

Optical method for simultaneous measurement of temperature and power line extension

Abstract

The work addresses the issues of temperature and elongation measurements of power lines and how to monitor them, with the aim of developing a method to measure temperature and line elongation in parallel using fibre optic sensors with Bragg gratings.

The phenomena affecting the condition of overhead lines and methods of monitoring them are reviewed. It was pointed out that monitoring systems for overhead transmission lines not only provide increased power transmission reliability, but also help to reduce power line maintenance costs by providing more timely and accurate data as to the location of fault sections, as well as predicting problem situations along the route. It was highlighted that for this reason the use of fibre-optic sensors, which can measure both temperature and cable elongation continuously, is becoming interesting. Examples of a system solution for temperature measurement using a distributed optical sensor using Raman scattering were discussed. Literature data on how to monitor line icing (a factor affecting line elongation) and determine fault locations is analysed.

The main part of the work is the development of a concept for the simultaneous measurement of temperature and power line elongation using fibre Bragg gratings. For this purpose, the temperature dependence of the stress in the line conductor and its elongation was determined. Possible solutions for the determination of the necessary quantities using optical sensors are presented.

The results of laboratory tests of optical sensors for temperature and elongation with homogeneous Bragg gratings are presented. The tests carried out covered the characteristic ranges of variation of the measured quantities for overhead power lines. This made it possible to propose a concept for a dual-channel optical fibre sensor allowing simultaneous measurement of temperature and power line strain.

Keywords: fibre Bragg gratings, temperature measurement, stress measurement