Enhanced Performance in X-ray Baggage Security Systems through Advanced Radiation Source Optimization

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There is an increasing demand for a high-performing X-ray baggage security screening system that maintains accuracy and reliability as globalization and trade volumes rapidly increase. However, detecting the hazardous materials or smuggled items due to multiple overlapping items in X-ray images are challenging. Precision in radiation source development is necessary to detect evolving concealment and false declarations in unstandardized items. The X-ray baggage screening equipment dominantly controlled by overseas corporations has taken over the global market, leading to heavy reliance on importing expensive foreign products in the domestic market. The majority of X-ray tubes, which are the core components of the system, are imported and assembled using reprocessed components. This emphasizes the necessity for indigenous X-ray tube technology. The internal components of the X-ray tube for baggage screening were designed considering thermal conductivity for extended operational hours. Additionally, introducing energy variability to the radiation source enables accurate and swift baggage screening. This allows to appropriately respond to various inspection scenarios. In addition, the performance of the X-ray screening system was enhanced by optimizing the radiation source using advanced technologies such as electron gun, focus control, and anode technologies. In this study, switchable on/off operations enabled extending the lifespan of the tube through detector synchronization during baggage screening based on the operational characteristics of the radiation source. Moreover, stable performance of the X-ray tube was achieved through the design of a 170 kV bipolar high-voltage power supply. Furthermore, the integration of system components increased system stability. It allowed us to obtain baggage images under the conditions of 100 kV and 0.1 mA.