第四届中国模式识别与计算机视觉大会
4th Chinese Conference on PatternRecognition and Computer Vision

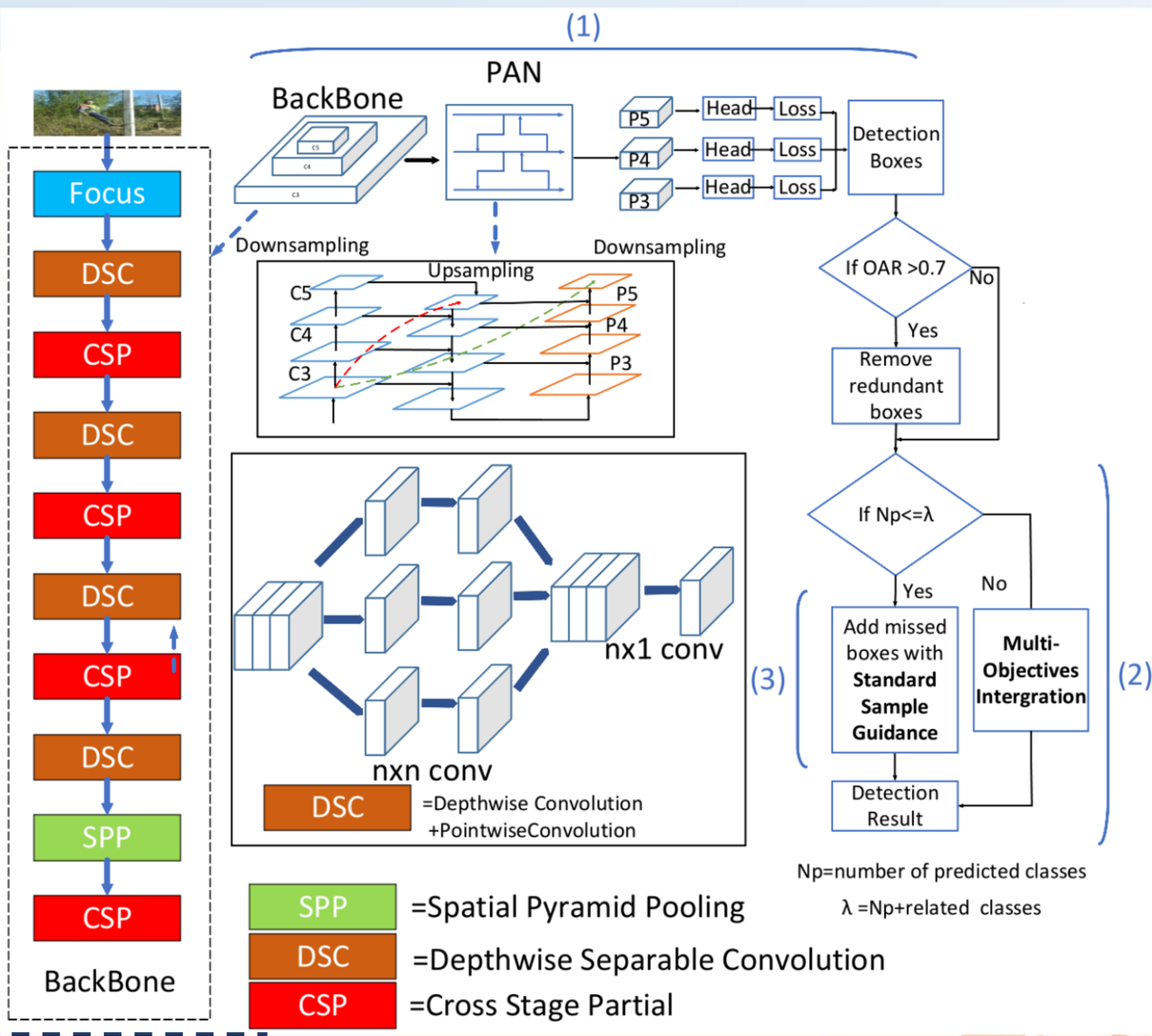
ID 254: DP-YOLOv5:Computer Vision-Based Risk Behavior Detection in Power Grids

