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An objective approach to determining the steel penetration capabilities of X-ray cargo inspection systems

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The ANSI* steel penetration test is an important measure of the image performance capability of a cargo inspection system. Currently, the method for determining the arrow's visibility is completely subjective, as what one may deem 'visible', another may claim as not. An objective method is to calculate the contrast-to-noise ratio (CNR) between the steel plate and the arrow. A series of penetration scans were taken with the thickness of the steel plate ranging from 290-335 mm, and it was found that CNR decreases with increasing steel thickness. There is a point at which the CNR begins to level off - namely the 'limit of determination'. This is where the arrow can be objectively deemed as being no longer visible and, in this experiment, it was found to be at a CNR of around 0.23-0.25. Under-sampling the image data was also tested, and it was found that it did not have a detrimental effect on the CNR, and therefore the image performance. Once tested on more data sets, a definite value of the 'limit of determination' can be found. In future, this method has the capability of replacing the current method as an objective approach to determining the visibility of the arrow, and therefore measuring image performance using the steel penetration test.

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Footnotes

*[IEEE, 2008, 'American National Standard for Determination of the Imaging Performance of X-Ray and Gamma-Ray Systems for Cargo and Vehicle Security Screening', p.8-10]

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