Student Thesis
Level: master’s

Aerial Thermography Inspections in Large-Scale PV Plants

Author: Salvador Selva Martí
Supervisor: Martin Andersen
Examiner: Ewa Wäckelgård
Subject/main field of study: PV Solar Energy
Course code: EG4001
Credits: 30
Date of public presentation/examination: 2018-09-17

At Dalarna University, you are able to publish your student thesis in full text in DiVA. The publishing is Open Access, which means your work will be freely accessible to read and download on the internet. This will significantly increase the dissemination and visibility of your student thesis.

Open Access is becoming the standard route for spreading scientific and academic information on the internet. Dalarna University recommends that both researchers as well as students publish their work Open Access.

I give my/we give our consent for full text publishing (freely accessible on the internet, Open Access):

Yes ☒  No ☐
Abstract:

In order to successfully compete against the use of fossil fuels to generate electricity, one of the challenges in the photovoltaic (PV) business currently in focus is on the asset management of large PV plants, in which developing control techniques to prognosticate and evaluate the future energy performance will be essential. Infrared thermography inspections can give meaningful support to assess the quality and performance of PV modules. However, the implementation of a cost-effective method to scan and check huge PV plants represents different challenges, such as the cost and time of detecting PV module defects with their classification and exact localization within the solar plant. In this context, it has recently been investigated the potential of a new innovative technology in the PV plants monitoring operations by using drones.

The main purpose of this work is to establish a scientific basis for the interpretation of thermographic images taken by drones, in particular, regarding the influence of thermographic irregularities which will negatively influence the performance of PV plants.

The drone is employed to monitor PV modules conditions by using special thermography sensors mounted on it in order to scan images. The captured images are then automatically sent to a technical office database for the image processing software. This special software receives, stores and analyses the captured images to detect the specific defect on the PV modules. Then, all information is processed and reported to the final decision-making team to decide about the best solution for the particular degraded PV module, in relation with the requirements from the operation and maintenance (O&M) services.

In this particularly study project of the inspected PV plant situated in the UK, which has been carried out by trained personnel at Quintas Energy (QE), the majority of identified faults, which influence the PV module performance (especially the power output significantly), are on a sub-panel level, either individual cells or uneven hot spots. There are also some modules with bypass diode faults as well as a string fault was detected. Such faults must be repaired by the PV module manufacturer, in relation to the manufacturer’s warranties, without any cost at all since the PV modules are indeed still in warranty.

It has been concluded that, in comparison with traditional manned systems by using hand-held cameras, the main functionality of using drones is the early fault diagnosis which could reduce corrective maintenance activities, since defects are easily and quickly identified and, then, repaired. This fact could reduce defects to become more serious and, thus, more difficult to be repaired, along with their correspondent production losses and costs.

QE has learned by making mistakes during this project study and gained experience of this unmanned aerial vehicles (UAV) technology. Currently, they are in the process of improving this technique and will continue to implement it to all their PV plants since the efficiency of PV systems can be significantly improved by appropriate use of O&M instruments and benefit from innovative monitoring tools, such as the unmanned aerial technology.

Keywords:

Infrared thermography inspection, large-scale PV plants, drone, unmanned aerial vehicles, Quintas Energy, operation and maintenance, monitoring operations.
Anything beyond this, the teacher’s directives apply.