基于ECA模式和GHOST模板改进的农业育种筛选系统

Track : AI

Grade : 2024

Batch: Batch 4

Background

- Corn, as one of the three major food crops in the world, has strong environmental adaptability and high nutritional value; As the staple food of about one-third of the global population, the growth of corn is closely related to seed quality.

背景

- 玉米作为世界三大粮食作物之一，环境适应性强，营养价值高；玉米作为全球约三分之一人口的主食，其生长发育与种子质量密切相关。

Background

- The appearance of corn seeds is one of the important indicators for quality evaluation, and the traditional screening mode mainly relies on visual inspection of their surface defects; Although computer vision is a relatively mature technology, it still requires manual feature extraction.

背景

- 玉米种子的外观是质量评价的重要指标之一，传统的筛选模式主要依靠对其表面缺陷的目视检查；尽管计算机视觉是一项相对成熟的技术，但它仍然需要手动提取特征

Data collection

- To train the model, we first captured 5740 images of corn seeds from two major categories and five subcategories using high-definition cameras. 121 images were grouped together to form our dataset, and four fifths of the images were used as the training set and one fifth as the testing set.

Types of Maize Seed	Number
Sound	2210
Damaged	1200
Insect-damaged	1105
Heat-damaged	1225
Total	5740

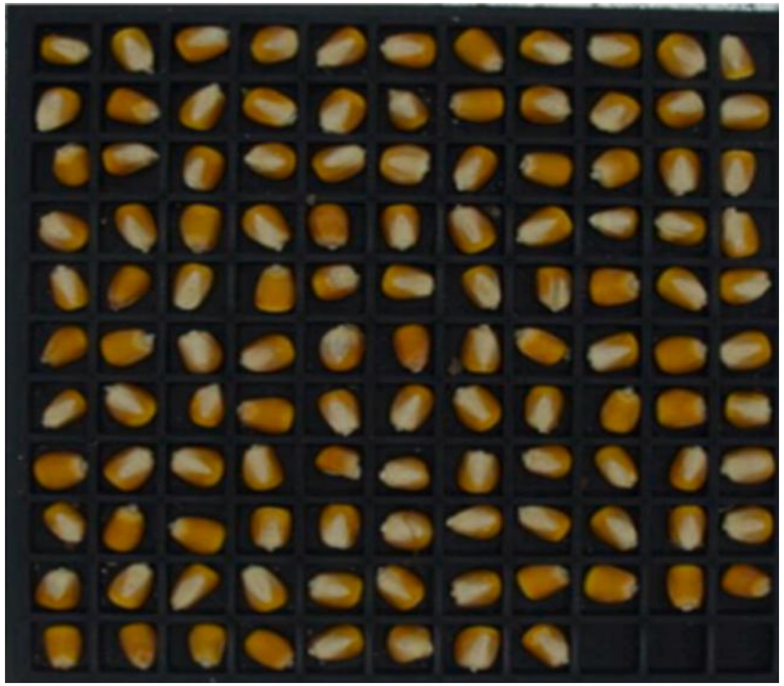
数据收集

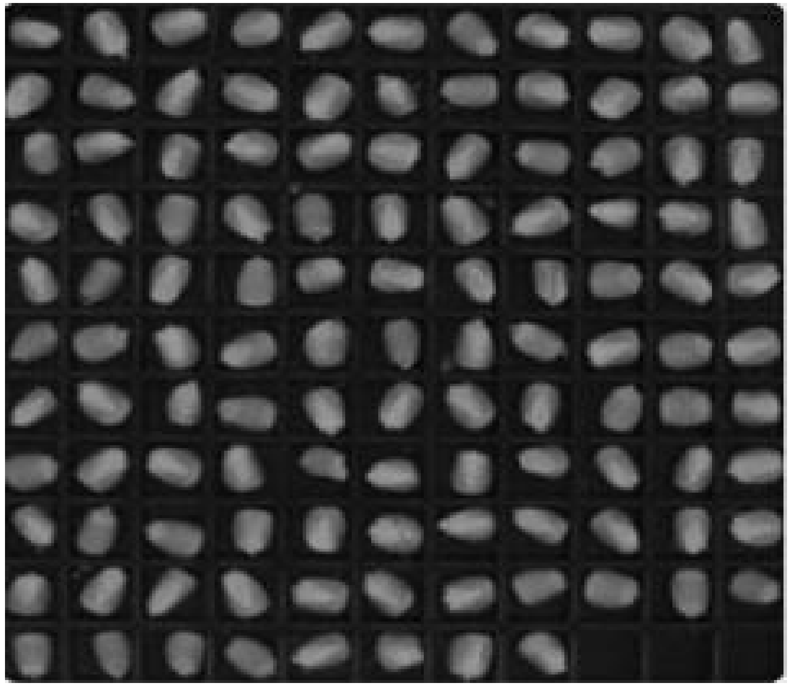
- 为了训练模型，我们首先使用高清相机从两大类和五个子类中捕获了**5740**张玉米种子图像。**121**幅图像被分组在一起形成我们的数据集，其中五分之四的图像被用作训练集，五分之一的图像被作为测试集。

Types of Maize Seed	Number
Sound	2210
Damaged	1200
Insect-damaged	1105
Heat-damaged	1225
Total	5740

Grayscale processing

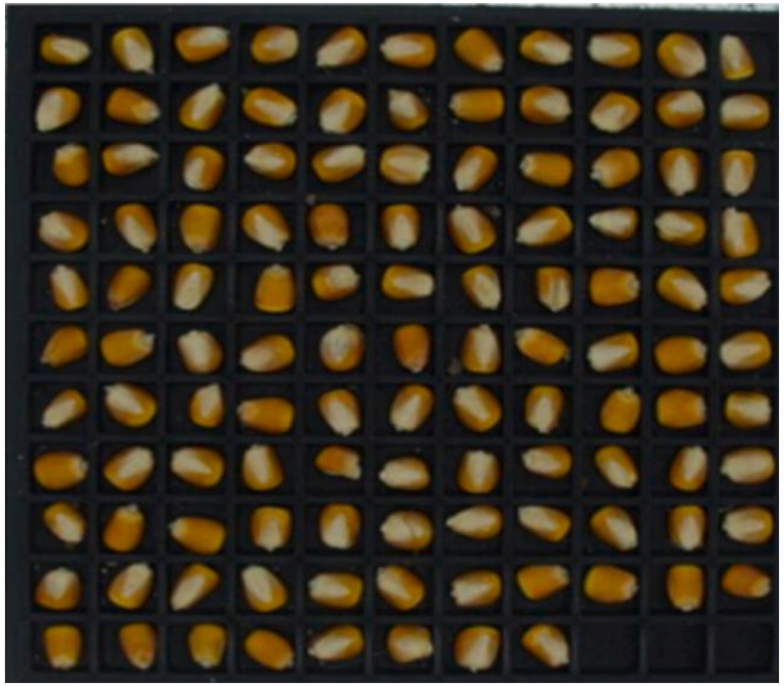
- Firstly, we converted the original image into a grayscale image.

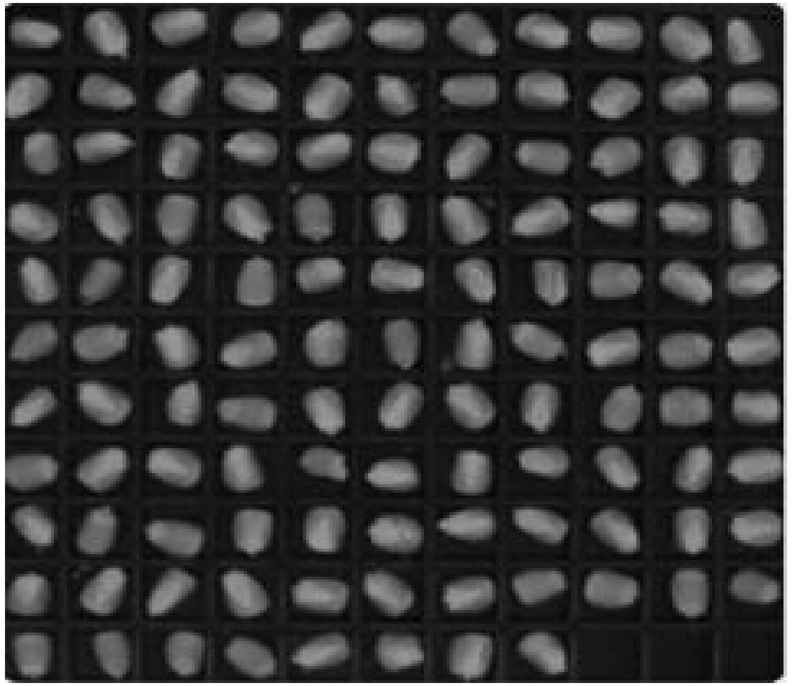




灰度处理

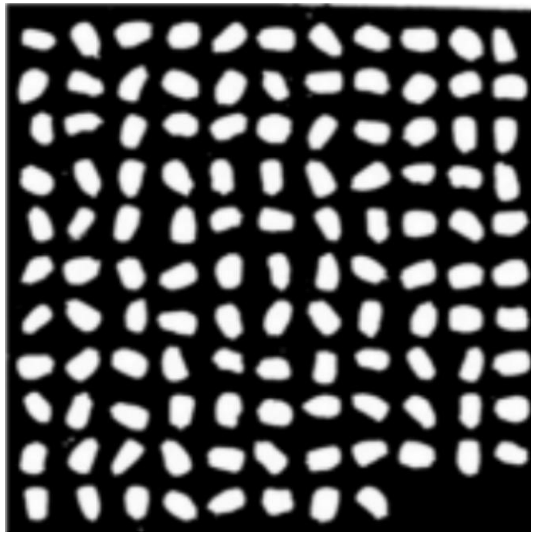
- 首先，我们将原始图像转换为灰度图像。





Filter processing

- Subsequently, we performed filtering on the grayscale images, including mean filtering, median filtering, and Gaussian filtering from top to bottom. From these three graphs, it can be seen that median filtering has the most significant effect.



