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Research Article

ANALYZING OF TESTING AUTOMOBILES USING STRAIN GAUGES CONSIDERING LOCAL CONDITIONS

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ABSTRACT

The given article deals with testing the validity of machines using strain gauges as well as the dynamic behavior of a vehicle the forces and moments acting on the wheels. The level of accuracy should be acceptable. Since all the tire models used in the literature calculate the tire forces and moments based on parameters which are difficult to measure or estimate online, in this paper a different approach is undertaken. A wheel rim from a formula student car was fitted with strain gauges and a study was conducted with respect to the feasibility to estimate the static load applied to it. The results of this research highlight the differences encountered and discuss possible solutions.

KEYWORDS

Gadget, Transport Industry, Friction, Dynamometric Wheels, Compressive Loads, Strain Gauges.

INTRODUCTION

At the present time up-to-date technologies are being developed day by day. The latest gadget of today will be tomorrow's antique and things for granted this is due to the rapid development in technology. One of those things include the wheel.

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Wheels are used everywhere, as tires, or in machinery.

n our research automotive industry wheels has a huge role while carrying out our research process. Wheel with axel allows to move the objects easily for one place to another, Improving the transport industry. The main function of the wheel is to move objects and reduce friction by the rotating motion. By doing so the wheels take up a huge amount of external forces and loads due to gravity. T Newton's third law, "Every action has an equal and opposite reaction" [1]. Assuming a vehicle is at rest, the weight of the vehicle is pushing down due to gravity and there is a reaction force from the ground pushing up. Other forces on the wheel include force due to motion, where the vehicle is moving forward and there is a rolling resistance or friction acting against it. Once in motion and the vehicle brakes, there is braking force acting on the wheels which the brake grips the wheels in order to slow it down but due to the momentum the vehicle tends to move forward. Problem formulation dynamometric wheels measure the forces and moments in a wheels, this is done by attaching Strain gauges on the wheel hub. These strain gauges measure the tensile and compressive loads on the wheels. [1]. The applications of a dynamometric wheel are to accurately model the dynamic behavior of vehicles and tyres, in product development to improve durability and reliability, to manufacture safer and efficient products and for research and education.

MATERIALS AND METHODS

In this regard, at the Department of Industrial Electronics and Automation of MTI, the possibility of increasing the accuracy of measuring humidity by using radiation at three wavelengths was investigated. As radiation sources, LEDs based on gallium antimonide for a wave of 1.93 μm, ternary solid solutions of gallium antimonide and aluminum for a wave of 1.79 μm, and ternary solid solutions of gallium and indium for a wave of 2.1 μm were used. In this case, the reflected radiation flux with a wavelength of 1.79 μm was used to compensate for the effect of tissue thickness, temperature, and fluctuations of the tissue surface relative to the measuring transducer, and the reflected radiation flux with a wavelength of 2.1 μm was used to compensate for the effect of the type of fiber, i.e. its physical and chemical properties.

As a photodetector, a photoresistor of the FSV-16-AN brand was used, which made it possible to obtain an agreement of IR-LED-photodetector pairs of about 0.97 in the range of 1.7 ... 2.1 μm.

Since the above-mentioned LEDs, when powered by direct current, give off power no more than 0.5 ... 1 mW, they were used in a pulsed mode, which made it possible, when powered by current pulses of 5 μs duration with a repetition rate of 1 kHz, to increase the power of the radiation emitted by them by 20-30 once. The inertia of the used photoresistor allows a pulse modulation frequency of up to 3-5 kHz.

Three rectangular pulse generators fed three LEDs with pulses with different repetition rates. The radiation fluxes of all three LEDs were fed to the controlled tissue using molybdenum glass

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The main objectives of this study are to design and evaluate a strain gauge equipped wheel using the following methods:

- Measurement of the wheel,
- Generation of CAD model.
- Finite element analysis of the model.
- Testing and validation of the models.
- Estimation of wheel loads.

