Multiple ROI Solution for DICOS v03

Abstract:
Different Prohibited Items (PI) algorithms to detect weapons, knives, blunts, etc., can be applied to the same image. Each of these PI algorithms identifies Potential Threat Objects (PTO) within the image. In some cases, the different PI algorithms identify the same PTO. This results in multiple PTOs Region of Interest (ROI) being recognized on the same object within the image. Multiple ROIs on the same PTO cannot be presented to the Transportation Security Officer for resolution since redundancy and frustration will result. The three solutions presented are in this paper.

Proposed Additional Tag Attributes:

Owner Module Attributes	Tag	Type	VR	VM	Attribute Description
ROI Resolution	(4010,1247)	1C	CS	1	The possible bounding box resolution methods are: • Summation • Largest ROI • Highest Assessment Probability • Other
Aggregating Method for ROI	(4010,1249)	1C	LT	1	Text description on how the Aggregate Application combined the different TDRs for the same PTO from different TDRs

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Background

Different Prohibited Items (PI) algorithms to detect weapons, knives, blunts, etc., can be applied to the same image. Each of these PI algorithms identifies Potential Threat Objects (PTOs) within the image. In some cases, the different PI algorithms identify the same PTO. This results in multiple PTOs Region of Interest (ROI) being recognized on the same object within the image. Multiple ROIs on the same PTO cannot be presented to the TSO for resolution since confusion and frustration will result. There are three solutions presented in this paper. The first solution is to combine all the ROIs into one, the second is to select the largest ROI over the PTO, the third is to select the ROI of the PTO with the highest assessment probability, making this the principal characteristic of the PTO and identifying the object with the ROI.

ROI Solutions

Three solutions are provided below instead of displaying the same PTO with three different ROIs, which may confuse the screener and cause them to perceive a more significant number of alarms in the bag.

Solution 1: Outermost sum of the ROIs

Three different PI detection algorithms have generated three different ROIs for a PTO, as shown in Figure 1.

- ROI-1 – by the weapons PI algorithm
- ROI-2 – by the knife PI algorithm
- ROI-3 – by the blunt PI algorithm

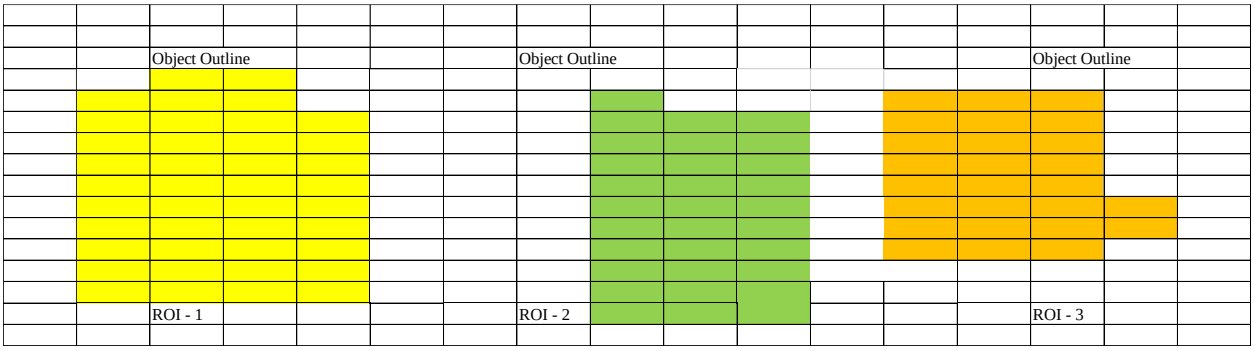

Figure 1. Three different ROIs were generated by three different PI algorithms identifying a potential threat. The ROIs are made more prominent for display purposes.

The ROIs are combined into one oversized ROI. ROI is composed of the summation of the overlapping ROIs, as shown in Figure 2. What is displayed to the screener is shown in Figure 3.

