PROTOTYPE DESIGN AND PRELIMINARY TESTS FOR ON LINE, REAL TIME SAG MONITORING OF HIGH VOLTAGE OVERHEAD LINES

Elena Golinelli[1], Gian Mario Ogliari[1], Daniele Bartalesi[1], Umberto Perini[2]*

1 R.S.E. S.p.A., Milano, Italy
2 Consultant, Milano, Italy
**elena.golinelli@rse-web.it*

A new optical system, based on image analysis, is being ad-hoc developed in RSE for the on line monitoring of the clearance to ground of overhead power line conductors and to study both winter ice sleeve formation and summer overheating.

Keywords: Optical systems, image analysis

1. Introduction

The global climate change has led to a substantial change in the climate areas previously defined for the design of the current electricity grid, this implies a greater probability that new climatic events cause damage to the network if not adequately monitored. Furthermore, the need for the production of energy from renewable sources implies a demand for greater flexibility in the transport of energy. In this context, the resilience of the electric grid is a hot and fundamental issue to ensure continuity and security of the service. It is therefore important to conduct a correct and effective management of the transmission grid and to assess the status of the components in order to identify appropriate intervention strategies.
Optical systems offer a decisive solution to monitor critical parameters, they can operate safely and, therefore, they are suitable for integration and security application to on-service electrical equipment. Their main characteristics are: high precision, contactless and real time. Here we describe a simple method to determine the position of conductors at mid span, based on an image processing technique.

2. Prototype description and preliminary tests

The technique we propose is based on the determination of the absolute position of targets, hanged at the conductors in the mid-span, illuminated with IR LED sources and displayed with an image-forming system placed on a trellis of the same line. The schematic arrangement of the system is shown in Figure 1. The monitoring system, based on a digital NIR video camera, is placed on one of the two pylons of the span of interest. An IR LED lighting system placed close to the camera ensures that the targets are easily observable in daytime and allows for night measurements. The positions of the mid-span targets is determined with respect to reference targets placed on the opposite trellis of the same span where the system is installed. This allows to eliminate, or at least significantly reduce, the effect of errors due to angular displacements of the trellis on which the system is installed (wind, ambient temperature, load), as shown schematically in Figure 1. In Figure 2 are shown the acquired images with two target tests at 70 m from the digital camera. Thanks to the NIR LED illumination the targets are easily detectable.

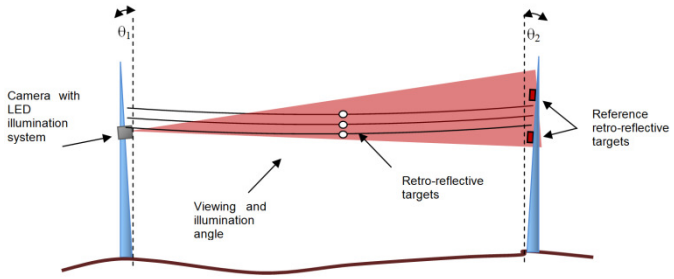

Fig. 1 Schematic arrangement of the system

(a) (b) (c)

Fig. 2 (a) target image with IR LED on, (b) target image with IR LED off, (c) image after background subtraction

The target positions can be determined with high accuracy, since the target images can be unambiguously located. The attainable position accuracy depends on the target distance, and is of the order of five pixels in the image (2,5cm at 70m) for these preliminary tests.

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