Strain is a physical quantity that is related to the deformation of the material under load resulting in either tension or compression. It is a response of the system to an applied stress. When force is applied on a material it produces stress, which results in the deformation of the material. It is also defined as the amount of deformation in the direction of the applied force divided by the initial length of the material [2]

Nowadays, the automotive industry is one of the most developed industries, the demand for cars is growing day by day, various technological tasks are being carried out to meet the needs and desires of buyers. The main focus in the automotive industry will be on human safety, which requires a high level of reliability and durability of the product. Every produced detail is checked by its quality. Metal parts are tested according to their hardness, durability, reliability, toughness, deformation. Strain gauge is widely used in this kind of tests. With the help of the sensor, micro-strain on the metal surface are measured and analyzed in detail. Strain gauges typically measure very small and precise mechanical strain.

How does it work?

Consequently, changes in resistance are also very small and thus cannot be measured directly with an ohmmeter. The strain gauge, therefore, must be included in a measurement system where the precise determination of a change in resistance is possible. To do this, a Wheatstone bridge circuit must be created. The first component in the Wheatstone bridge system is formed by the strain gauge itself. It converts the mechanical strain into a change in electrical resistance. [8]

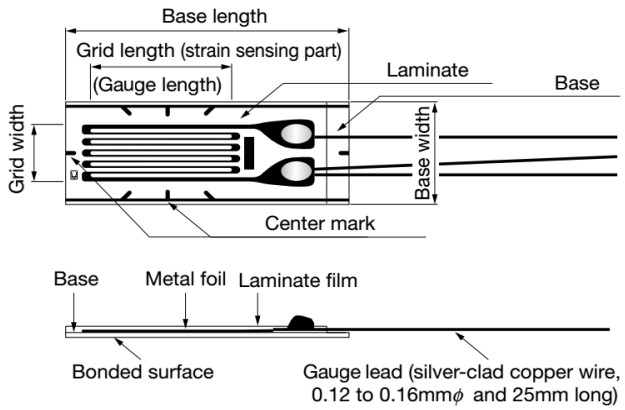

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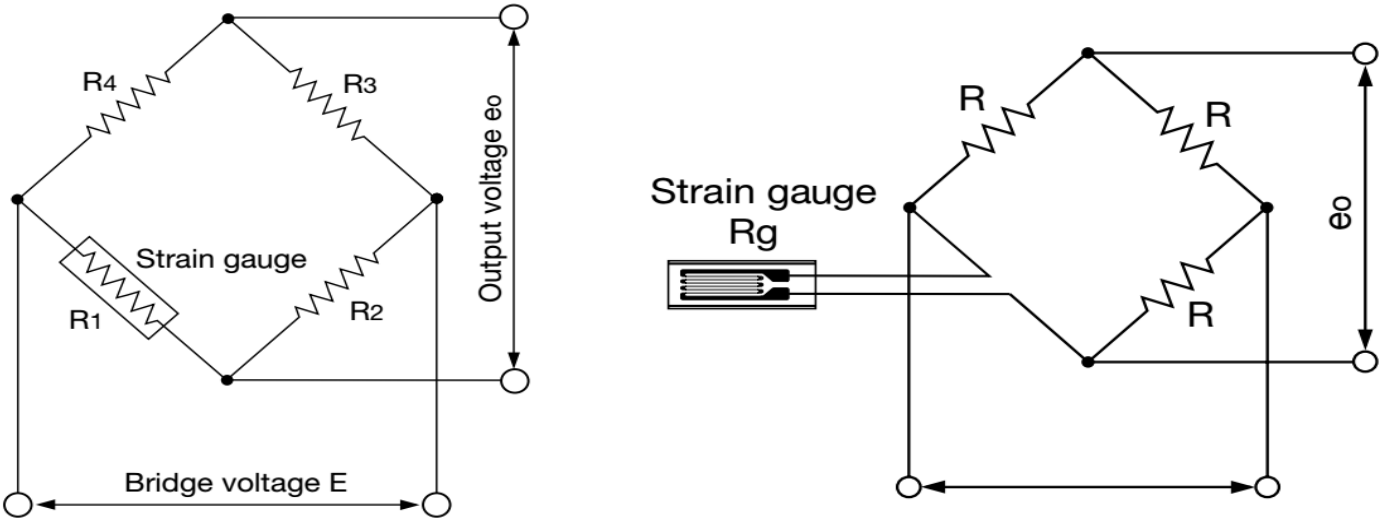
Figure 1. Structure of Foil Strain Gauge



The foil strain gauge has metal foil photo-etched in a grid pattern on the electric insulator of the thin resin and gauge leads attached. The strain gauge is bonded to the measuring object with a dedicated adhesive. Strain occurring on the measuring site is transferred to the strain sensing element via the gauge base. For accurate measurement, the strain gauge and adhesive should match the measuring material and operating conditions including temperature.

