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Associated Image Processing Algorithm in Dual-Projection Systems

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Methods like single-projection detecting and CT detecting are widely used in radiation scanning systems, however, these methods have shortages such as an inability to differentiate materials and low efficiency so that methods with high accuracy and efficiency are required.

In this paper, we introduce a dual-projection radiation detection technique. Two groups of radioactive sources and detectors are fixed to obtain gray-scale images of target objects from two orientations. Algorithms are developed to combine these images and calculate the shape, position, attenuation coefficient and density of target objects rapidly and accurately. Ideally, target objects are assumed as convex polygons of single material. The gray-scale curves follow the ray attenuation theorem which contains physical property information such as attenuation coefficient and density. Inflections on the curve show when vertexes on target objects are scanned. To recover the target object geometry from gray-scale images, algorithms are developed with functions as follows:

1. Locating the position of each inflection on the curves and calculating their coordinates in real space coordinate where the vertexes are.
2. Combining these calculated vertexes to form polygons and remove those that do not meet the mentioned assumptions.
3. The selected polygons are re-projected by emulation. The calculated polygon whose gray-scale curves are closest to the ones of target object is chosen as the result of recovering. And its position, shape and density can also be calculated.

Matlab simulations were performed, verifying the feasibility of the algorithms. Given 10 mm detectors and an arbitrary pentagon target object, the result shows that the relative error of calculated absorption coefficient is 0.33%.

Realistic experiments with ideal target were performed. Standard aluminium blocks with sections of quadrilateral and pentagon are used as the target. The detectors are 7 mm in size and the radioactive source is ^{60}Co. The relative error of calculated density is within 3–5%. The difference between two experiment results of absorption coefficient is 4×10^{-3} which shows the high reproducibility of this system. Further experiments using non-ideal objects were made. A bucket of water was put in a container as the target. By moving the container continuously, a series of gray-scale curves, representing different sections of all things in it, are obtained and processed to recover the shape and position. The results show that the relative error of calculated density is 10.4% after eliminating the impact of background noise.

Details of the method and its application will be presented.

Country/Organization invited to participate

China

Primary author: Ms ZHAO, Xi (Institute of Nuclear and New Energy Technology, Tsinghua University; Shanghai Nuclear Engineering Research and Design Institute, China)

Co-authors: Mr LI, Litao (Institute of Nuclear and New Energy Technology, Tsinghua University; Beijing Key Laboratory on Nuclear Detection and Measurement Technology, China); Mr CONG, Peng (Institute of Nuclear and New Energy Technology, Tsinghua University; Beijing Key Laboratory on Nuclear Detection and Measurement Technology, China); Mr XIANG, Xincheng (Institute of Nuclear and New Energy Technology, Tsinghua University; Beijing Key Laboratory on Nuclear Detection and Measurement Technology, China); Mr ZHANG, Yanmin (Institute of Nuclear and New Energy Technology, Tsinghua University; Beijing Key Laboratory on Nuclear Detection and Measurement Technology, China)

Presenter: Mr CONG, Peng (Institute of Nuclear and New Energy Technology, Tsinghua University; Beijing Key Laboratory on Nuclear Detection and Measurement Technology, China)

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