameters which contribute to the increase of the engine performance. Our team has used the PWM, a common technique employed for controlling power to inertial electrical devices, in order to show the benefits of the injection time control; the results regarding the engine management have been very good. We have taken into account a few parameters such as pressure, battery voltage, lambda signals, fuel and air amount, etc., as well as their time evolution, with the help of the ECU control. Using the MATLAB/Simulink software, we have managed to control, by using the pulse width modulation, the reference speed, the throttle position, as well as other parameters and data collected from the tests carried out on Dacia Logan 1.4 MPI (powered by Renault), and the evolution of the injection time. By creating a PWM signal, we can precisely control the injection time.

Keywords: *current measurement, digital signal processing, oscilloscopes, pulse width modulation, voltage control*

Modeliranje i operativno testiranje modulacije širine impulsa kod vremena ubrizgavanja za motor paljen pomoću svjećice

Izvorni znanstveni članak

Danas, kada govorimo o bilo kojem polju moramo uključiti upravljanje računalom. Zbog prednosti njegovog binarnog sustava, ono može upravljati signalima iz uređaja i kontrolirati ih u vrlo kratkom vremenu. U ovom radu smo željeli predstaviti studije i istraživanja tehnologije PWM (Pulse Width Modulation - modulacije širine impulsa). Današnji motori su opskrbljeni s elektronički upravljanim sustavom ubrizgavanja. Tijekom istraživanja uspostavili smo vezu između nekoliko parametara koji su uključeni u povećanje performansi motora. PWM, najčešće korištena tehnika za kontroliranje snage inercijskih električnih uređaja, korištena je za predstavljanje prednosti kontrole vremena ubrizgavanja, s vrlo dobrim rezultatima u sustavu upravljanja motorom. Uzeli smo u obzir neke parametre, kao tlak, napon baterije, lambda signale, količinu goriva i zraka, itd., a sve to u vremenskom razvoju s ECU pomoćnim upravljanjem. Korištenje MATLAB/Simulink softvera uspjeli smo upravljati, počevši od referentnih brzina, položaja regulacije i drugih parametara, potrebnih podataka iz ispitivanog vozila, Dacia Logan 1.4 MPI (pokretanog Renaultom), razvojem vremena ubrizgavanja uporabom modulacije širine impulsa. Stvaranjem PWM signala možemo točno kontrolirati vrijeme ubrizgavanja.

Ključne riječi: *digitalna obrada signala, modulacija širine impulsa, osciloskopi, regulacija napona, trenutačno mjerenje*

1 Introduction

The internal combustion engines have always represented a very good topic of discussion in the field of the propulsion systems. The processes in the combustion chamber engage different elements involved in chemical reactions between air and fuel. The thermal engine opens a new direction of research in science and, consequently, it raises new questions that have to be answered.

The invention of the injector was inspired by a woman using a perfume spray bottle; this woman was the wife of Rudolf Diesel, the inventor of the diesel engine, who had a moment of enlightenment when he saw his wife perfuming herself. This raised the idea to use a nozzle in order to spread the fuel inside the combustion chamber. Nowadays, the road vehicles are very complex due to many sensors, actuators, control units, systems prepared to meet drivers' needs.

The MATLAB/Simulink software used by our team helps us to optimize a few parameters involved in raising the engine performance. Both the injector and the injection time must be very well analysed and calculated.

The oxygen sensor is able to monitor the amount of oxygen in exhaust gases. Thus, the upstream and the downstream oxygen sensors can control the fuel consumption and the level of exhaust via the ECU (Engine/Electronic Control Unit).

The engine speed is also a very important parameter for our study and experimental research. Due to the throttle position, the engine speed either increases or decreases. The battery voltage has also been monitored.

The injectors and the fuel quantity must be precisely pre-calculated for both engines, namely the compression engine and the spark ignition engine.

The main purpose of the paper is to present the benefits of the pulse width modulation, an application belonging to the electric field. We have analysed how the PWM works [1, 2], its benefits for the automotive area, and we have described the way in which we can implement our ideas.