Strain-initiated resistance change is extremely small. Thus, for strain measurement a Wheatstone bridge is formed to convert the resistance change to a voltage change. Suppose in Fig. 2 resistances (Ω) are R_1, R_2, R_3 and R_4 and the bridge voltage (V) is E. Then, the output voltage e_0 (V) is obtained with the following equation:

$$e_0 = (R_1R_3 - R_2R_4) \div ((R_1 + R_2) \times (R_3 + R_4)) \times E$$

Suppose the resistance R_1 is a strain gauge and it changes by ΔR due to strain. Then, the output voltage is,

$$e_0 = ((R_1 + \Delta R) \times R_3 - R_2R_4) \div ((R_1 + \Delta R + R_2) \times (R_3 + R_4)) \times E$$

If $R_1 = R_2 = R_3 = R_4 = R$,

$$e_0 = ((R^2 + R \times \Delta R - R_{-2}) \div ((2R + \Delta R) \times 2R) \times E$$

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Since R may be regarded extremely larger than ΔR,

$$e_0 = \Delta R \times E \div 4R = Ks \times \varepsilon \times E \div 4$$

Ks: Gauge factor ε: Strain

Thus obtained is an output voltage that is proportional to a change in resistance, that is a change in strain. This microscopic output voltage is amplified for analog recording or digital indication of the strain

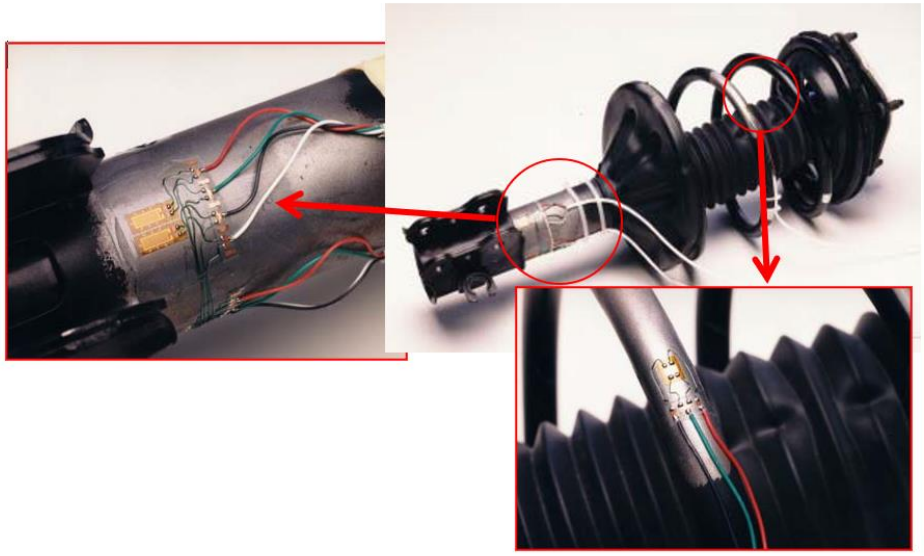

Figure 3. Installation and application

Why Measuring loads are important?

Road load data is one of the best sources of fundamental information necessary for analysis of the design, reliability, and structural integrity of vehicle components.

CONCLUSION

Having observed some researches, we came to the conclusion that testing the automobiles can be tested by two ways: full vehicle test and detail test. Parts which are tested in the laboratory are reability and durability tests and they can show the realibility and perfectness or durability of the product or machines. And this test is carried out using strain gages. It measures micro-movement. As we mentioned above, it is given extra

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movement for the parts and in this process it is observed the inner reaction or the action of the structure of the product. By this way, we get information about this process. And we measure the percentage of durability. It shows how much time the product produce the amount of durability of itself. It guaranties the product to work when it is given maximum energy.

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