过滤器处理

- 随后，我们对灰度图像进行了滤波，包括从上到下的均值滤波、中值滤波和高斯滤波。从这三张图中可以看出，中值滤波的效果最为显著。

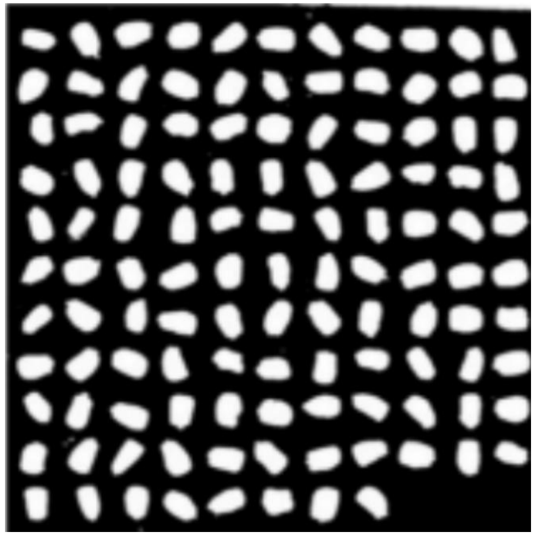


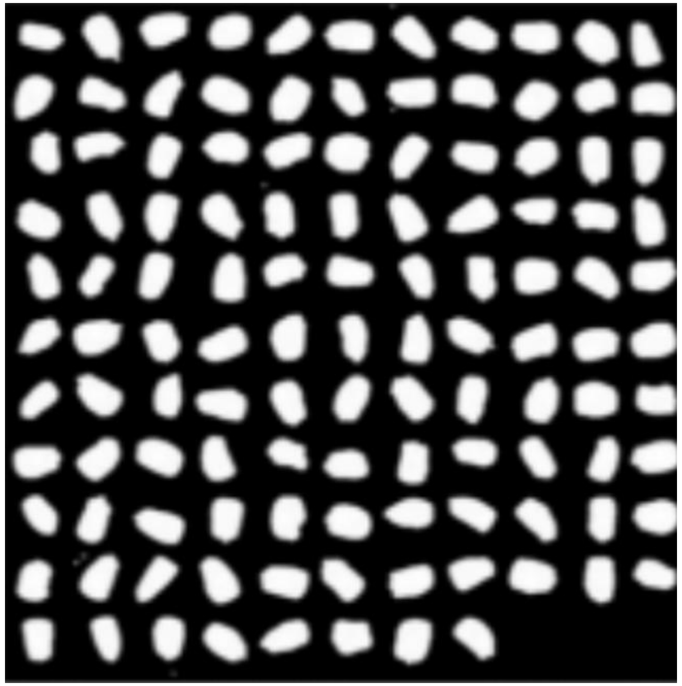
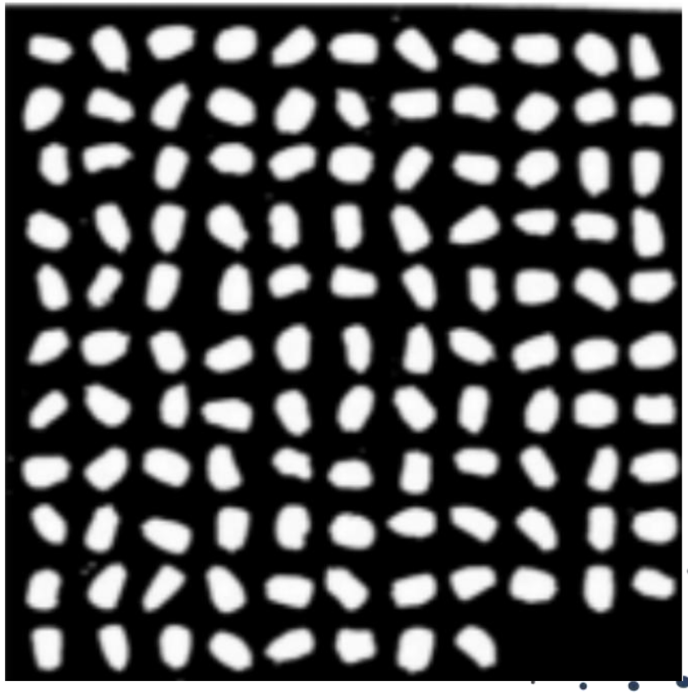
Image segmentation

- Then, the OTSU algorithm is used to segment the object target and background in the image. After processing, the discrimination between corn and background is high, but noise still exists.

图像分割

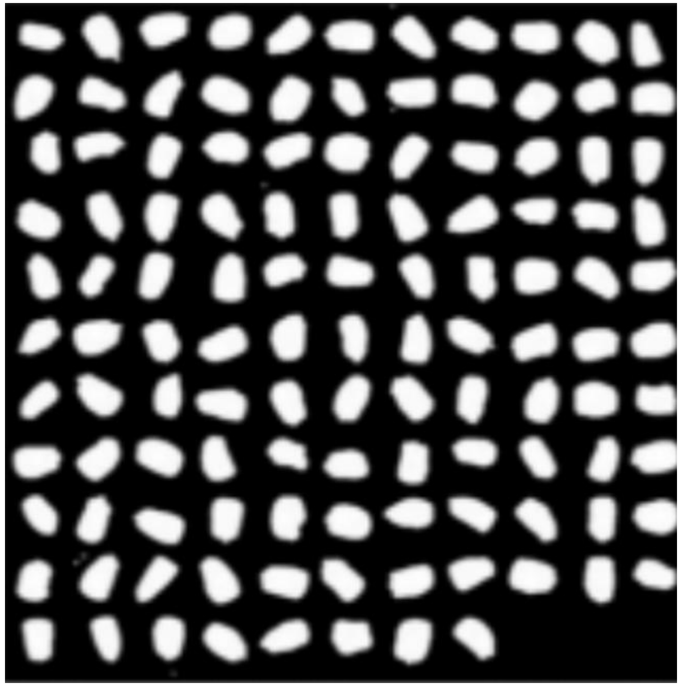
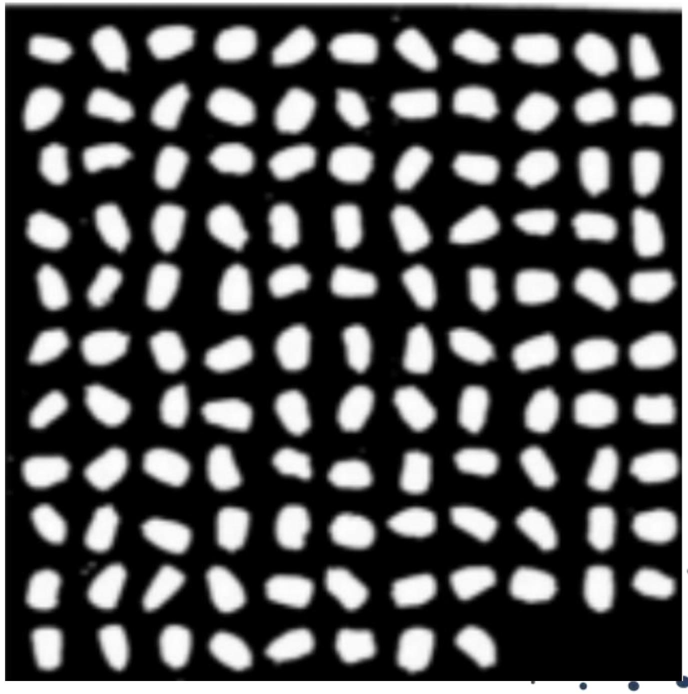
- 然后，使用OTSU算法对图像中的目标和背景进行分割。经过处理后，玉米和背景之间的区别很高，但噪声仍然存在。