2 Technical data

The route of the fuel is already well-known, but the connection between the engine power and the PWM must be dealt with and explained in detail. The basic application of PWM [3, 4] to the machine motor, to the AC electric motor, etc., is widely-known. One early application of PWM was made in the 1960s to an audio amplifier; the evolution of this technology led to innovative studies carried out in new areas of development.

What is a PWM? How does the PWM contribute to the increase of the thermal engine performance? Do we really need this application, belonging to a different area, in our spark ignition engine, where we have to do with fuel, lambda, etc.? The PWM is a "technology" which allows us to control, with high precision, the increase of the engine performance, in which many parameters are

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EMISSIONS MODEL FOR SPARK IGNITION ENGINES FUELLED WITH GASOLINE–BIOETHANOL BLENDS

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Abstract. Automotive transportation plays a major role in air pollution. Conventional technologies for reducing internal combustion engines emissions are reaching their limits, and one way of reducing pollution levels is using biofuels with obvious environmental benefits. Spark ignition engines can be fuelled with pure ethanol or different gasoline–ethanol blends. This theoretical study presents a method of evaluating emissions reduction when bioethanol is used. Several operating strategies are investigated, for the entire speed range of a 2-litre overhead camshaft (OHC) multi-port fuel injection engine, with different air–fuel ratios. CO_2, CO and NO_x emissions values are calculated and the effect of ethanol addition in the fuel blend is evaluated. A reduction of all 3 emissions values is noticed as the ethanol volume in the fuel blend increases. Calculated values should be considered engine out emissions and not tail pipe emissions. Modern engines for transport vehicles are equipped with catalytic converters, systems that manifest variations in conversion efficiency for different temperature values during operation. The effect on catalytic systems that lower combustion temperature has, when increasing ethanol content in the fuel mix, is subject to further studies.

Keywords: bioethanol, emissions, air pollution, spark ignition engines.

AIMS AND BACKGROUND

As biodiesel has become the main biofuel for compression ignition (CI) engines, bioethanol seems to be the fuel most likely to be used as an alternative for spark ignition (SI) engines. Bioethanol is a renewable energy source as it is obtained from biomass, and using it as a fuel produces less pollutant emissions. Other alcohols such as iso-butanol feature an increased heating value compared to ethanol[1], but also present several specific issues such as difficult cold start[2] and a drop in performance, as well as fuel conversion efficiency when used as a 'drop-in and drive' manner[3,4]. Also, compared to other biofuels such as biogas[5,6], ethanol can be used in existing engines without extensive modifications to the fuel system and other components.

The use of ethanol in SI engines is widely known on local levels in countries like Brazil for several decades. Only recently the interest for this biofuel has become a general issue[7]. Ethanol can be used in pure form (E100) or as a blend with

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Fuzzy Logic Control Applied on SI Engine Concerning the Injection Time Evolution

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***Abstract*—the papers present studies and researches of fuzzy logic system application, analyzing the evolution of a spark ignition (SI) engine. The advantage offered by the fuzzy logic system allowed us to monitor same of the parameters involved in burning process. As we know, thermal engines must be optimized because of the problems with exhaust gases from fossil fuel, used as energy sources. Our team succeeded to work with MATLAB/Simulink software, which takes into consideration data acquired from the tested vehicle, namely Dacia Logan, with purpose to manage the injection time. The amount of air and the amount of fuel are two elements which must be taken into consideration, because if the amount of fuel varies, than and the amount of air will also varies, with consequences in exhaust. Also we mention and about the AFR (Air/Fuel Ratio), which is a value with variation due to the lambda sensor modification. Lambda sensor also was a parameter control with fuzzy logics controller. The results are very interesting, fuzzy control system allowed us to manage most of the important parameters, and the relation between them help us to affirm important conclusion.**

I. Introduction

Today's vehicles are equipped with engine control units (ECU's) and this is a very good advantage. Due to them high response in very short time, the vehicle can run on the streets, where are subjected to many different regimes, without problems.

Also, due to the problems with exhaust, the SI engines must follow the international rules, to decrease the emission level of the exhaust gases. Some of the most important elements involved in burning processes and also in exhaust, is the AFR, which is controlled by the oxygen sensor, and the injection time, which is controlled by the injection ECU.

