

INVESTIGATION OF THE UNMANNED VEHICLE HYBRID PROPULSION SYSTEM

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Abstract

Investigation scheme of the unmanned vehicle is shown in the paper. It is the unmanned vehicle planned to use in military application. Using the unmanned vehicles on modern war field is increasingly popular. The unmanned vehicle is powered with a hybrid propulsion system. The main source of energy is diesel engine and electric generator. It supplies the battery and six propulsion electric motors. In the propulsion system is a lot of components: controllers and electric devices. Is important to know how it works in load condition. Investigation stand was constructed to break all drive wheels. There will be done measuring of electric parameters of the hybrid propulsion system. Temperature of the battery and electric motors, fuel consumption of internal combustion engine needed to appreciate of load and energy balance will be measured as well. Investigation equipment which will be used during investigation is also performed in the paper.

Keywords: *unmanned vehicle, hybrid propulsion system, UGV, electric vehicle, electrical parameters measurements*

1. Introduction

Unmanned vehicle which is studied has hybrid propulsion system equipped with diesel engine powered electric generator and six electric motors driving all wheels. The generator with power 7.5kW is charging li-polimer battery with capacity 100 Ah. Current from battery supply all electric motors which drive the wheels thru the gear. Speed is reduced and torque increase 14 times. To know how the unmanned platform works under load there was designed and built investigation stand as shown on the Fig. 1.

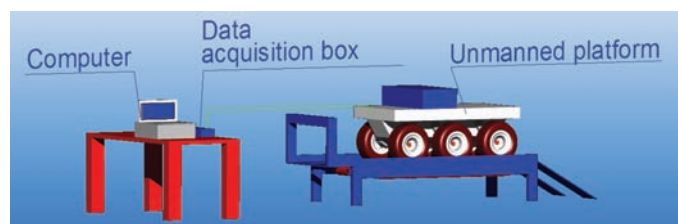


Fig. 1. The examination stand of the hybrid unmanned vehicle

The stand let to measure same parameters in propulsion system like:

- voltage and current in the electric generator;
- voltage and current on the battery;
- current between the battery and the electric motor controller;
- current between the electric motors controller and the electric motor;
- temperature of the battery;
- temperature on the electric motors controller;
- temperature on the electric motors;

- fuel consumption in diesel engine;
- measure of acoustic background of the vehicle;
- wheel's speed;
- vehicle speed.

Electric quantities will be measured in every propulsion module (eq. controller – electric motor) in the same time. There will be used a data acquisition system. It measure data from sensors and deliver to the computer.

Measured results will be used to elaborate new and cheap unmanned vehicle to directly support to battlefield systems with autonomy of action. It need to led intensive scientific investigation about development and implementation of new technology in area of unmanned platform.

2. Propulsion system investigation

In aim of investigation of propulsion system the first activity is connected with measure of current made by electric generator. It is important to know real value. To current measure there will be used clamp amperemeter (Fig. 2). That type of amperemeter is perfect to strict measure in circuit when current has high strength (about 2000A). Very wide clamps are easy fit to wire with big diameter. It is especially use when current is very high. This device may measure pick current in mode of measure engine starting and is also perfect to voltage and resistance measure in electric motors and induction loads [1]. To measure voltage and current value those multimeters will be used on the wire between electric generator and the battery. Measured values will be delivered thru the data acquisition system to PC and recorded. Data may be later analysed as shown on the Fig. 3.

Clamp AC/DC current meter (Fig. 2) may be also used to current measure no the battery when we use connecting wires delivered with the measuring device. We can assess a real state of the battery.

The next step will be current measure on wires between battery and electric motors controllers (Fig. 4). It let appraise cooperation and energy balance between this devices.

The same way will be led voltage and current measure on wires between electric motor controller and electric motor. The main problem is to measure parameters on six propulsion modules in the same time. It let to appreciate if every module is loaded in the same rate (Fig. 5).



Fig. 2. Clamp AC/DC current meter

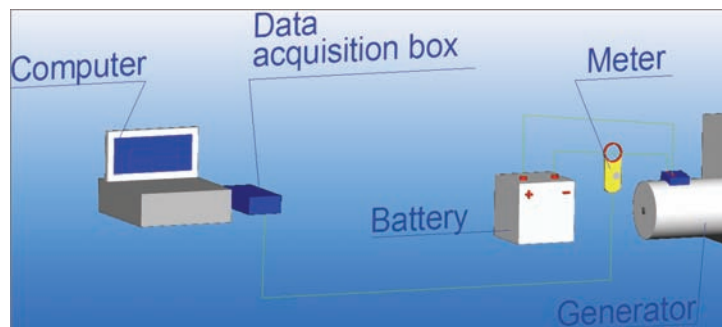


Fig. 3. Scheme of the generator current measurement

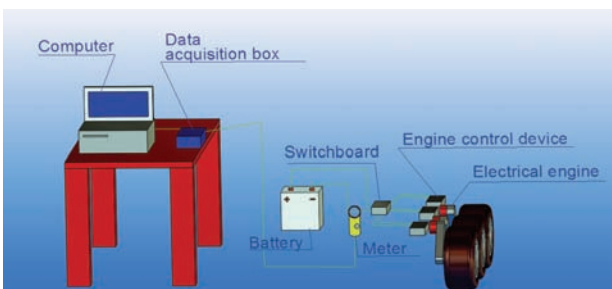


Fig. 4. Scheme of current measurement between battery and electric motor controllers