Morphological operations

- To eliminate noise, we used three different kernels to perform open and close operations by changing the order of operations.
-   

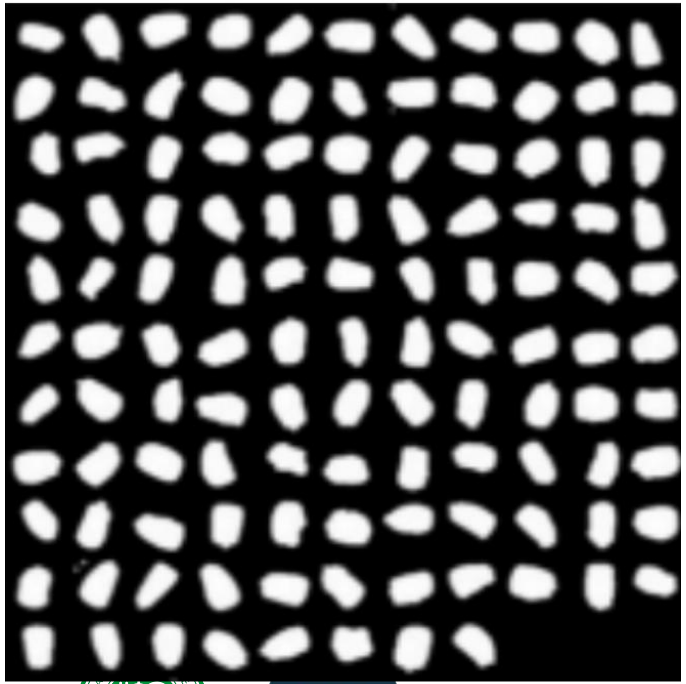
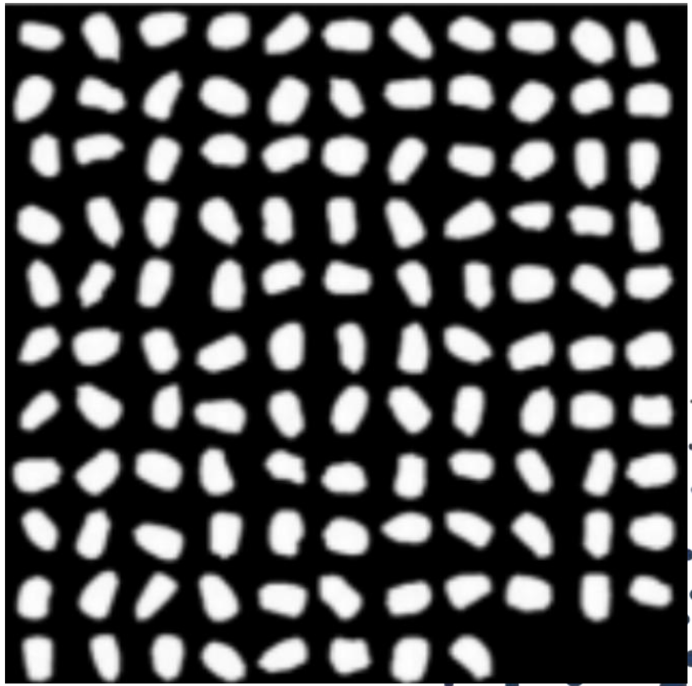
形态学运算

- 为了消除噪声，我们使用三个不同的内核通过改变操作顺序来执行打开和关闭操作。

Morphological operations

- It can be seen that the effect of opening first and then closing is better, and using a 5 * 5 kernel can significantly reduce noise while ensuring that the geometric features of the target are not affected

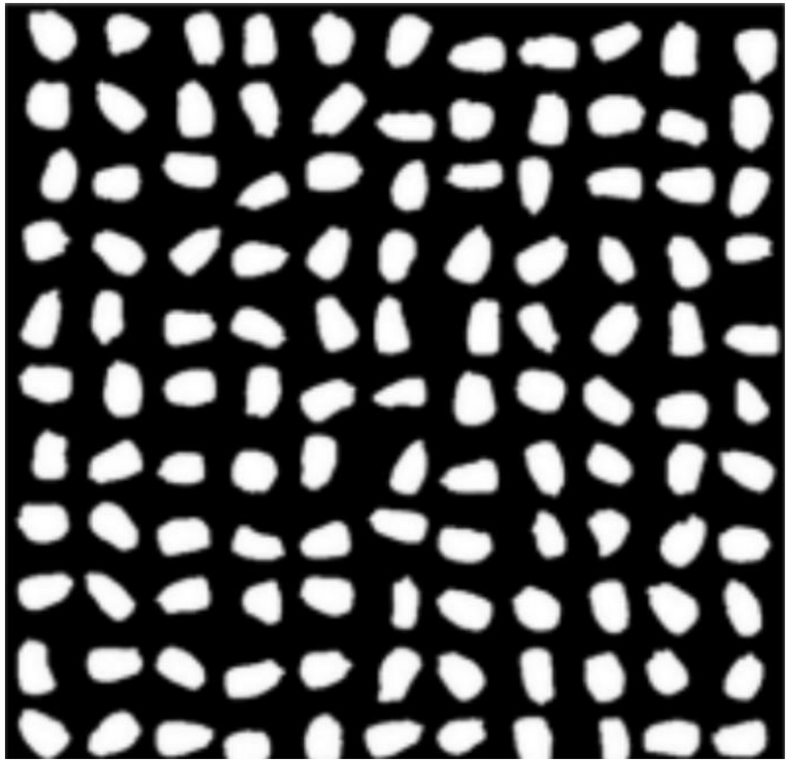




形态学运算

- 可以看出，先打开后关闭的效果更好，使用**5*5**内核可以显著降低噪声，同时确保目标的几何特征不受影响

Noise removal

- However, after morphological operations, the hole like noise still exists, so we use the cv. flowFill() formula to fill in the hollow areas in the image



噪声消除

- 然而，经过形态学运算后，类孔噪声仍然存在，因此我们使用cv.flowFill（）公式来填充图像中的空心区域

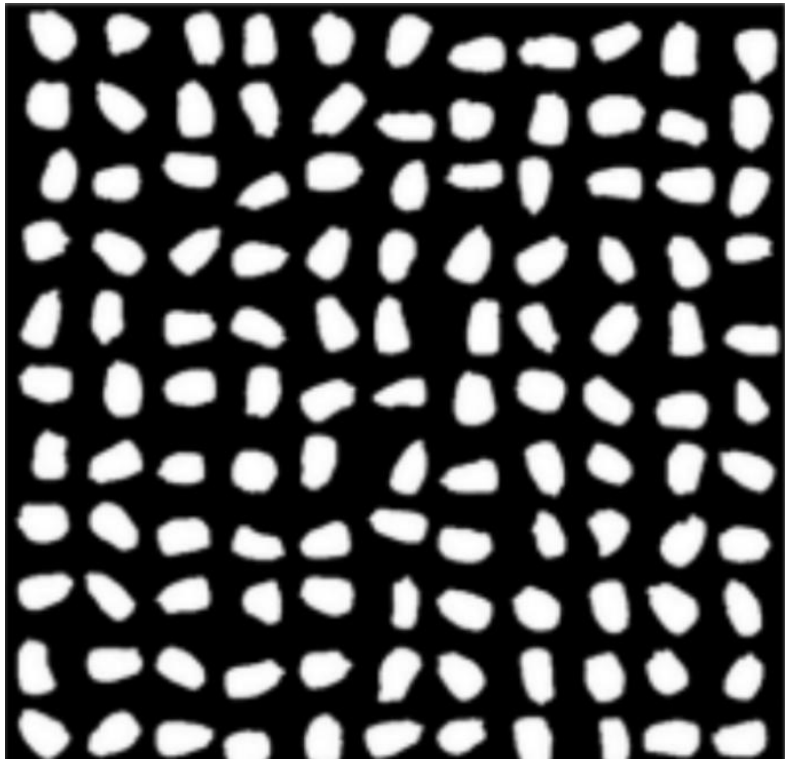
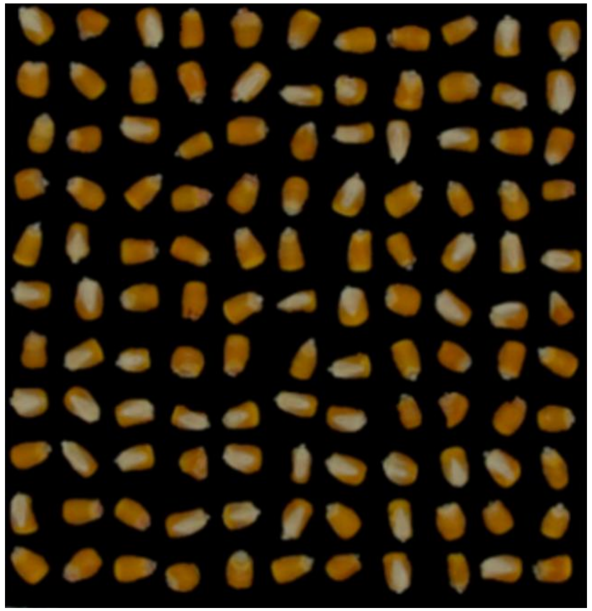