Following the 3D maps, the ECU will offer a response to the engine, according with the driver, which will modify the throttle angel, to run faster or not. These maps are created by the engineering and programmers, who take into consideration all the parameters involved in vehicle behaviour, all sensors and all transducer. Disadvantage of these mapping is the time which is necessary to implement this maps for all the engines and for all the different regimes, which a vehicle is subjected.

Fuzzy control is a system used by our team exactly for these two very important elements, the injection time and the lambda control.

Fuzzy control is a system with many advantages, and applied to a SI engine, to control the paramagnets evolution, help us to conclude that using this system we are able to control the map of the SI engine.

II. Technical Data

Fuzzy Control – what is this system and how it's work? It is a system able to monitor and control many parameters which varies between 0 and 1, as false or true or minimum and maximum. His application covers a large area, and also can be applied and on SI engines.

The fuzzy logics idea appear in year 1965, with Zadeh help, and, today it has a very large domain of application due his very easily logics [1], [2].

Using the logic offered by word "if" and "than", the conclusion will take into consideration all the input data mentioned by us.

Being an application toolbox of MATLAB software, it has five steps, graphical user interface (GUI) which can be followed to implement a fuzzy logic controller:

- Fuzzy Inference System (FIS) Editor
- Membership Function Editor
- Rule Editor
- Rule Viewer
- Surface Viewer

There are many Fuzzy logics applications, and for our research we used the Mamdani's fuzzy control.

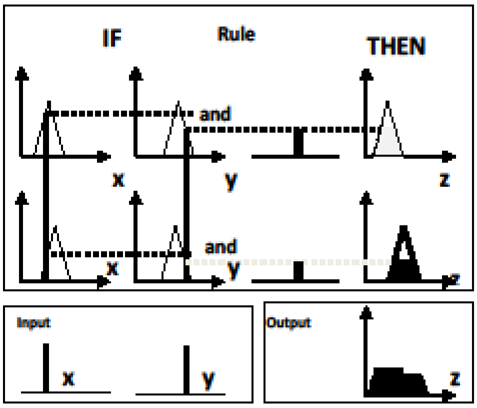

Figure 1. Mamdani interface system

IMPROVING PERFORMANCE OF A DIESEL-GAS ENGINE

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KEYWORDS - diesel, LPG, CNG, methane number, combustion mixture

ABSTRACT - This paper presents a solution for an injection system of a diesel engine, that uses gas mixture, consisting of diesel and gas (CNG - Compressed Natural Gas), which proves to be more advantageous of economically but also ecologically aspects. The ecological aspects are not treated widely on this paper. These claims are proved by experimental tests that were made for this purpose, both in Germany and Romania, and analyzed on the local public transport company in Saarbrucken city, Germany. The park fleet is equipped with such systems, installed on buses for public transport, and they took into account all stakeholders, namely the experience gained over decades in this field, the technology and the specialists with whom they collaborate, the desire for collaboration. The new injection system improoves the power charactersitics of the engine and decrease noxes.

INTRODUCTION

Often was discussed what means a diesel engine with gas mixture. Numerous attempts have been made both in laboratories and in service, the main segment being the local public transport. Countries like Germany, Italy, Spain, Greece, Australia, USA etc., have implemented such systems and the benefits they have brought these engines were primarily financial, this being the target. In this paper were presented results of measurements and calculations on local public transport network in the Saarbrucken city - Germany, but also in our experiments in order to obtain almost the same results as in Saabrucken.

EXPERIMENTAL FACILITY AND TEST VEHICLES

The advantages afforded by the mixture of diesel-gas engines are costs and noise reducing, exhaust emissions and their quality are left on the second plan in this article. In order to reveal these advantages, below we present a scheme to prove this. In the diagram below you can see the difference in yield between the two engines, Otto and Diesel+60% CNG and noted the difference in costs at 100km.

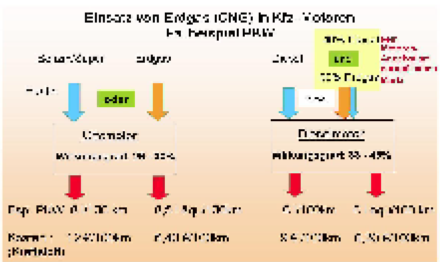

Figure1. Using CNG in motor vehicles (passenger cars).