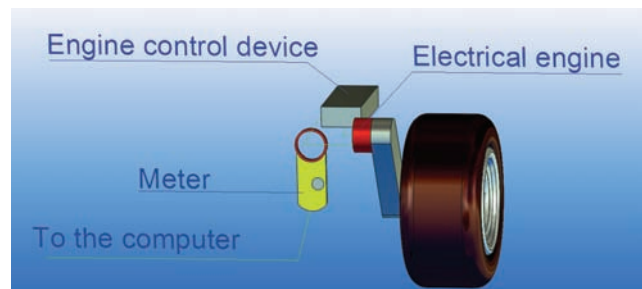


Fig. 5. Scheme of current measurement between electric motor controllers and electric motors

After measure of electric parameters of hybrid propulsion system there will be also measured temperature parameters. Thermometric sensors will be mounted on the battery as well as in electric motors controllers and even electric motors. Temperature will be used as very simple diagnostic parameter because it changes the first when in the system appear any technical problem or for instance load of any device will be too big. Temperature will be used to let basic, simple tests in the danger situation for equipment in the unmanned vehicle. Temperatures may be analysed very fast and finally warning message may be delivered to person who control unmanned vehicle. This investigation let to determined efficiency of the propulsion system in dependency of temperature. Results of investigation may be used to estimate heat screening of the vehicle. It let to improve vehicle insulation against infrared radiation. Measuring of temperature outer surfaces of vehicle body and temperature of exhaust gases will be done with use of infrared thermometer (Fig. 6). This device let to carry out measuring without contact. It is only needed to direct sensor on investigate thing. Results of measuring are very precise in wide range of temperature.



Fig. 6. Infrared portable thermometer

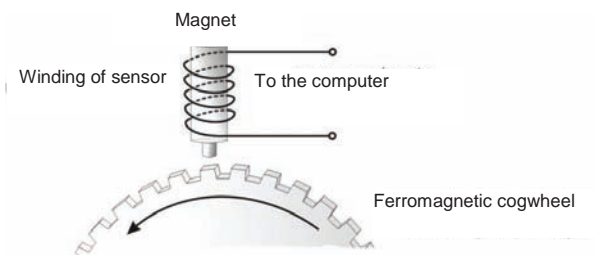


Fig. 7. Magneto-induction transducer of engine speed

Measuring of wheel speed will be carry on with use of induction transducers (Fig. 7). This devices work when geometry of magnetic circuit is changing. Wide of air gap between sensor and signal wheel is changing in this devices. Sometimes sensor may use changing of resistance of induction solenoid, in dependence to position of moving part of the sensor because of swirl currents. Measured value is an input signal to measure transducer. Output value is a measured signal. Usually transducers like this may be self-dependent measure device or part of complex measuring system. Cyclic changes of magnetic stream because of rotation toothed signal wheel made inducted output voltage. Voltage is changing in function of rotational speed of the signal wheel.

Transducers of this type will be mounted on every wheel of the vehicle. Data will be delivered to PC to analyze and compare with other measured values [2, 3].

In order to measure temporal speed of the cogwheel will be used an optical meter show in the picture below (Fig. 8).

During the examination the degree of noise, generated by platform propulsion system will be researched too, using both a combustion system as well as only electric engines. The examination will be carried out by means of precision microphone (Fig. 9). Received data will allow to asses a real noise created by the platform and will be used to further work to limit it.



Fig. 8. Optic speedometer



Fig. 9. Exact acoustical microphone



Fig. 10. Ultrasonic flow meter

In order to assess the range of the unmanned platform, the fuel consumption by the vehicle propulsion system will be investigated too. It will be done by using an ultrasonic flow meter (Fig. 10). The vehicle wheels will be broken with different strength, imitating a move of the platform in different terrain conditions.

3. Conclusions

In the scope of „Unmanned land platforms” is intentional to concentrate in development directions assuring high mobility and utility on battlefield. Researchers results of working out of unmanned vehicle with hybrid propulsion surely will contribute to receive essential knowledge to optimisation drive platform system and also features characterize such type of vehicle such as a proper operational range and it should has ability of secretive warfare. The drive system heat researchers and acoustic examination results will reveal, which area should be a subject of work to get an assumed level of heat and acoustic masking.

References

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