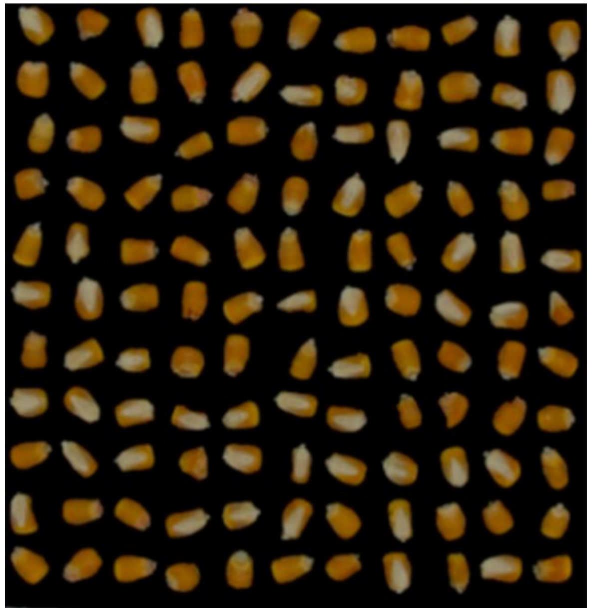
Image Merge

- After completing the above operation, we use cv. bitwise () to merge the dual core image with the original image, so that it retains the original appearance of the corn and the background becomes pure black



图像合并

- 在完成上述操作后，我们使用cv.bitwise（）将双核图像与原始图像合并，使其保留玉米的原始外观，背景变为纯黑



Model improvements

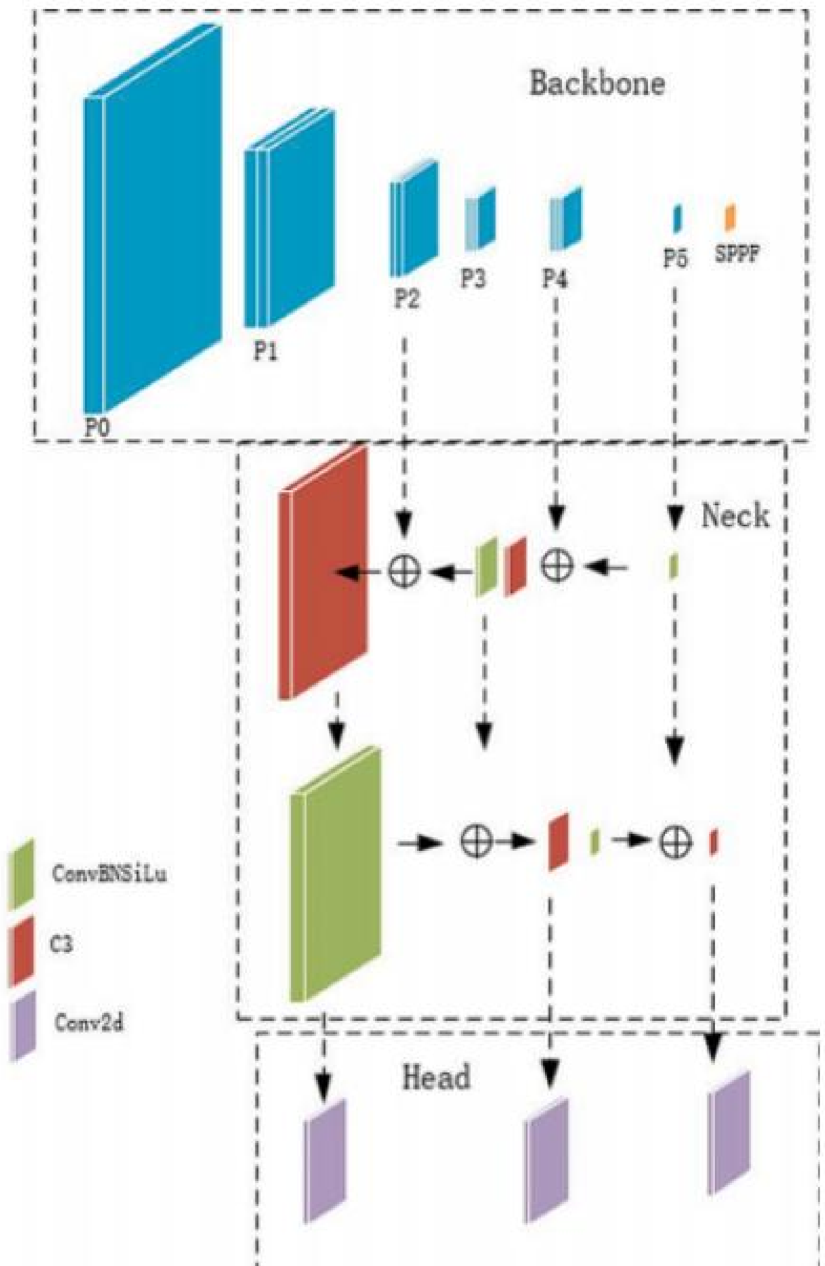
Next is the improvement of the network model. We first used the yolov5s model for training, and then introduced the SE attention mechanism on this basis. Then, we replaced the conv and c3 modules of the neck network in yolov5s with C2f modules. However, after the modification, while the accuracy, recall, and mAP0.5 decreased, the model also became larger, which obviously did not meet our original intention.

模型改进

- 其次是网络模型的改进。我们首先使用**yolov5s**模型进行训练，然后在此基础上引入**SE**注意机制。然后，我们将**yolov5s**中的**neck**网络的**conv**和**c3**模块替换为**C2f**模块。然而，修改后，在准确率、召回率和**mAP0.5**下降的同时，模型也变得更大，这显然不符合我们的初衷。