NUMERICAL SIMULATION STUDY OF A HYBRID ROAD VEHICLE REGARDING FUEL ECONOMY AND AMBIENT EMISSION DELIVERY

STUDIU PRIN SIMULARE NUMERICĂ PRIVIND CONSUMUL DE COMBUSTIBIL AL UNUI VEHICUL HIBRID ŞI EMISIILE ELIBERATE ÎN AMBIENT

REZUMAT

Lucrarea prezintă un studiu comparativ de simulare numerică privind economia de combustibil şi emisii al unui vehicul hibrid, atunci când valorile parametrilor temperaturilor respectiv starea de încărcare a sistemului de stocare a energiei sunt alterate şi vehiculul urmează un ciclu standardizat (UDDS). Studiu comparativ are ca şi rezultat folosirea acestuiaşi tip de vehicul, dar cu configuraţie paralelă hibridă, menţinând condiţiile iniţiale.

Key-words: *Fuel efficiency, emissions, UDDS cycle, hybrid electric vehicle – HEV, parallel configuration, state of charge.*

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1. INTRODUCTION

In this scientific paper the ADVISOR (Advanced Vehicle Simulator for System Analysis) 2.0 tool will be used to perform the comparison study. Version used for the numerical simulation is 2003-00-r0116. The first version of ADVISOR software was developed and released in November 1994. At the request of U.S. Department of Energy (DOE) for understanding hybrid vehicles behavior, the tool was developed, used later in consultancy and R&D contracts with the automotive big players in that time. The success of the tool developed combined with flexibility and progress, conducted in usage of many other clients in order to assess and understand the system-level interactions of hybrid and electric vehicle components [1].

The ADVISOR tool analyzes vehicle powertrains, focusing on power flows among the components. When used on a model that follows a driving cycle, such as the Federal Urban Driving Schedule (FUDS), its main outputs are fuel consumption and tailpipe emissions. Other capability is to simulate the vehicle in maximum effort acceleration, where outputs are 0-60 mph time or 40-60 mph time, or to determine the maximum road grade the vehicle can climb at constant speed [1].

In accordance with the goals designed, ADVISOR approximates the continuous behavior of a vehicle as a series of discrete steps. During each step, the components are at steady state assumed. This assumption allows the use of efficiency maps or power-usage for the components, derived from steady-state tests in the laboratory. This main assumption is short-duration drivetrain dynamics; however, this not allows investigation in detailed. For example, vibrations in the driveline or oscillations in electric fields is a phenomenon beyond ADVISOR's scope [1]. ADVISOR is an open source license software, developed in MATLAB® /Simulink® environment/graphical program. The program runs under MATLAB® (from 5.2 version on)/ Simulink® (from 2.2 version on), and it can be loaded/started from the command prompt in the

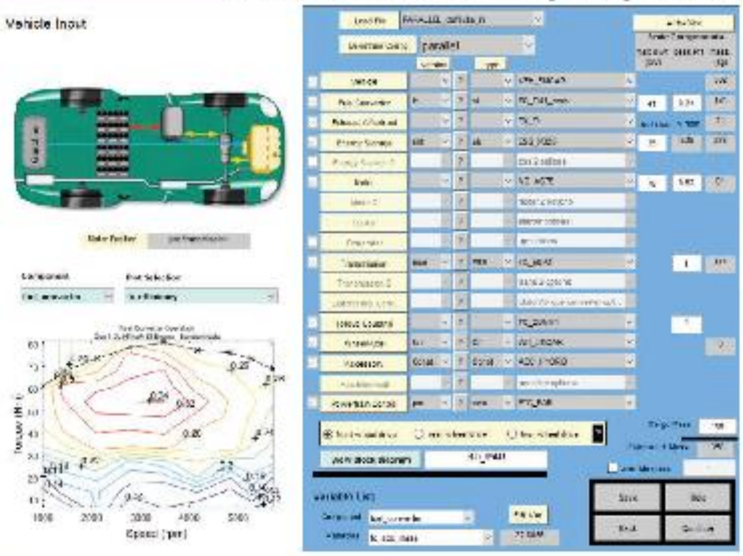

Fig. 1. ADVISOR 2.0 Vehicle Input Screen [2]

