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CONTROL OF THE HYBRID WHEELED VEHICLE IN THE GRAPHICAL PROGRAMMING ENVIRONMENT - NI LABVIEW

Abstract: The paper presents the concept of a hybrid wheeled vehicle simulated and controlled by NI LabVIEW software. Modelled control system was build based on a mathematical model of wheeled vehicle and powertrain components. Powertrain composed of an electric motor and an internal combustion engine (ICE). In the software implements several types of electric motor (DC, BLDC, PMSM and AC Induction Motor) and ICE's described by thermodynamic-mechanical models and by mechanical characteristics.

1. Introduction

Hybrid powertrain control in wheeled vehicle is extremely difficult to implement in practice. Many aspects of the movement of the vehicle must be included in the control algorithm.

Wheeled vehicles with ICE-electric powertrain, have better dynamics and higher efficiency than conventional solutions. In addition, the internal combustion engine running at a higher load is excreted smaller amounts of toxic substances, and the electric motor does not require a clutch and maximum torque is already available from a minimum speed. Therefore electric motor can serve as a machine to accelerating wheeled vehicle in the first phase of the movement.

Hybrid drives can be divided into 3 groups [1,2,3]:

- serial structure (Fig. 1), (presented in the paper),
- parallel structure (Fig. 2),
- synergies of power (Fig. 3).

Serial structure is typically used in vehicles in which the main drive is electric motor – electric motor drives the vehicle. The internal combustion engine in this case is in the optimal speed range, which is the value for which the power and torque is optimized for electricity demand.

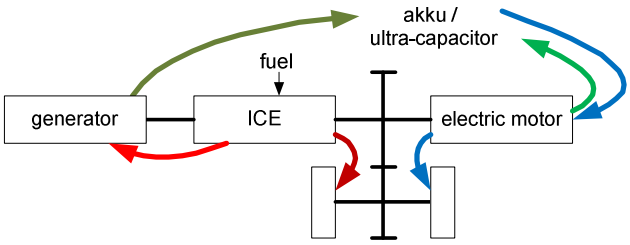

Fig.1. Serial structure of hybrid powertrain [1]

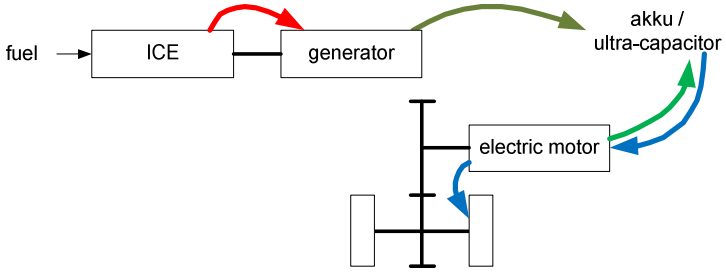

Fig.2. Parallel structure of hybrid powertrain [1]

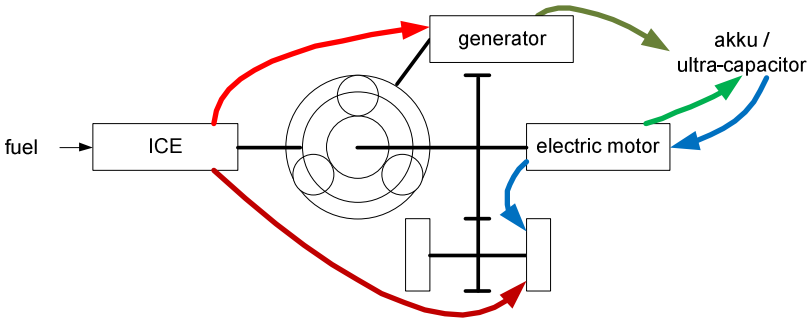

Fig.3. Synergies of power in hybrid powertrain [1]

2. **Obtained results**

Virtual driver is a control circuit based on a mathematical model of a wheeled vehicle, taking into account the exact mathematical description of the internal combustion engine and electric motor stored in the LabVIEW software. The big advantage of this approach is to adopt a virtual drive system, so it is possible to optimize the operation of this system in the laboratory in LabVIEW, before constructing the actual hybrid system.

