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Abstract

Detection of Foreign Items in Laundry Industry—A Dual Energy XRT Approach †

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Abstract: Even outside of the instance of a global pandemic, the proper cleaning of professional work wear is crucial—thus, laundry technology becomes more and more efficient and automated. A bottleneck in the professional laundry process of working garments is the detection of foreign items in pockets and belts; undetected items may not only stain the clothes, but also harm the laundry machines and cause malfunctions or damages. However, the process of locating them is also potentially dangerous, as state-of-the-art is the manual scanning of every piece of garment to find items such as scissors, highlighters, syringes, screwdrivers, scalpels, paper notepads, and sweets. Some of the found objects are completely harmless, but several bare a high potential of injury for the worker involved in the laundry process. Due to the variety of the objects' materials—plastics, paper, metal, and glass—the items are very challenging to detect with conventional sensors, such as cameras or metal detectors. In non-destructive testing, X-ray transmission (XRT) proved to be a powerful tool for detecting items inside of objects that can not be found by superficial sensors. Unfortunately, XRT does not allow for the distinction between thick objects with low X-ray mass attenuation coefficient and thin objects of stronger attenuation. Thus, similar gray values may be detected, for instance, for components of clothes, such as reflective stripes and pens. In this case, a segmentation by simple thresholding would be hopeless. In contrast, dual energy XRT allows for the obtainment of quantitative information concerning the chemical composition of the scanned materials, which helps to identify objects. In this study, different kinds of working garments were loaded with realistic foreign items in order to show the potential of dual energy XRT in the laundry industry.

Keywords: laundry industry; laundry; X-ray transmission; dual energy; dual energy X-ray transmission; basis material decomposition; sorting

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