MVT 2012 1018

DYNAMICAL BEHAVIOUR OF A POWERTRAIN

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Abstract: The paper presents the results of the modeling process of a motor vehicle in order to obtain appropriate parameters for controlling the propulsion system. Are used advanced models of the powertrain and specialized softwares for verifing the theory and equations of the models of the similar models and performance's values for a tested car. The models analyze the whole behaviour of the vehicle in different rolling conditions and the results offer exploitation parameters and optimization values for obtaining lower fuel's consumption and lower emissions on different surfaces and roads.

Keywords: motor vehicle, powertrain, vehicle dynamics, modelling

Introduction

The dynamics of a motor vehicle studies the movement of the motor vehicle and the interaction between the rolling system and the road, taking in consideration all the resistances and influence items that exists and act at an certain moment during the motor vehicle's exploitation.
In order to establish the behaviour of a specific motor vehicle response, with the purpose to improve the stability and maneuvrability of the vehicle, reducing fuel consumption and noxes and increase the safety and passengers protection during road accidents we need a giant number of research hours, specialized equipments and high quality staff.
In this paper we present the results of modelling and simulation of a motor vehicle using dedicated softwares, starting from the engine and transmission of the car, made with AVL Cruise® and and „tested" on a road designed with IPG CarMaker®.
The AVL Cruise consists as an excelent interface and assembling of subassembly models of a motor vehicle's (engines, clutches, gear boxes, transmissions etc.) with the possibility of choosing/modifying values of characteristics or even import them from own data bases. On the other hand, even if in some parts the AVL Cruise and IPG CarMaker overflow, the possibility to „virtualy" tests a motor vehicle on a specified road/surface is easier on the second software. That's why the two companies decided to a strong collaboration in this field and in offering a complete solution for these purposes.

Building a model

Both software's interfaces are very friendly and help the user to select datas for the model from several menues, grouped on specific items. Thus, if we take in consideration the interface from the AVL Cruise, Figure 1, the operation with this software is similar with the Matlab interface, and the modules and associated values of the variables and parameters could be picked from data bases or directly introduced from the keyboard. The connections between the modules are conventionaly made through wires. Each module could be more or less complex, depending on the „reality" of the car's model, or could exists or not in a specific configuration. The same problem is discussed if the motor vehicle has or not special controls or even hybrid sollution.
As we can observe in Figure 2, the CarMaker interface consists also in a multifolders menu, with the possibility of choosing values or insert them for calcullus.
For a complet and extended analysis of the motor vehicle, the AVL Cruise software has direct interfaces with other programs such are AVL BOOST®, FLOWMASTER®, KULI® and of course IPG CarMaker®.

Parameters Control of a Spark Ignition Engine through Programmable ECU for Specific Regimes

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***Abstract**—The article purpose is to present the advantage of a programmable ECU (Engine Control Unit) [1], on an intelligent system of a spark ignition control to increase the vehicle's performances for specific regime and, as much as possible, to keep the exhaust gases in legal limits. Concentrations of CO_2 in the atmosphere - very high now - have their origins mainly as a result of burning fossil fuels in the combustion chambers of the internal combustion engines. The experimental measurements and the tests presented in the paper wish to offer support to the researchers in this field, regarding the working of the internal combustion engine in normal parameters, on specific regimes, with high performance, all this with a programmable ECU.**

I. Introduction

Electronic Control Units (ECU) in today's vehicles are able to satisfy many requirements that drivers demand. Different regimes which a motor vehicle is subject to running a city with over 300,000 inhabitants, almost as many vehicles, and automotive engineers have to look upon for solutions that can meet these demands.

Performance sports cars are in top series, reminding only the Bugatti Veyron Super Sport car, vehicle powered by a W16 engine that produces 895 kW (1200HP) and a maximum torque of 1500Nm, but CO_2 emissions are not within the current rules on exhaust gas regulations, having the concentration of CO_2 up to539 g/km. But when talk about the cars with higher performance, the nature of exhaust gases passing on second plane. All these achievements were possible through the electronic management with ECU.