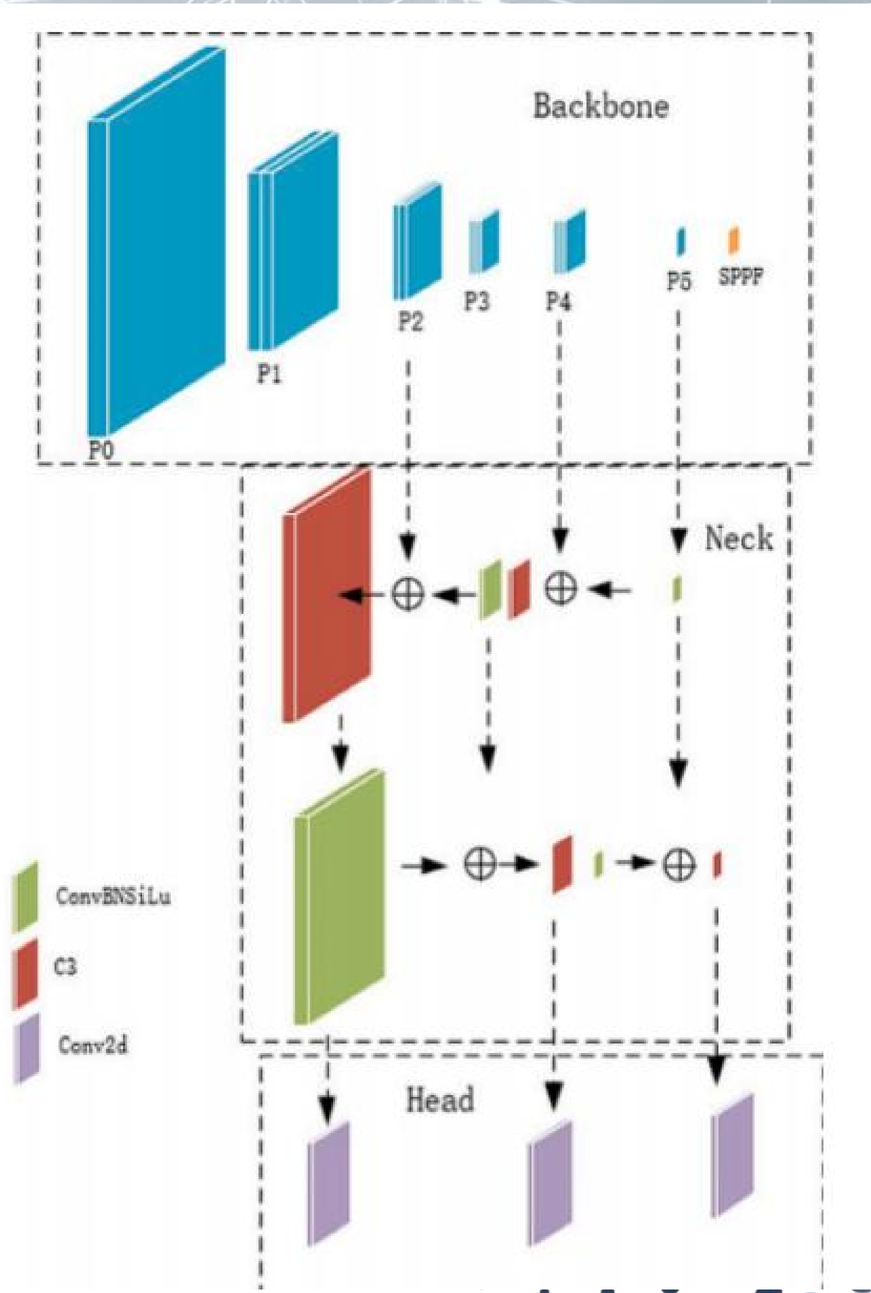
Model improvements

- Later, I thought of using Mobilenetv3 small to replace the backbone network of YOLOv5S, which reduced the size of the model by almost twice, but the accuracy and mPA0.5 decreased too much.



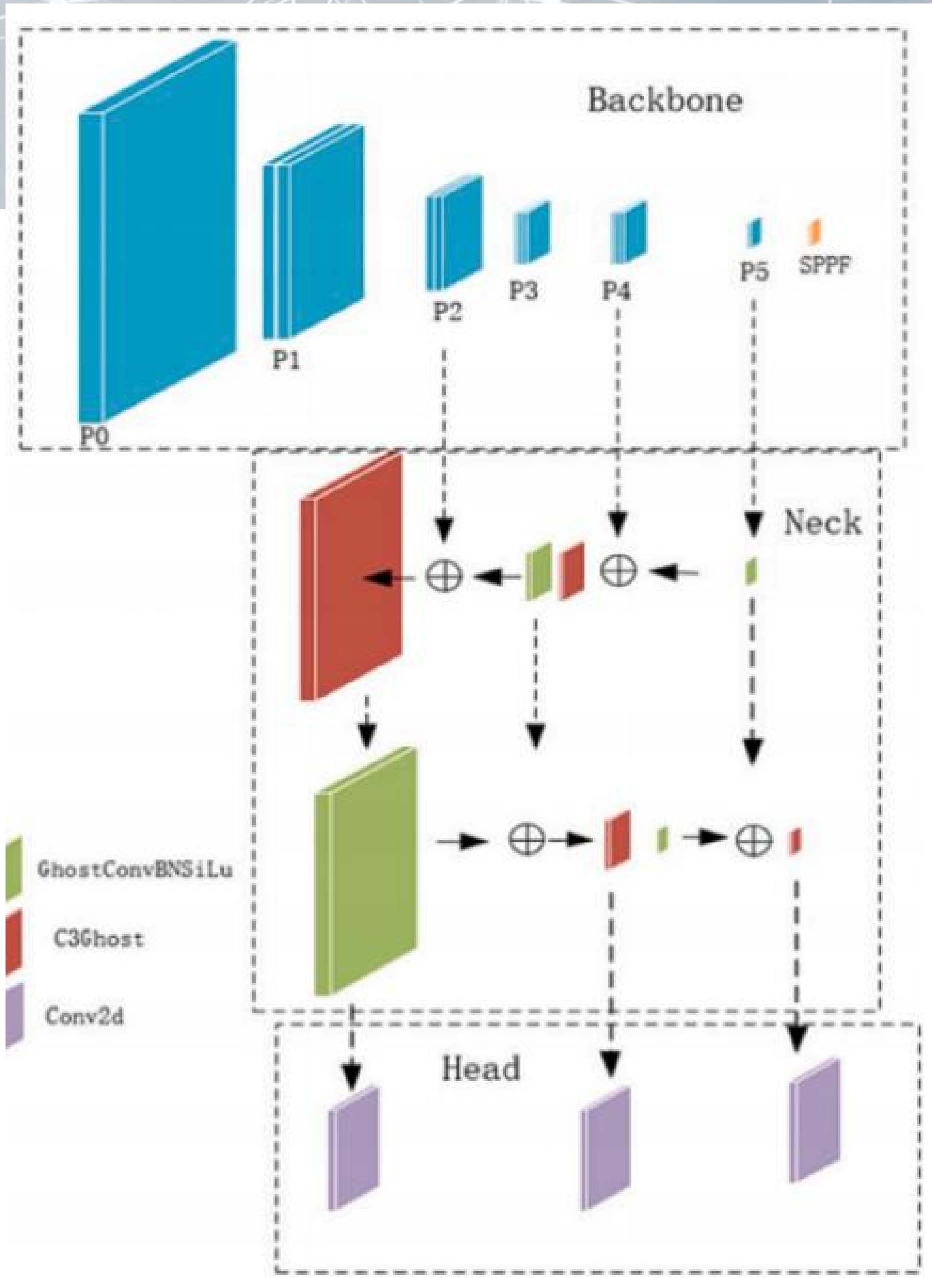
模型改进

- 后来，我想到用Mobiletv3 small代替YOLOv5S的骨干网络，这使模型的大小减少了几乎两倍，但精度和mPA0.5下降太多



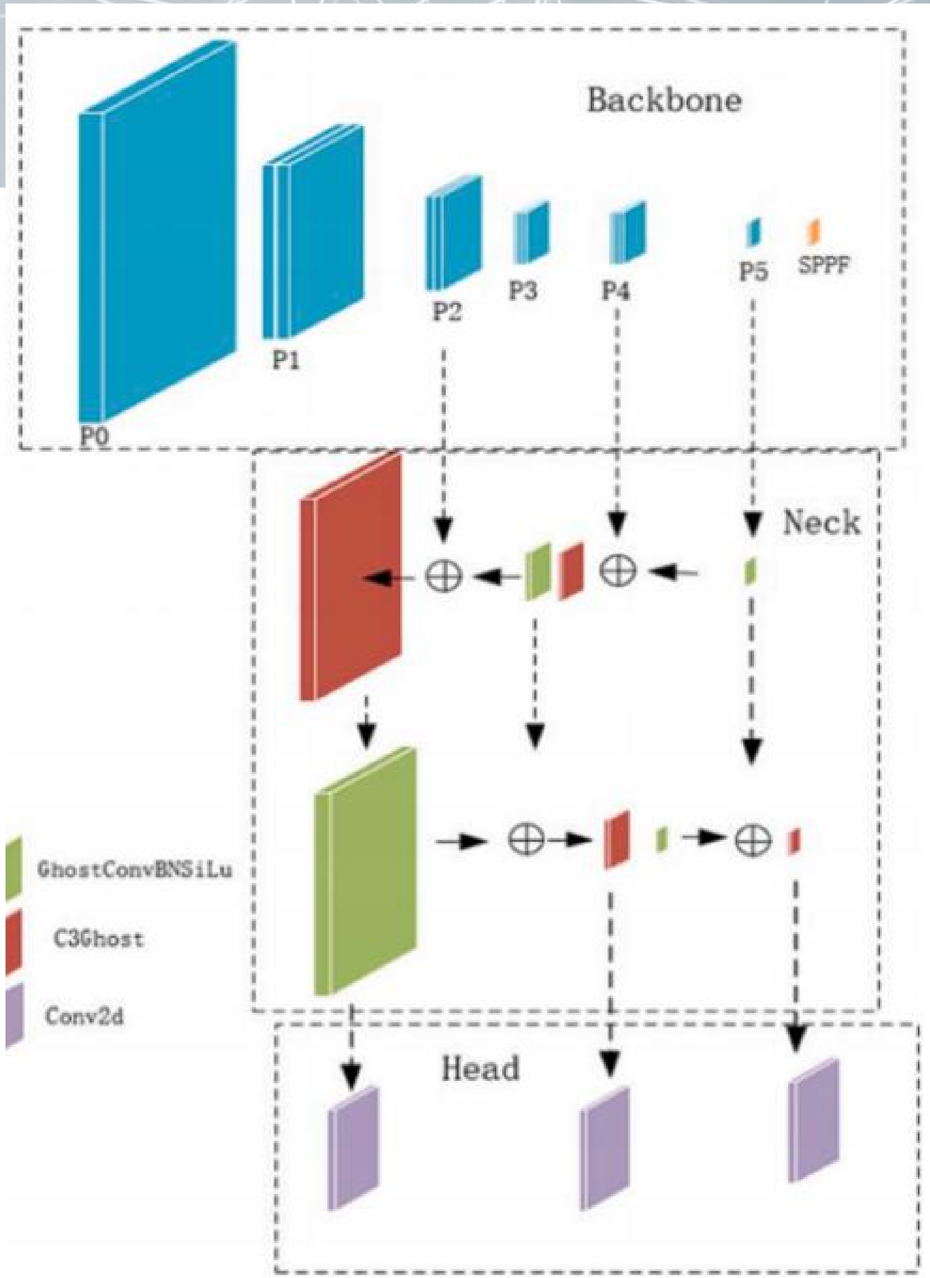
Model improvements

- Next, we introduced the Ghost module to replace the Conv and C3 modules of the neck network in the previous network model, and introduced an ECA attention mechanism model based on SE improvement. Compared with other models, we achieved the best results with minimal memory.



