Application of image big data analysis technology in China Railway

Research and Application Innovation Center

for Big Data Technology in Railway

CONTENT

01 Introduce

- The suspension device of catenary is mounted on the prop through a support device, and its function is to transmit the electrical energy obtained from the traction substation to the electric locomotive.
- Catenary inspection car is equipped with the newest suspension condition monitoring device, which get HD images of each part of suspension device of catenary .
- By analyzing the image of the catenary components, we can judge whether the catenary has security flaw.

01 Introduce

- The detection devices of catenary suspension condition generates a huge number of HD pictures.
- At present, in order to find security risks, the work mainly rely on man power to analyse pictures.
- **Shortcomings** :

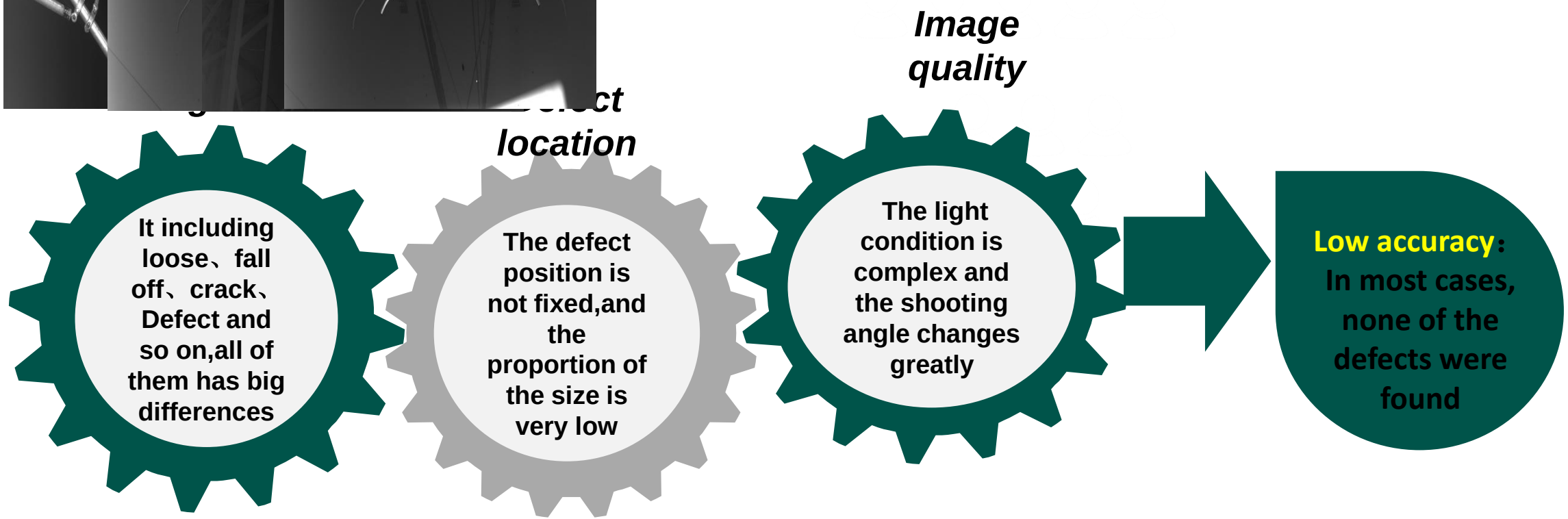
①High labor intensity;

②The uncertainty of detection accuracy, which depends on tester's skill level and state;

③ Long detection cycle.