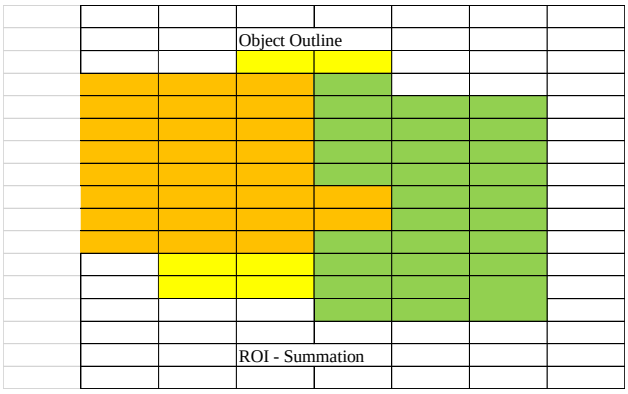

Figure 2. Generating a summation ROI as an outline of the ROIs.

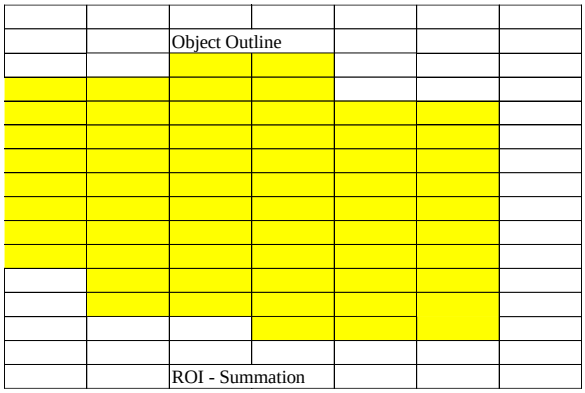

Figure 3. Shows the resultant ROI for the potential PI using the summation of the individual ROIs.

The method used to combine or report the associated tag attributes for this solution will be determined by the implementor. This method will be described in the *Aggregate Method for ROI* attribute using long text.

Solution 2: Largest ROI

In this case, ROI with the most significant area is chosen as the display ROI, and the other ROIs are not displayed.

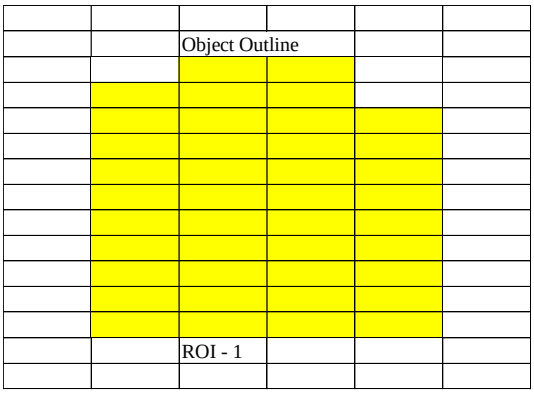

Figure 4. The ROI that is displayed is the ROI with the most significant area, as shown in Figure 1. The other ROIs would not be shown to the screener for the PI.

The associated tag attributes for Solution 2 will just be a copy of the existing associated tag attributes.

Solution 3: Highest PTO Assessment Probability

The ROI selected to be displayed is the one with the highest level of *Assessment Probability* for the PTO.

For the above example, the following ROIs are provided along with the confidence level of each:

- ROI-1: by the weapons PI algorithm, 80% of weapons
- ROI-2: by the knife PI algorithm, 30% of knives
- ROI-3: by the blunt PI algorithm, 20% blunt

Using just the confidence levels, ROI-1 would be the ROI selected for the PTO. The other ROIs would be disregarded.

The associated tag attributes for Solution 3 would just be a copy of the existing associated tag attributes.

Suggestion: Add a tag attribute to the TDR which states which type of bounding box resolution method is being used and how the associated tag attributes are populated as shown in Table 1.

Table 1. Additional Region of Interest (ROI) Attributes

Owner Module Attributes	Tag	Type	VR	VM	Attribute Description
ROI Resolution	(4010,1247)	1C	CS	1	The possible bounding box resolution methods are: • Summation • Largest ROI • Highest Assessment Probability • Other
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ACRONYM LIST

PI	Prohibited Items
PTO	Potential Threat Objects
ROI	Region of Interest
TDR	Threat Detection Report