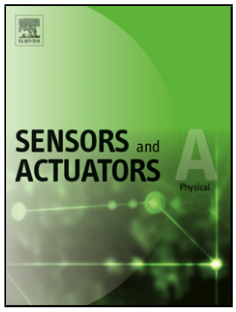
Journal Pre-proof



Wireless stress sensor based on piezoelectric energy harvesting for a rotating shaft

Piotr Micek, Dariusz Grzybek

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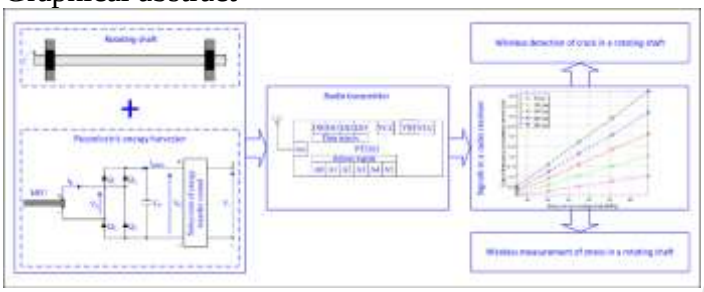
Wireless stress sensor based on piezoelectric energy harvesting for a rotating shaft

Piotr Micek
AGH University of Science and Technology,
Faculty of Mechanical Engineering and Robotics,
al. Mickiewicza 30, 30-059 Kraków, Poland
E-mail: micek_pt@agh.edu.pl

Dariusz Grzybek – corresponding author
AGH University of Science and Technology,
Faculty of Mechanical Engineering and Robotics,
al. Mickiewicza 30, 30-059 Kraków, Poland
E-mail: dariusz.grzybek@agh.edu.pl

Graphical abstract



Highlights

- Wireless stress sensor in rotating shaft is based on piezoelectric energy harvesting.
- Sensor consists of energy harvester, energy transfer control system, radio transmitter.
- Wireless stress sensor detects value of stress on the basis of radio signals.
- Wireless stress sensor can be also used to detection of crack appearance in shaft.

Abstract

A shaft is a mechanical component which transmits mechanical power and torque. A failure of the shaft may result in serious damage to machine in operation. Contact or noncontact monitoring techniques of rotating shaft have been developed in order to prevent this damage. The application of contact monitoring techniques requires the use of additional devices. First of all, a slip ring assembly, which enables a sensor supply and a sending of measurement data from a rotating shaft to some receivers. The use of the slip ring assembly, which requires an access to the front of the rotating shaft and an additional channel located in an inside of this shaft, are the most important weaknesses of contact techniques. In contrast to these approaches, the article presents a contact technique of stress monitoring in the rotating shaft, in which the slip ring assembly is not required. Presented contact technique consists of a wireless sensor based on piezoelectric energy harvester and a radio transmission system. The piezoelectric energy harvester consists of Macro Fiber Composite (MFC) patch and a system of energy storage and energy transfer control. MFC patch is directly glued to the rotating shaft surface and product an amount of electric energy which is enough to supply only a radio transmitter. Such built wireless sensor based on piezoelectric energy harvester was tested in laboratory stand which contained a rotating shaft with a system of force generation, a belt transmission with a system of generation of rotational motion, and a measurement system. The time between radio signals was measured for selected values of the rate of rotation of the shaft and for selected values of stress in