01 Introduce

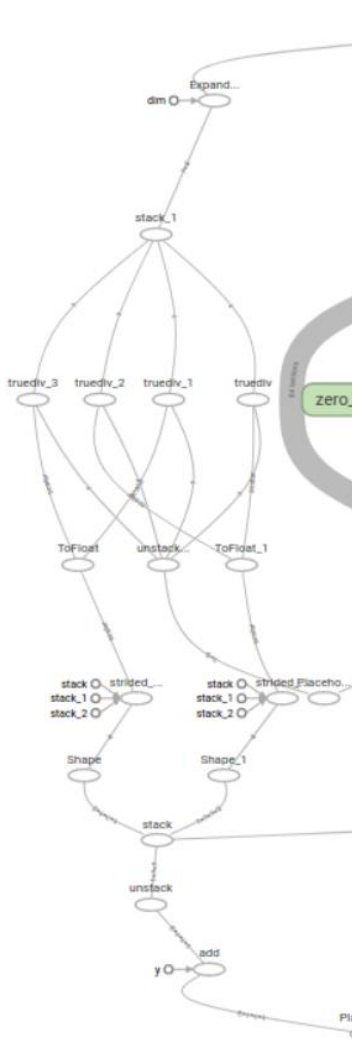
ect catenary images automatically, and the main idea is t plate, compare the detected image with the known t ough similarity measurements.

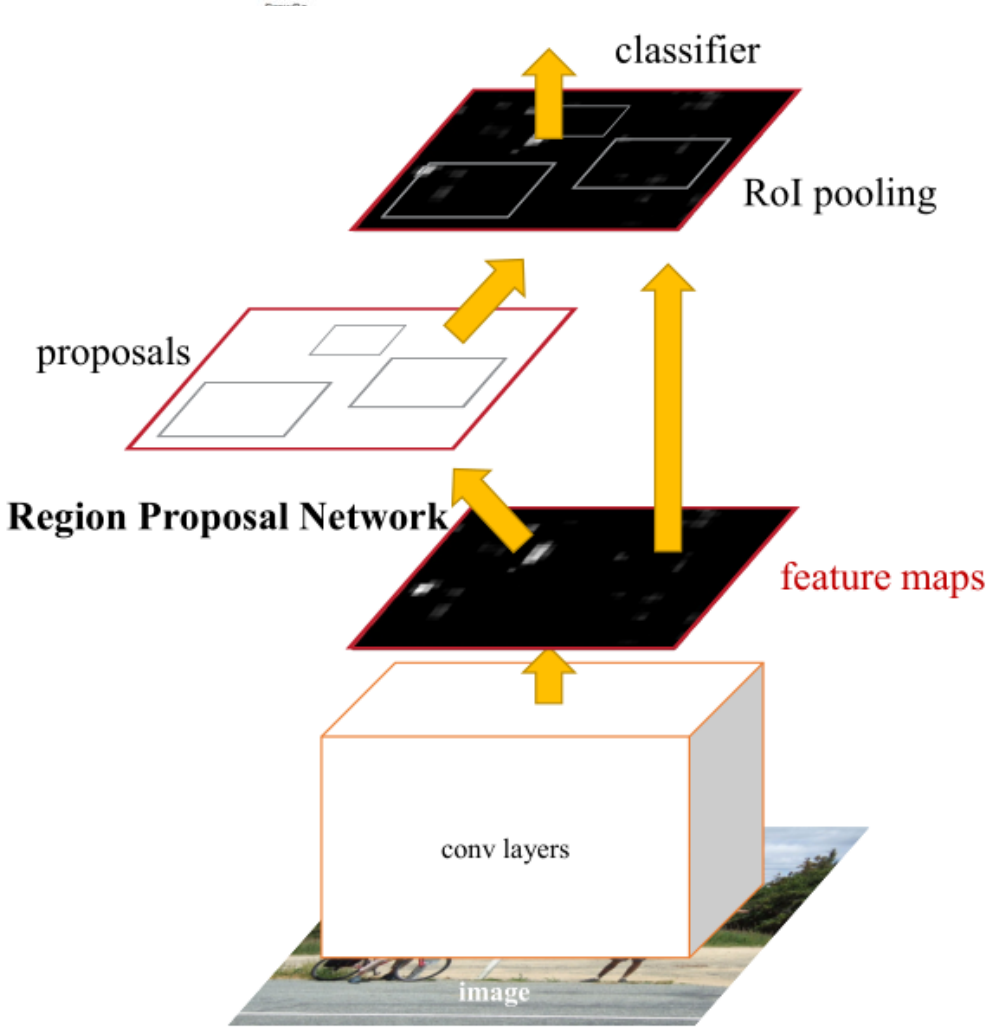


02 Technical solution

Data sources：there are more than 10000 images, labelled and divided into training data and test data. We choose the typical defects such as “cap missing", "casing slip","tie line is not binding".