What is a programmable ECU? Is one of the categories of on-board computers that can be programmed [1], a system designed to increase the performances of the engine,an programmable ECU with destination on fuel injection controller for spark ignition internal combustion engines,concerning the sensors limits which are pushed up, and this advantage can be used when significant changes have been made on standard engine – like engine-tuning – changes like installing turbines, inter cooling system, exhaust changes and another pieces, or when extra performances are needed, like engine tuning. Due to these modifications, the original ECU, [4], could not offer the optimal control and here comes the programmable ECU, managed manually. The programmable ECU could be driven by a computer and the OBD/USB interface with the engine and all the sensors of the engine (rpm sensor, lambda sensor, exhaust gas temperature sensor, etc.) [2], [3].

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II. Technical Data

It is known from the calculus that the heat exchange of the engine and the thermal balance, that the spark ignition engine works on optimal conditions if the air/fuel ratio is closer to the ideal value, that means the stoichiometric ratio, meaning 14.7:1, namely 14.7 kg of fresh air to 1 kg of gasoline fuel [7], [8]. This reference was made for the gasoline/octane.

For the situation when we want/need more power from the engine, this can be done by different ways. One of the solutions is to monitoring and control the amount of intake air or intake fuel into the combustion chamber. Therefore, if we follow this purpose, we must take into account that in ordinary conditions, the excess air ratio could vary between 0.85 – 0.95. Increasing the performances of the engine involves the increase of the fuel consumption by reaching the mixture, which, combined with a possible higher compression ratio, will reach a higher power, but also increasing exploitation costs.

The opposite pole is the economic driving regime, lower fuel consumption. The excess air ratio varies between 1.05 – 1.15.

In this paper, measurements were made for a sport vehicle, the car being involved in rally competitions. The car is a Renault 5, with his original turbo supercharged spark ignition engine, with 1721 cm^3displacement, 89.5 kW maximum power at 5400 rpm, 175 Nm maximum torque at 3300 rpm, 8.1:1 compression ratio [13].

The engine described above was modified to obtain higher performances and the solution that we used was to

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The behaviour of a vehicle's suspension system on dynamic testing conditions

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Modeling and Analysis of a Vehicle Suspension

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Abstract. The present paper will be focused on determining the tire-suspension assembly behavior involved in vehicle dynamics for a car through a dedicated model developed in Matlab/Simulink software. The Matlab/Simulink environment will be used, by the last release, 2018a, which offer a dedicated powertrain and vehicle dynamic modules. The analysis will use a model for the tires and a model for the suspension response for a vehicle configuration. The road simulation will be used for a complex analysis of the car response as input in model simulation. Will be expected models and mathematical equations for a complete simulation, with Simulink environment, in order to obtain rapid responses and pre evaluation of complex analysis for car-environment interaction. The study could be applied, in this analysis, only for a dedicated type of suspension, from the geometry point of view, but not limited to the viscosity and cinematic response of the damping assembly. The Matlab/Simulink parametrization will allow multiple ways parameters changing and time response of the model will shorten the analytical studies of vehicle dynamics.

Keywords: Tire, Suspension, Vehicle Dynamics, Modeling.

1 Introduction

Road vehicle's movement on a dedicated surface, like concrete and asphalt, could be controlled by a driver in longitudinal and transvers directions as well as around the vertical axis (yaw rotation) within the limits imposed by the physical laws and the surfaces interaction through adherence. The transverse and yaw movement are very well connected each other.

In the vertical direction the movement of the vehicle follows the roadway, including all the bumps (ascending or descending) and declivities, without any action on the part of the driver. For comfort and a safety driving all these irregularities of the road should be minimized through the tires and suspension system of the vehicle.

Thus, the suspension of a vehicle could be precept as a complex system which generate forces at the tire's contact patches and serve to transmit these to the vehicle: wheels and tires, brakes, suspension arms, hubs and nuts, steering system, springs and shock absorbers [1].

Due to his role of linking the vehicle and the road, the suspension system direct influence the handling dynamics and ride comfort and also affects space utilization, aerodynamics and costs. The suspension alone is not decisive in establishing handling