Zhe Wang, Yubo Zheng, Xinhang Li, Xikang Jiang, Zheng Yuan, Lei L, and Lin Zhang*

leili@bupt.edu.cn

Abstract

The level of safety in power grid construction has been improved by Computer Vision (CV) recently with deep Convolutional Neural Networks (CNN). However, due to environmental complexity and risk behaviors diversity, the current detection algorithms still have false and missing detection problems. This paper quantitatively analyses these practical problems and proposes a **Double Precise YOLOv5** (DP-YOLOv5) method. Compared to other state-of-art detectors, DP-YOLOv5 highlights three points: integrating multi objects for each classification to avoid false detection in complex environments, adding standard operation samples for guidance to reduce the missing detection caused by risk behaviors diversity, and using Depth-wise Separable convolutional networks to reduce model parameters. The proposed DP-YOLOv5 method is evaluated on a dataset with 2.5k images generated in real power grid operation environments provided by State Grid Jiangsu Electric Power Co., Ltd. Compared with the state-of-art YOLOv5s detector. Experimental results show that the **precision of DP-YOLOv5 is 7.1% higher**, while the **model size is 20% less**.



Multi-objects Integration & Standard Samples Guidance

Standard Samples Guidance

Algorithm 1: Standard Samples Guidance Algorithm

Input: Risk behavior objects $B=\{B_1,B_2,...,B_j\}$
Output: B with missed behavior objects $M=\{M_1,M_2,...,M_j\}$
for *i=1:length(B)* **do**
  Check whether the behavior B_i has associated behaviors
  if Behavior B_i is associated with Behavior M_i **then**
    if Operation M_i is not detected then
      Add operation M_i to objects set B
    end
  end
end
return objects set $B=\{B_1,B_2,...,B_j,M_1,...,M_i\}$

+

Multi-objects Integration

Sort **Risk behavior objects** Rr = {Rr(1), Rr(2), ..., Rr(i)} by location from left to right

Sort **Specific part of risk behavior objects** Rd = {Rd(1), Rd(2), ..., Rd(j)} by location from left to right

Calculate **Overlapping Area Ratio** (OAR)

Compare OAR with **threshold** γ=0.7

Delete redundant objects with **lower confidence**

Ablation Studies

	Methods	Precision	Recall	Parameters	Infer Time	Total Process Time (3070)
A	YOLOv5s	0.858	0.752	13.7MB	1.6	2.3
B	**A** + DS Convolution	0.849	0.773	11.9MB	1.4	2.1
C	**B** + Smaller Input Size	0.838	0.726	11.9MB	0.9	1.6
D	**DP-YOLOv5**	**0.935**	**0.746**	**11.9MB**	0.9	1.9

Visual Process Comparision with Common method

Simulation and Results

Methods	Image Size	Precision	Recall	Parameters	Infer Time	Process Time (3070)
YOLOv5s	640	0.858	0.752	13.7MB	1.6	2.3
YOLOv5s	480	0.87475	0.68575	13.7MB	0.9	1.6
YOLOv5s	320	0.88275	0.6385	13.7MB	0.5	1.1
YOLOv5s+Mobilenetv2	640	0.653	0.804	7.2MB	2.0	3.0
YOLOv5s+Mobilenetv2	480	0.705	0.738	7.2MB	2.0	3.0
YOLOv5s+Mobilenetv2	320	0.750	0.733	7.2MB	2.0	3.0
YOLOv5l	640	0.849	0.772	89.4MB	5.4	6.0
YOLOv5l	480	0.878	0.662	89.4MB	3.2	3.9
YOLOv5l	320	0.79	0.756	89.4MB	1.7	2.3
YOLOv5l+Mobilenetv2	640	0.684	0.71	29.6MB	3.1	4.1
YOLOv5l+Mobilenetv2	480	0.75	0.722	29.6MB	1.8	2.8
YOLOv5l+Mobilenetv2	320	0.73	0.69	29.6MB	1.0	1.9
YOLOv5m	640	0.887	0.778	40.5MB	3.4	4.0
YOLOv5m	320	0.863	0.699	40.5MB	1.1	1.7
YOLOv5x	640	0.889	0.80	167MB	10.3	11.0
YOLO-Mobile	640	0.67	0.749	42.3MB	2.7	3.7
YOLO-Mobile	480	0.702	0.733	42.3MB	1.6	2.6
YOLO-Mobile	320	0.734	0.644	42.3MB	0.9	1.8
DP-YOLOv5	**480**	**0.935**	**0.746**	**11.9MB**	**1.2**	**2.1**

2021