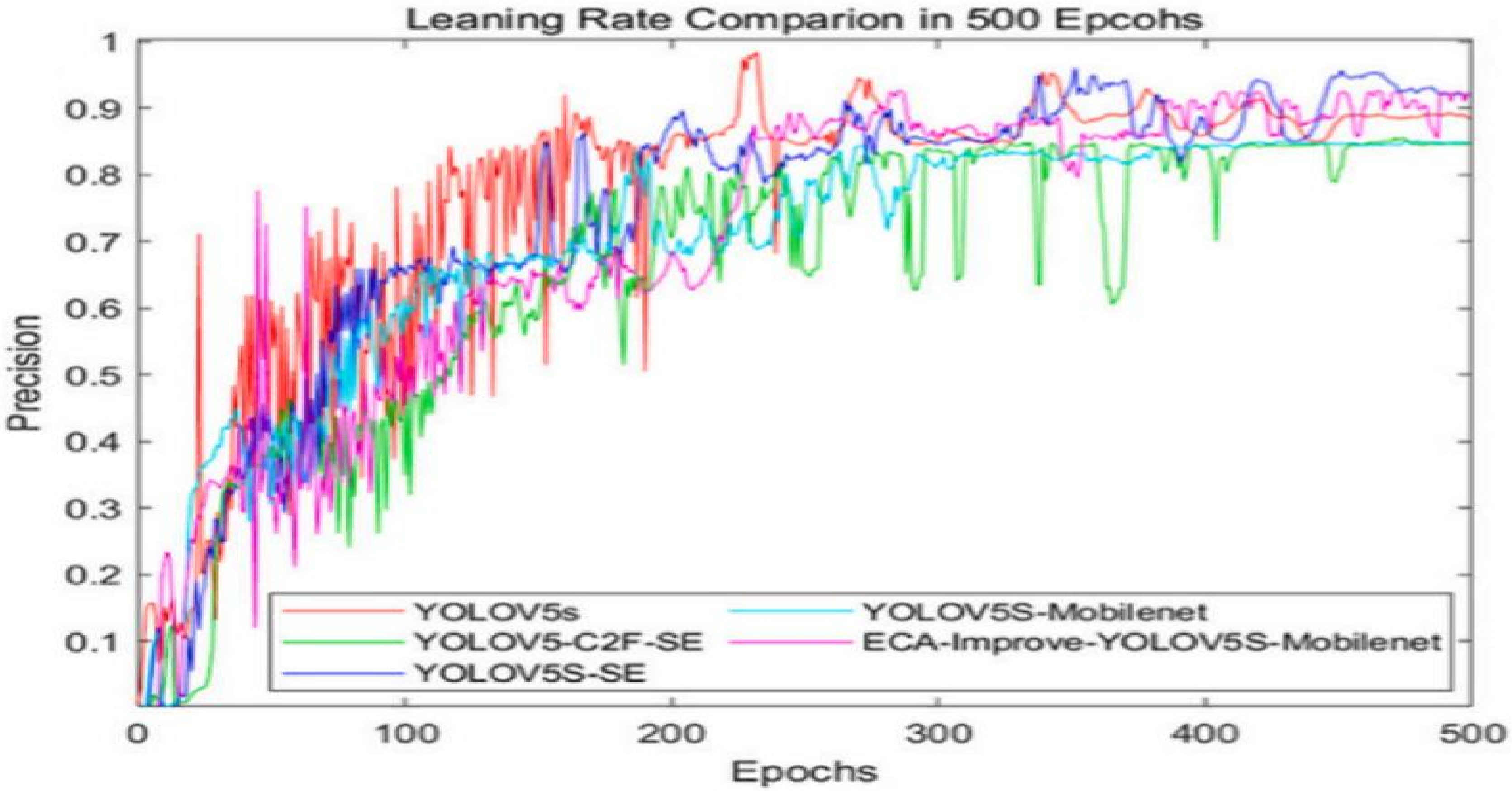
模型改进

- 接下来，我们引入了Ghost模块来取代先前网络模型中颈部网络的Conv和C3模块，并引入了一种基于SE改进的ECA注意力机制模型。与其他模型相比，我们用最少的内存获得了最好的结果。