Model：vgg16 network is selected for feature extraction, and adjust parameters with defect characteristics.

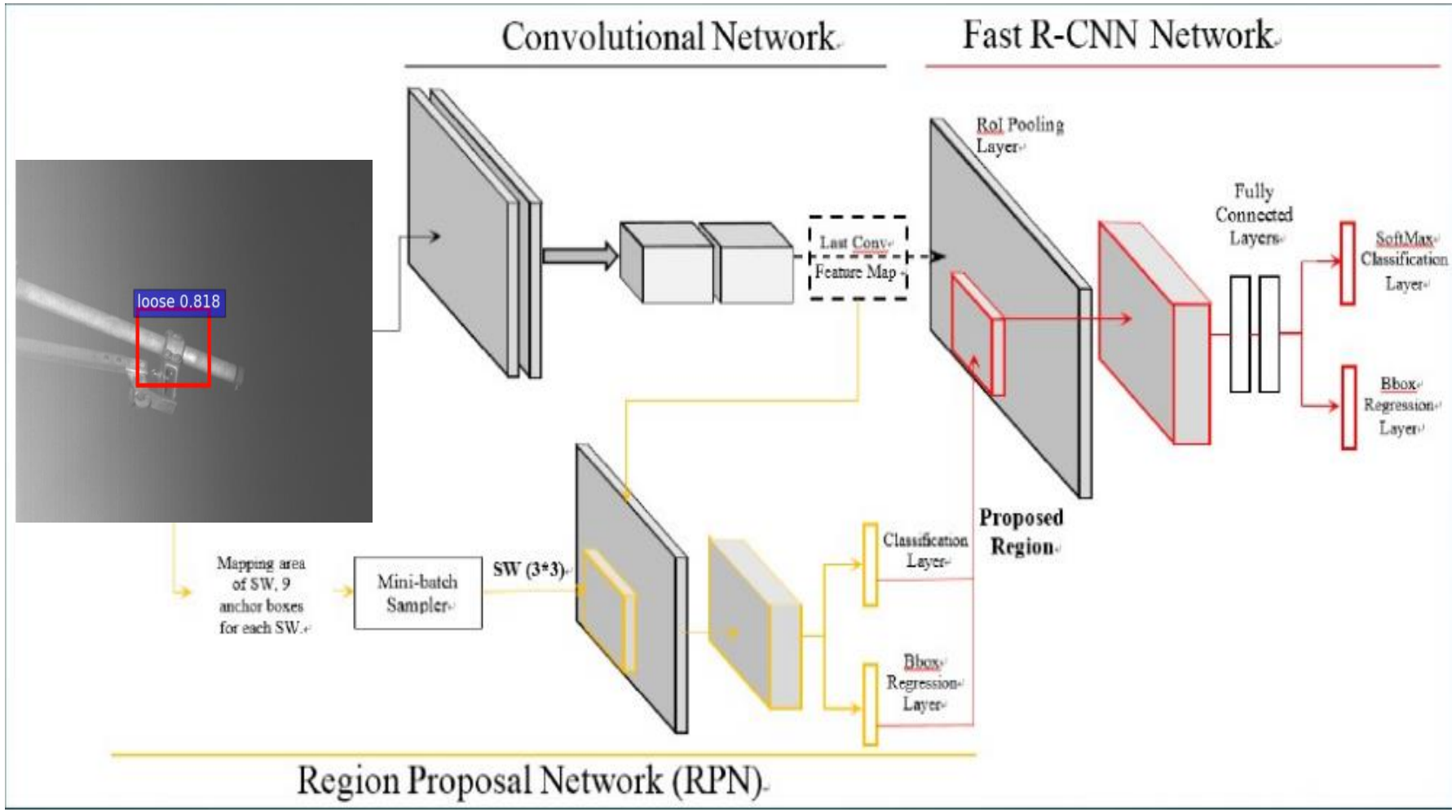




02 Technical solution

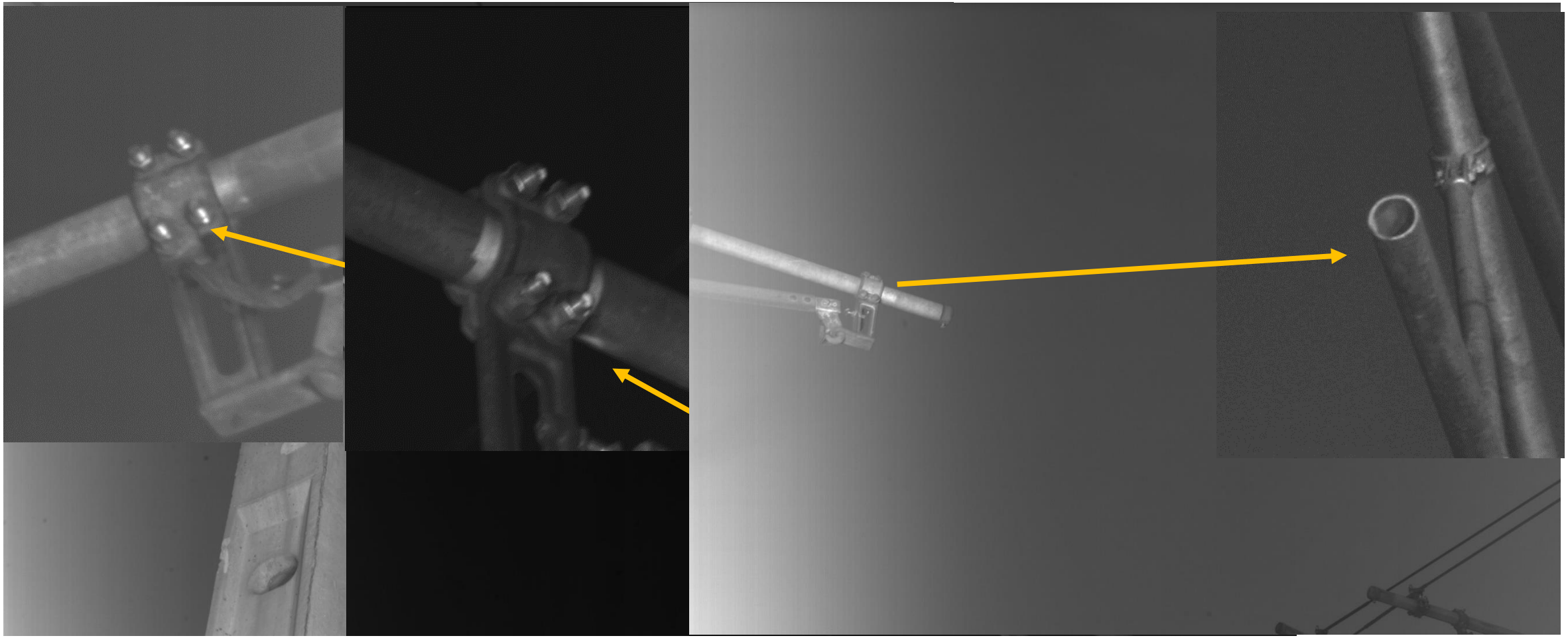
Architecture

The right picture is an architectural process for our entire work, taking defect as an example, which not only locates the defect location, but also defines the type of defect.