The simulation of hybrid powertrain was performed in LabVIEW software from National Instruments. The software assumes a mathematical model of the electric motor (DC Motor, Fig. 4), model of IC Engine (Fig. 5) and model of drivetrain.

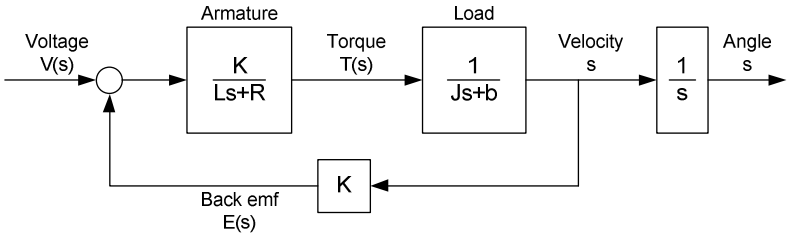

Fig.4. Diagram of DC motor [1]

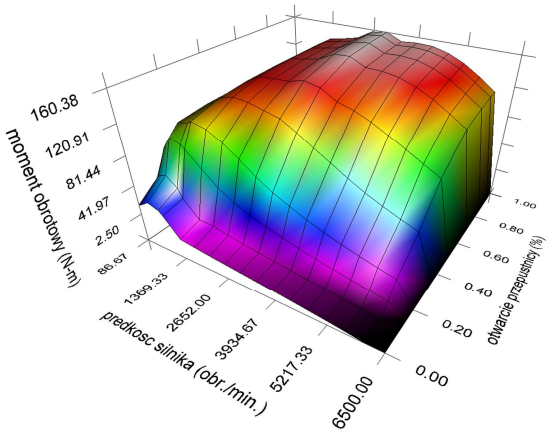

Fig.5. Mechanical characteristics of IC Engine [4]

External signals, the circular control of the vehicle by the driver, is performed by an external device - Logitech wheel, which was configured to work in LabVIEW (Fig. 6). To build the source code uses a set of libraries NI-VISA, which is dedicated to external devices that communicate with the device through a USB port.

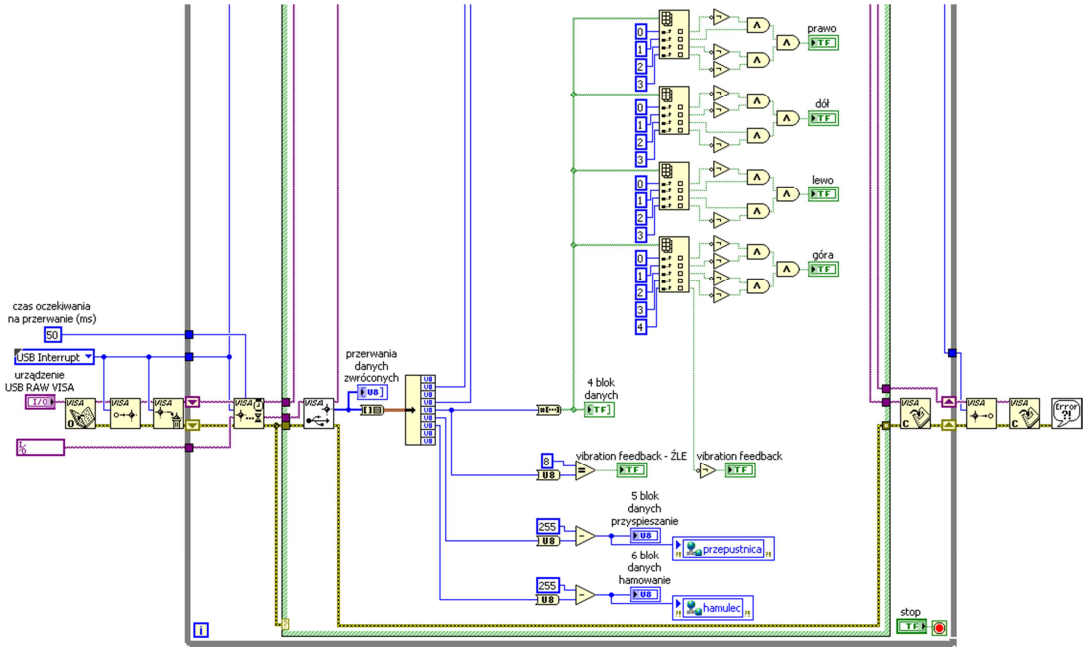

Fig.6. Block diagram of configured external device [4]

