

## Title: Applying Deep Learning Technology in UAV to Realize Defects Detection of Overhead Transmission Lines

Industrial Application Field: ☐Intelligent Manufacturing ☐Intelligent Driving ☐Intelligent Life  
☐Smart Medicine ☒Smart City

### [Overall background]

In order to ensure the safe and stable operation of the power grid, according to the relevant regulations, the staff must conduct regular inspections of overhead transmission lines. Traditional detection methods mainly rely on manual patrol inspection and visual inspection, in the presence of false detection or missing detection problems. Meanwhile, they also consume a lot of manpower and material resources. High voltage transmission lines are large and wide, and there are many potential hazards in the surrounding environment, which is not conducive to manual detection, so the application scope of traditional maintenance and inspection methods is greatly reduced. In order to solve this problem, the helicopter inspection and unmanned aerial vehicle (UAV) patrol technology have been widely used. They are equipped with photography or camera equipment along the transmission line corridor, close range filming line and its key parts, fetching aerial images, and the defective parts of the aerial transmission lines in the aerial images that annotated manually. The traditional image annotation is operated artificially, where understanding and annotation on the image are relatively accurate. However, in the big data environment of image annotation, the manual annotation is a hard work, and it is easily influenced by the subjective experience. As the result, the annotation of the same image is not consistent. Therefore, some scholars have proposed the intelligent detection method of automatic annotation of images using computer technology. As a new route inspection method, intelligent detection method has been paid more and more attention because of its excellent performance, wide sphere of application, and the requirements of modern intelligentization and automation.



图1 无人机巡检航拍场景图

Fig. 1 Inspection and aerial images of UAV

### [Business background]

As an important technical means of modern inspection, unmanned aerial vehicle (UAV) plays an important role in detecting defects in overhead transmission lines. Machine learning is an important branch of artificial intelligence. It is the fundamental way to make the computer intelligent. While deep learning is the branch of machine learning, it plays an extremely important role in defect detection. Therefore, the combination of deep learning and modern inspection technology has high convenience and superiority in power defect detection. However, the sample

used in the training of deep learning model needs manual annotation and time-consuming. If the computer technology is used to mark the defects of the training samples, a lot of manpower and material resources will be saved. Therefore, the improvement of the original deep learning defect detection can be made to meet the requirements of modern intelligent inspection.

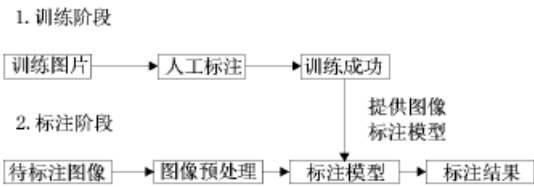


图2 基于人工标注的研究思路示意图

Fig. 2 Illustration of research idea for manual annotation

[Problem description]

At present, the specific parts of the draping clips in overhead transmission lines are based on manual annotation, and the manual annotation is a hard and inefficient work, and it is easily influenced by the subjective experience. On the one hand, the efficiency of defect annotation can be greatly improved on the premise to guarantee low error detection rate. On the other hand, the model training efficiency can be improved by avoiding the manual participation.



图3 销钉脱落

Fig. 3 Pin dropping



图4 销钉完好

Fig. 4 Pin in good condition

[User expectations]

- (1) The image data for training and testing (a single background) contains two categories of normal and pin dropping, providing 1000 unlabeled images for the participants' training and testing; 200 pictures are used to verify the model built. The models that are set up by the participants can mark out the falling position of the defective images;
- (2) Data sources of 1000 images are provided to the participants for training and testing, the proportion of the training set and the test set is 7:3. In addition, the participants can manually

annotate the training model (follow up model 1).

(3) As an evaluation index, mAP( mean Average Precision) is above 0.65 for validation set.

[Expected economic effect]

During the "12th Five-Year" period, China's power grid construction has experienced a rapid development stage, and the scale has ranked first in the world. At present, China has built six major trans-provincial power grids, which are the six power grids in the south, northwest, east, center, north and northeast of China, with the total length of the transmission lines exceeding 1 million 150 thousand km. The transmission lines of 500KV and above have become the main power transmission lines in all areas. China has a vast territory, relatively complex terrain, more hills, less plains, and complex and changeable weather conditions, which bring some difficulty to the construction of the cross district power grid and ultra high voltage transmission lines. The existing inspection methods and conventional tests can't not only satisfy the maintenance after the completion, but also achieve good results of high efficiency and fast demand. The application of UAV technology can complete the task of electric power inspection and construction planning well. The combination of deep learning and UAV inspection technology will naturally get the approval and large-scale application of electric power enterprises.

[Technical path]

(1) Defect detection based on deep learning (convolution neural network, etc.);

(2) Contestants can manage to obtain no more than 1000 image data (not required for the background, but must be loosed for the pinch pin) for batch automatic marking (instead of manual marking) training model (follow up model 2), and the participants with automatic batch marking will have extra bonus points;

[Technical indicators]

Model 1 and model 2 have to be validated, with the final 200 image data sources as validation sets, mAP (values between 0-1) as validation indicators, for test sets, the mAP of model 1 is above 0.65, and the mAP of model 2 is above 0.6;

[Standard submission]

Participants are required to design a scheme which requirements patrol inspection from the perspective of power inspection.

(1) For defective images, it is possible to accurately mark defects with rectangles.

(2) Competitors can submit model 1 only, or submit model 1 and model.2, but for the test set, the mAP of model 1 is required to be over 0.65, and the mAP of model 2 is required to be over 0.6;

(3)The final score of the contestants is: the mAP value of model 1 \*50\*0.3 + the mAP value of model 2 \*50\*0.7 (full score is 100 points, if only submits model 1, the mAP value of model 2 is recorded as 0).

[Highlight]

The theme of this contest is to encourage each contestant to solve a major technical difficulty that is manual marking training samples in defect detection based on deep learning by thinking and practice. The participants to solve this problem can achieve higher score. In addition, in order to encourage more participants to participate in the competition, participants are allowed to train the

model by manual annotation.

[Task lists]

- (1) For the contestants that only submit model 1, they need to hand in model source code or executable file.
- (2) For the contestants that submit model 1 and the model 2, all the model source code or executable files are required. In addition, a program for automatic annotation, not manual annotation, and data sources which are automatic annotated are also required.

[Reference tool]

LabelImg

[References]

<https://github.com/experiencor/keras-yolo2>

<https://pjreddie.com/darknet/yolo>

<http://blog.csdn.net/hjimce/article/details/50187029>

[Data interface]

None