Learning Modulated Loss for Rotated Object Detection

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Horizontal object detection and Rotated object detection
Traditional Definitions of rotated bounding box
The discontinuity of loss in five-parameter methods

(a) Width is longer than height.

(b) Height is longer than width.
The discontinuity of loss in five-parameter methods

Figure 2: Loss discontinuity: rectangles in blue, red, and green respectively denote reference box, ground truth, and prediction. Here the reference box is rotated one degree clockwise to get the ground truth and is rotated similarly counterclockwise to obtain the prediction. Then the three boxes are described with five parameters: reference (0, 0, 10, 25, -90°), ground truth (0, 0, 25, 10, -1°), and prediction (0, 0, 10, 25, -89°). Here ℓ₁ loss is far more than 0.
The discontinuity of loss in five-parameter methods
The discontinuity of loss in five-parameter methods
\[ t_x = \frac{x - x_a}{w_a} \quad t_y = \frac{y - y_a}{h_a} \quad t_w = \log \left( \frac{W}{w_a} \right) \]

\[ t_h = \log \left( \frac{h}{h_a} \right) \quad t_\theta = \frac{\theta \pi}{180} \]
The discontinuity of loss in five-parameter methods

\[ \ell_{cp} = |x_1 - x_2| + |y_1 - y_2|, \quad (2) \]

\[ \ell_{mp}^5 = \min \left\{ \begin{array}{l}
\ell_{cp} + |w_1 - w_2| + |h_1 - h_2| + |	heta_1 - \theta_2| \\
\ell_{cp} + |w_1 - h_2| + |h_1 - w_2| \\
\quad + |90 - |	heta_1 - \theta_2||,
\end{array} \right. \quad (3) \]
(a) Discontinuous $\ell_1$-loss

(b) Continuous $\ell_{5p}^{\infty}$
The discontinuity of loss in eight-parameter methods
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\[
\ell_{mr}^{8p} = \min \left\{ \sum_{i=0}^{3} \left( \frac{|x(i+3)\%4 - x_i^*|}{w_a} + \frac{|y(i+3)\%4 - y_i^*|}{h_a} \right) \right\}
\]

\[
= \min \left\{ \sum_{i=0}^{3} \left( \frac{|x_i - x_i^*|}{w_a} + \frac{|y_i - y_i^*|}{h_a} \right) \right\}
\]

\[
= \min \left\{ \sum_{i=0}^{3} \left( \frac{|x(i+1)\%4 - x_i^*|}{w_a} + \frac{|y(i+1)\%4 - y_i^*|}{h_a} \right) \right\}
\]

(6)
The discontinuity of loss in eight-parameter methods

\[ t_x = \frac{x - x_a}{w_a} \quad t_y = \frac{y - y_a}{h_a} \quad t_w = \log \left( \frac{w}{w_a} \right) \]

\[ t_h = \log \left( \frac{h}{h_a} \right) \quad t_\theta = \frac{\theta \pi}{180} \]
(a) Loss curves (five-param.)  (b) Loss curves (eight-param.)
THANKS