The simulation results are shown in Front Panel (Fig. 7), provides basic controls (accelerator pedal and brake, shift, slope) and the graphs of basic parameters of the propulsion system (ie, the speed of the drive units) and the linear velocity of the vehicle.

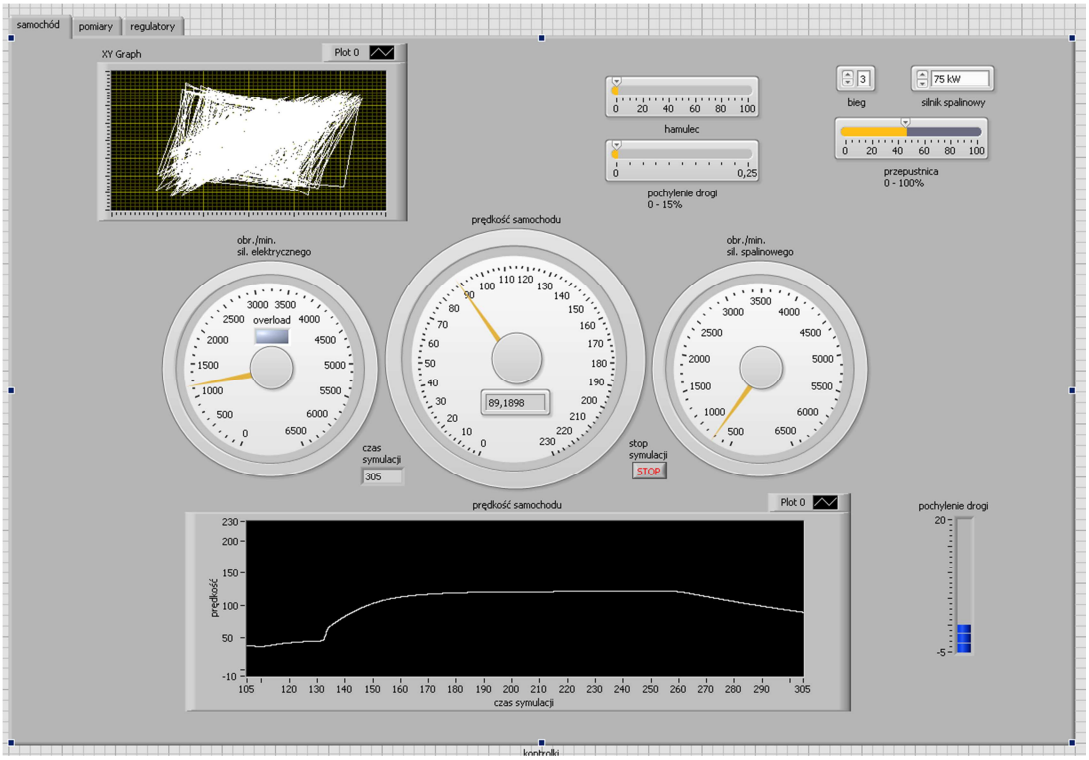

Fig.7. Results of the simulation

3. **Conclusion**

The paper presents a model of a powertrain hybrid of wheeled vehicle. A mathematical model of DC motor stored in the form of differential equations and taking into account the Laplace transform. Was used as an external device (Logitech steering wheel), which was designed to accurately reflect all the actuators in the vehicle wheeled (such as acceleration and brake pedals, gear shifters) without which there would be no currently available on the market wheeled vehicle.

References

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