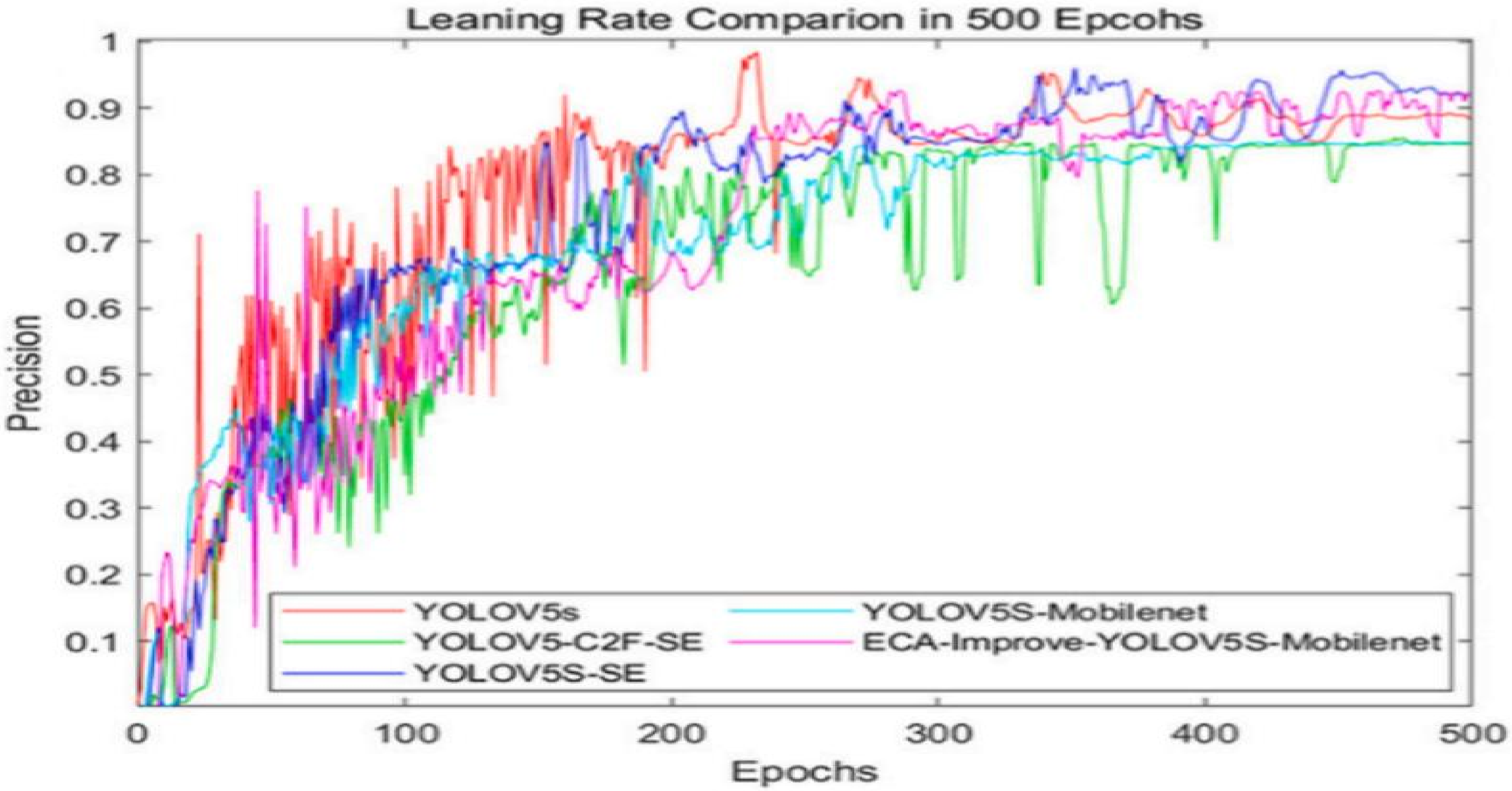
Comparison of experimental results

- Precision



实验结果比较

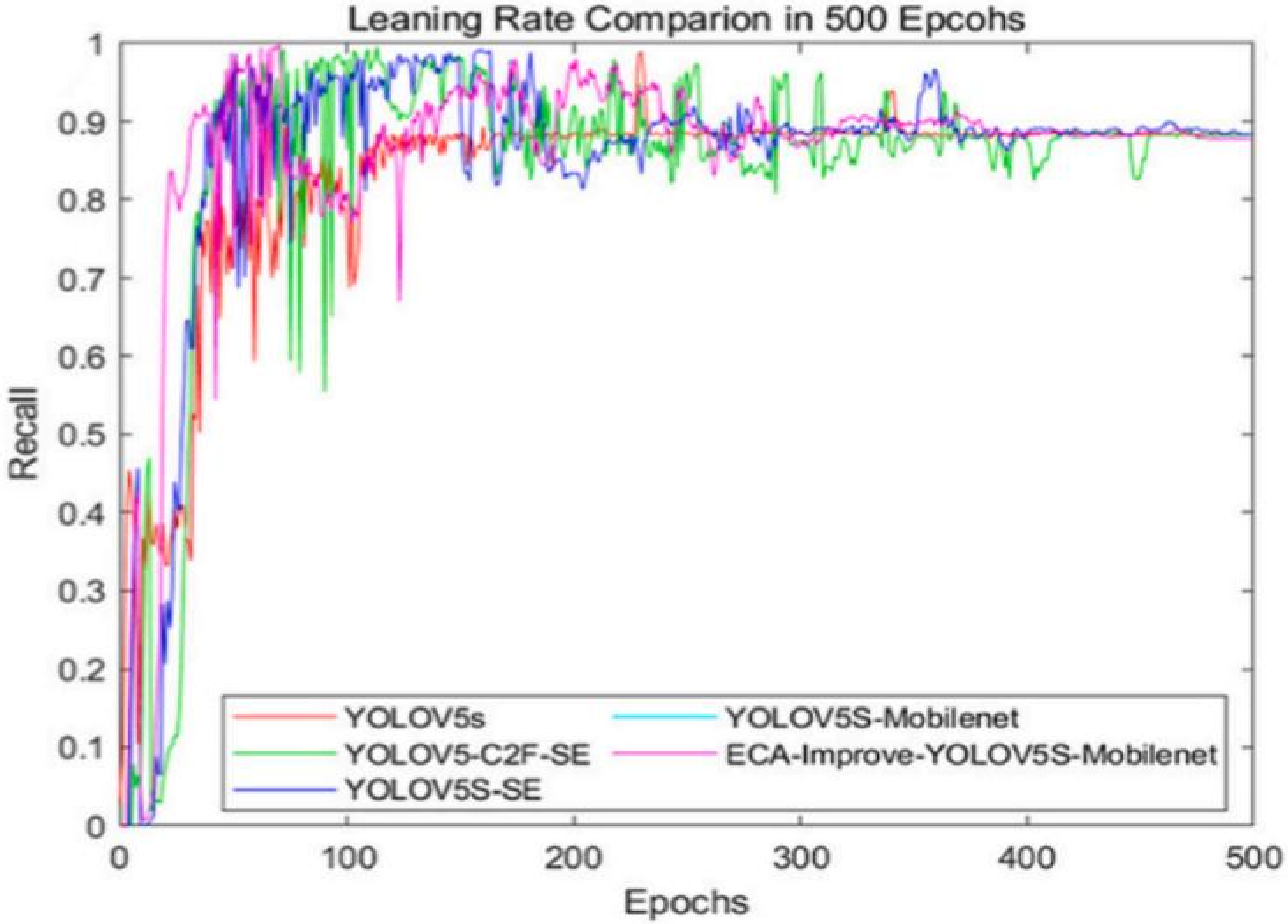
- 精确



Leaning Rate Comparion in 500 Epcohs
Precision
Epochs
0
100
200
300
400
500
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
YOLOV5s
YOLOV5-C2F-SE
YOLOV5S-SE
YOLOV5S-Mobilenet
ECA-Improve-YOLOV5S-Mobilenet

