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Thermal Monitoring for Condition Based Maintenance of an X-ray Generator

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The modern Non-Intrusive Inspection Systems (NIIS) are a highly sophisticated machines that incorporate quality x-ray generation and detection capabilities, supported by state-of-the-art electronics, electro-mechanics, software algorithms and solutions. They are the backbone of air transportation security, and the commercial aviation is impossible without NIIS. Thus, the adequate real-time evaluation of the NIIS technical condition is critical for airport operators. However, most of the NIIS operating worldwide are designed before the Internet of Things (IIoT) era, and they don't have options to provide sensor data in real-time. A solution for condition-based and predictive maintenance, developed recently, aims to provide an early warning for possible failures based on predictive algorithms using machine learning and AI technologies [1]. That solution relies strongly on the technical data collected from the NIIS itself, along with retrofitted sensors designed to monitor different physical and environmental parameters [2].

In the present study, we propose a 2D thermal monitoring approach as a new source of valuable data for estimating the x-ray generator's technical condition and input to the predictive models. The study provides both semi-analytical and experimental results. The proposed semi-analytical model has been compared with the experimental results based on the large datasets (big-data), collected by the sensors. The experimental setup consists of contact sensor arrays and a distant infrared sensors system, combined with mapping of the entire x-ray generator body outer side thermal boundary conditions. The examined x-ray generator is the most common type, equipped with a stationary anode x-ray tube, mounted on an HS 100100V (Smiths Heimann Gmbh). This x-ray generator type is widely implemented on similar x-ray security inspection systems for luggage and cargo. The thermal parameters of the x-ray generator were studied during many long tests run series conducted on HS 100100V, located at the Danlex research centre. To reach a steady state of the x-ray generator thermal parameters, most of the respective test runs have lasted more than 24 hours of continuous workload (x-ray beaming), simulating real-live operating conditions.

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References:

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