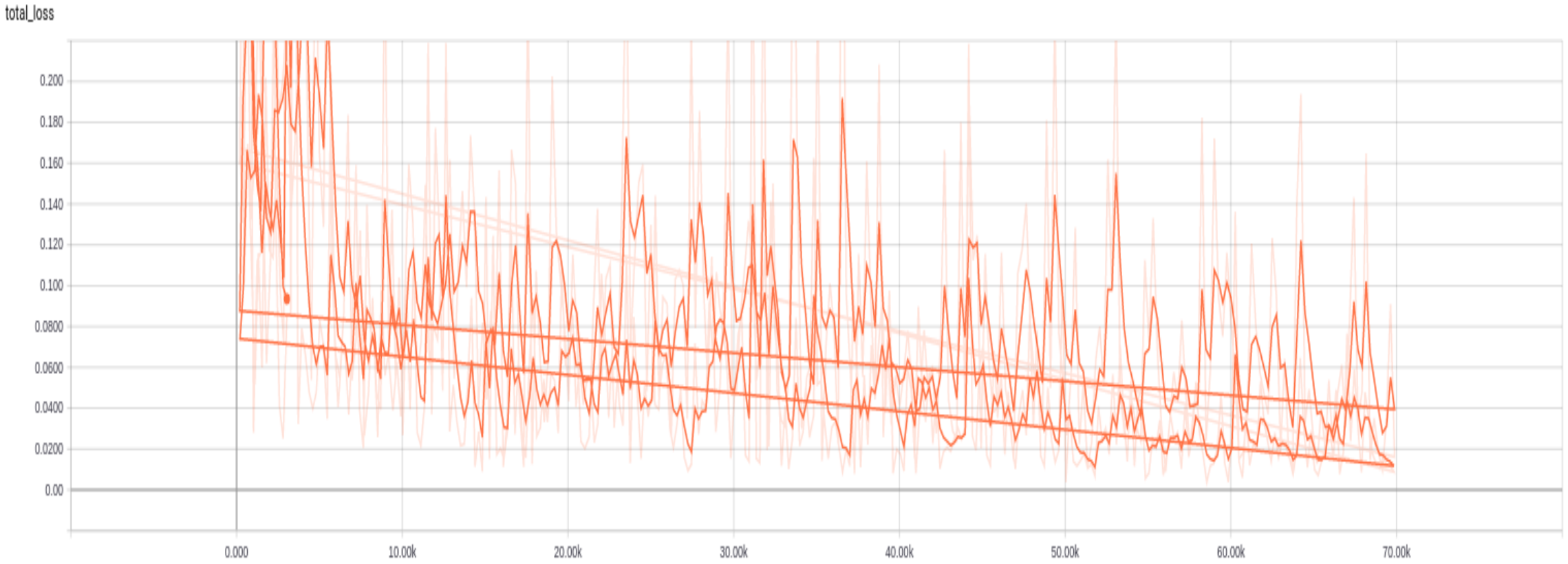
03 Test effect

Some input data are as follows:



03 Test effect

The training time of 280 thousand iterations in a GTX1080 gpu server is about 54 hours, and the value of loss close to convergence.



03 Test effect

Result：The deep neural network model can detect and locate the defects automatically. The average recognition accuracy rate of defect position is 97.3%, the average recognition accuracy rate of defect type is 91.6%, and also has the space to continue increasing.

04 Conclusion

Catenary inspection car produces 2 million HD images after performing a test on a route. The following is comparison between man power analysis and deep learning method:

	Deep Learning Analysis	Man Power Analysis
Efficiency	• Each photo processing time is about 0.3s; • One machine can handle 10,000 pictures an hour; • 10 Machines can complete whole analysis within 20h;	• A skilled image analyst can analyze 40 images a hour; • A team consists of 100 analyst needs 2 months to complete the analysis
Accuracy	• When model training is finished, accuracy of model stay stable; • Accuracy is not affected by other factors;	• The accuracy of different analysts has a large fluctuation; • Accuracy is affected by people's working status; • Poor analysis stability

04 Conclusion

technology innovation：

Apply advanced artificial intelligence technology to railway catenary image defect detection. The method improves the testing efficiency and shorten the detection cycle at the same time, compared with the existing technology method, the automatic detection accuracy of the defects in catenary increase by orders of magnitude.

follow-up work：

1. Incorporate more defect types into the model.We hope to detect image only one time with one model, achieve full coverage of major defects.

2. Continue to adjust the model to improve the efficiency and accuracy of the detection.

05 Team Introduction

- ***Research and Application Innovation Center for Big Data Technology in Railway*** was established in 2016,with a team of 50 people.
- The **purpose** of institutions is to implement China big data strategy ,and promote the research and application of railway big data.
- **Business direction**
  - Build railway big data platform
  - Realize data sharing in railway industry
  - Ensure security of railway big data
  - Analysis and mining of railway big data
  - Research on application of artificial intelligence in railway

Thank you !