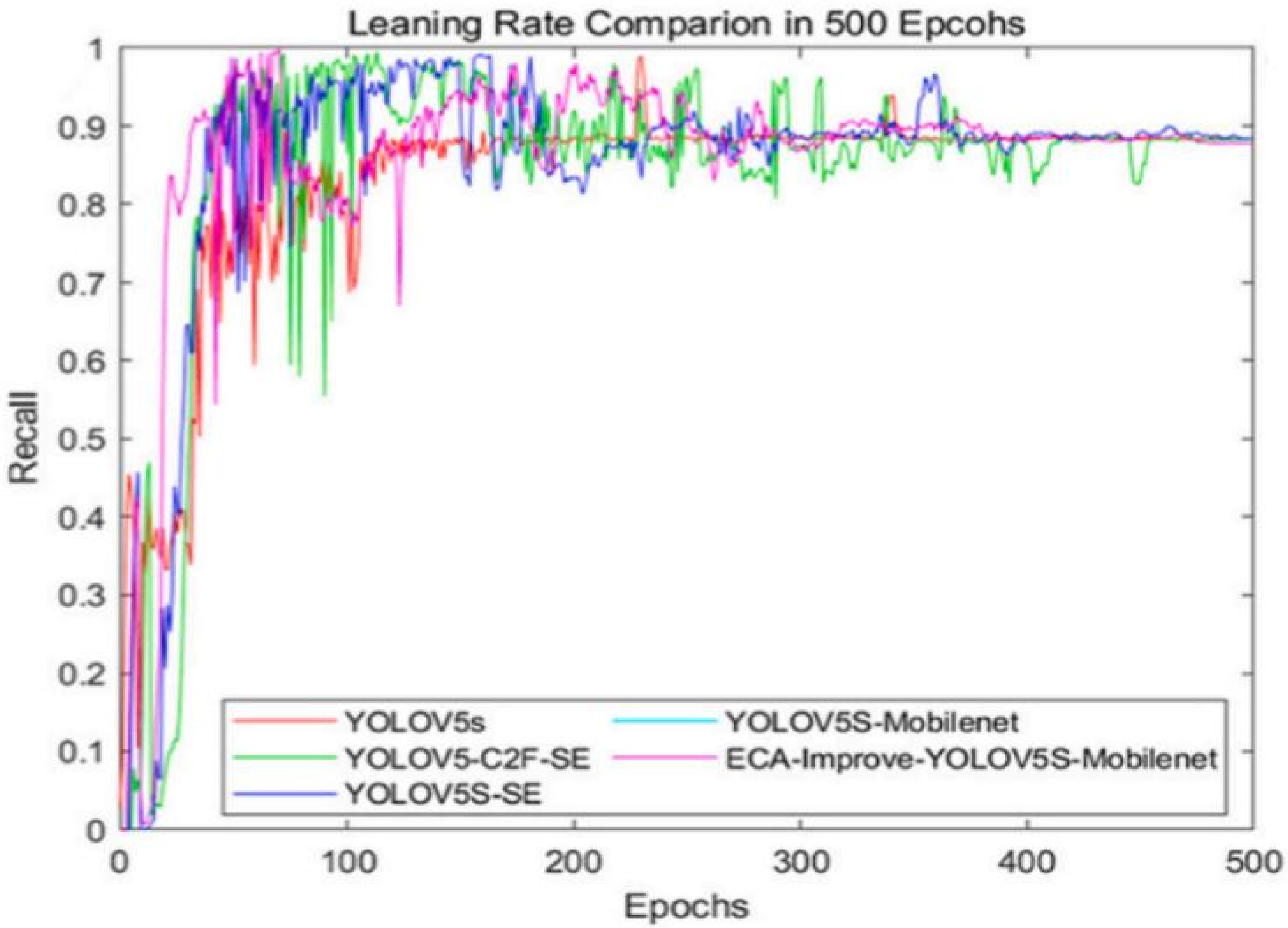
Comparison of experimental results

- Recall



实验结果比较

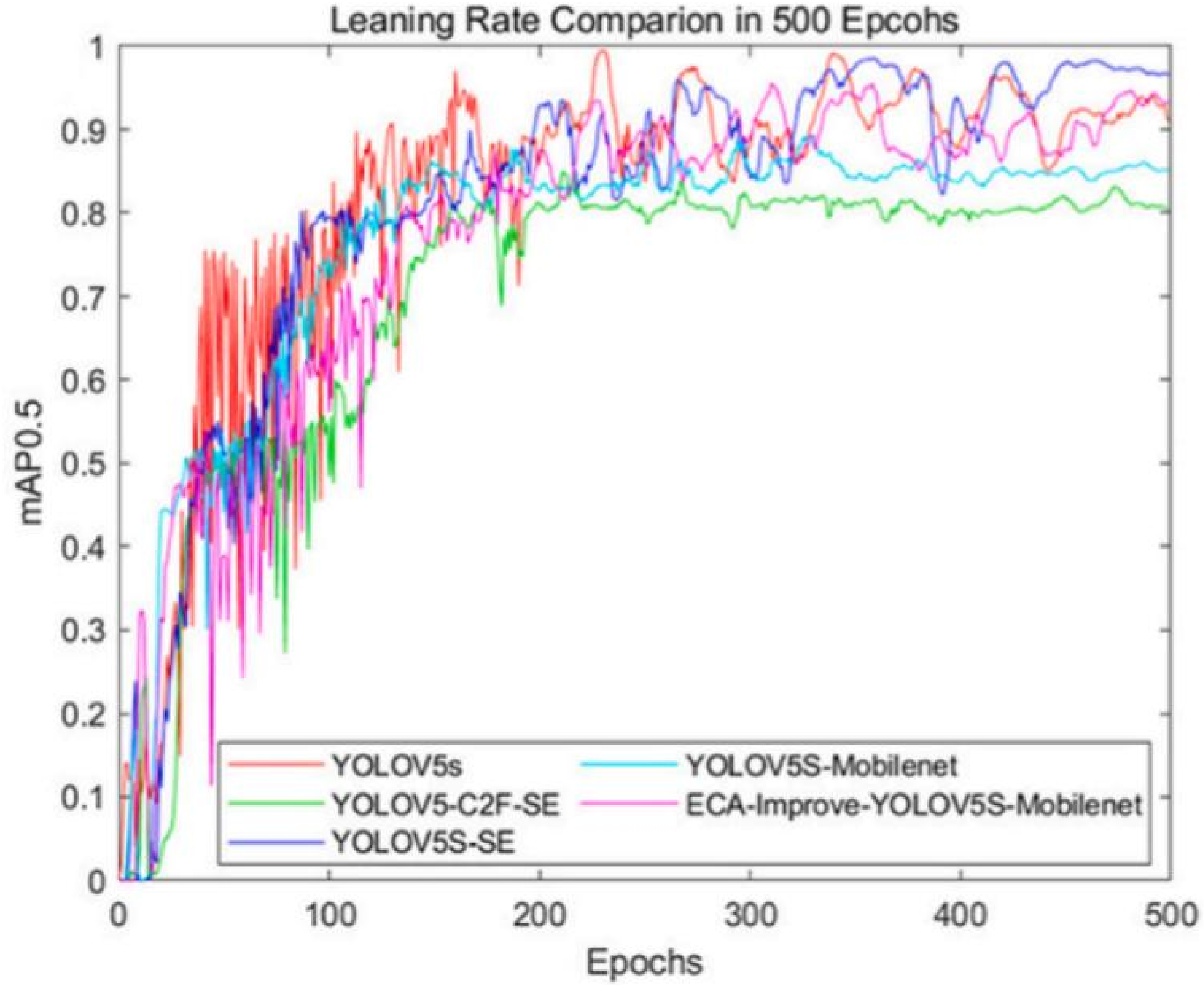
- 回忆起



Leaning Rate Comparion in 500 Epcohs
Recall
Epochs
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
100
200
300
400
500
YOLOV5s
YOLOV5-C2F-SE
YOLOV5S-SE
YOLOV5S-Mobilenet
ECA-Improve-YOLOV5S-Mobilenet

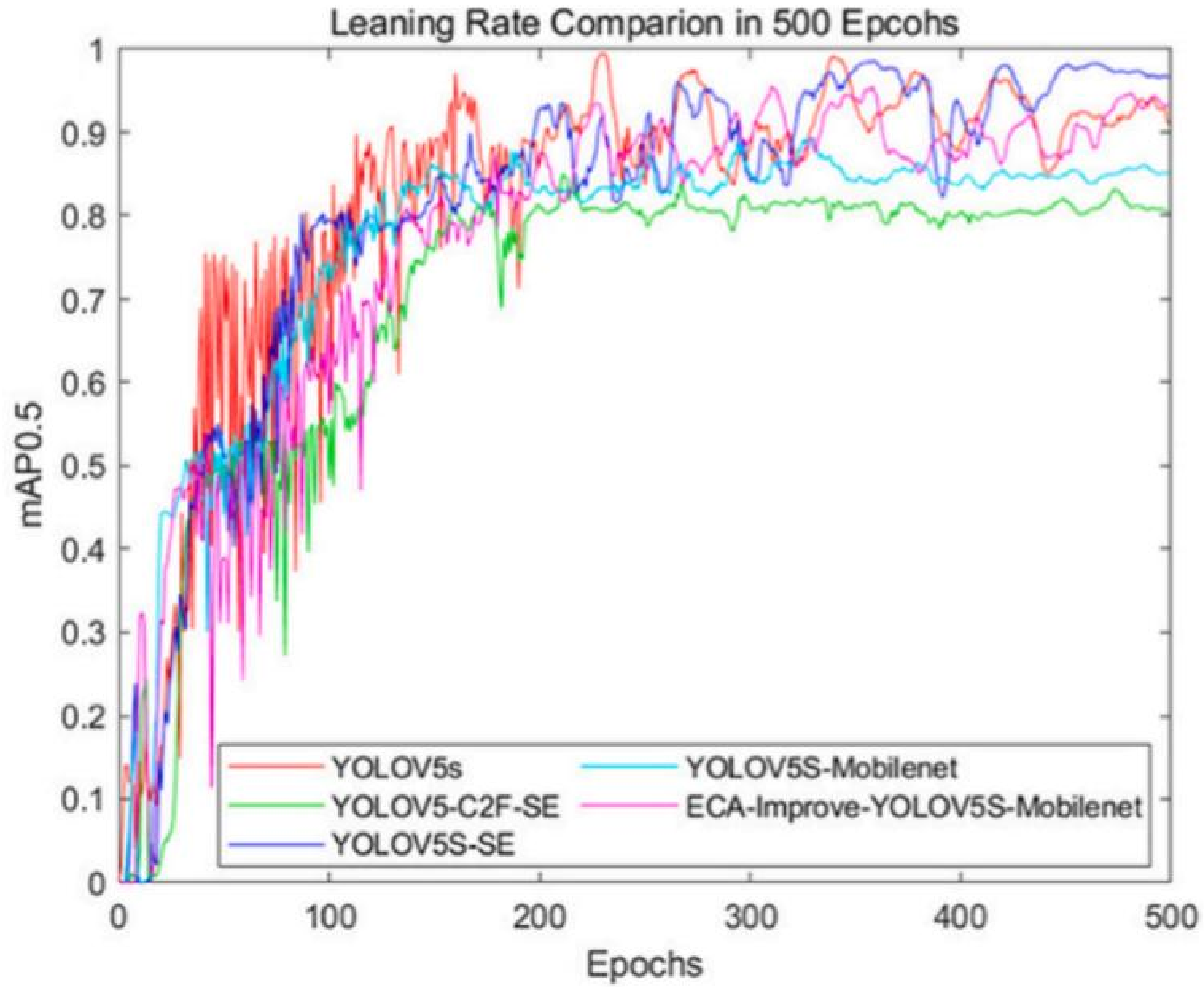
Comparison of experimental results

- mAP0.5



实验结果比较

- mAP0.5



Comparison of experimental results

- This is the final result graph

Module type	Precision (%)	Recall (%)	mPA0.5 (%)	Model size (MB)
YOLOv5S-Mobilenet	84.9	99.5	89.3	7.7
ECA-Improved-YOLOv5S-Mobilenet	**92.8**	**98.9**	**95.5**	**8.1**
YOLOv5S	98.4	99.1	99.4	14.1
YOLOv5S-SE	96.0	99.2	98.5	14.6
YOLOv5S–C2f-SE	85.5	99.4	85.0	19.0

实验结果比较

- 这是最终结果图

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YOLOv5S	98.4	99.1	99.4	14.1
YOLOv5S-SE	96.0	99.2	98.5	14.6
YOLOv5S–C2f-SE	85.5	99.4	85.0	19.0


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
go raibh maith agat
mochchakkeram
dziękuję
bedankt
sukriya
kop khun krap
terima kasih
감사합니다
ευχαριστώ
grazie
arigatô
takk
dakujem
мерси
спасибо
tapadh leat
dank je
hvala
mauruuru
sagolun
taiku
ありがとう
Баярлалаа
рахмат
хвала
asante
manana
trugarez
shukriya
dhanyavadagalu
diolch
xiexie
rahmet
tanemirt
najis tuke
chnorakaloutioun
gracies
sulpay
dekuji
sobodi
mesi
enkosi
kiitos
dankie
dhanyavad
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misaotra
matondo
paldies
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barka
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rahmat