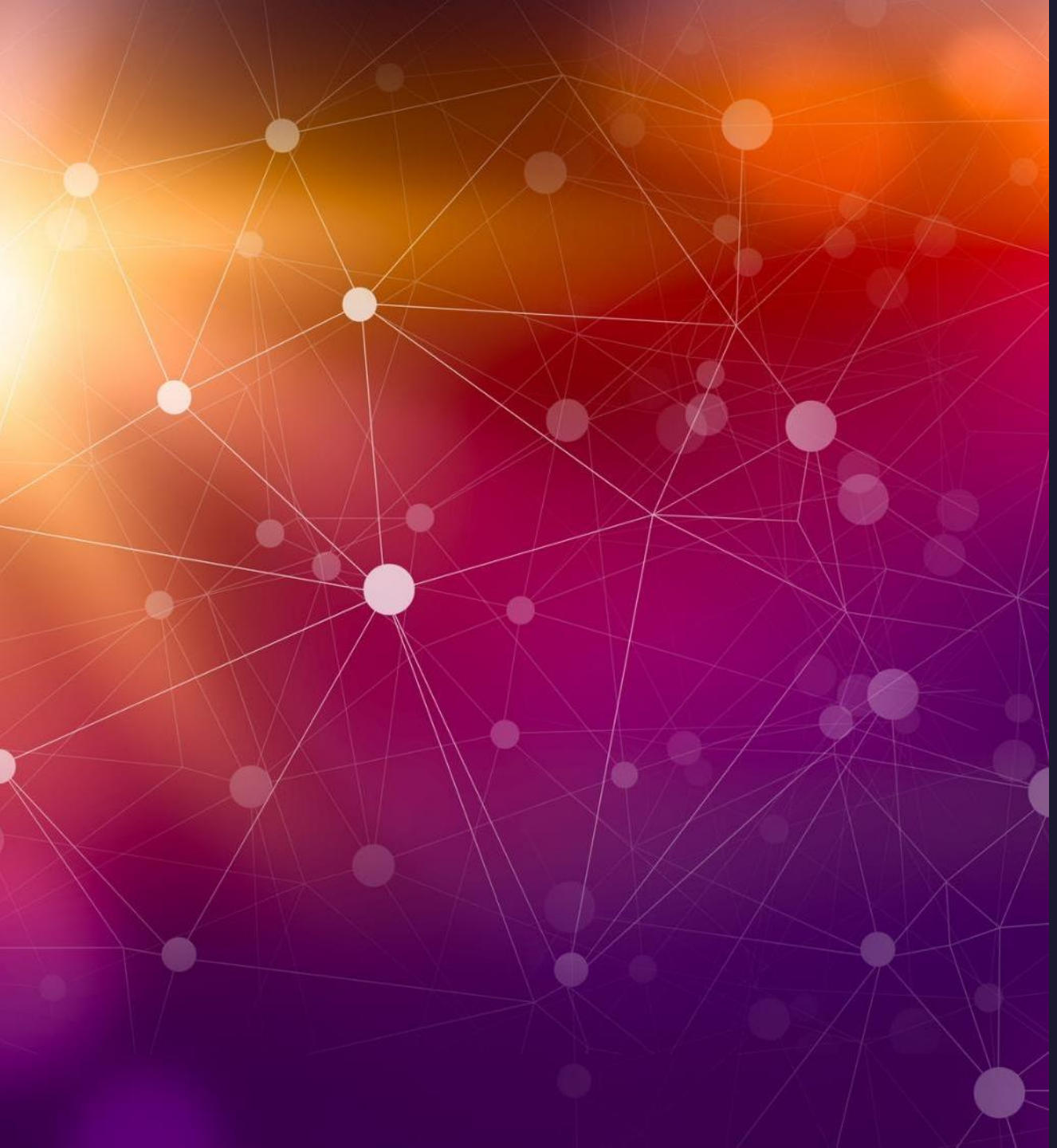


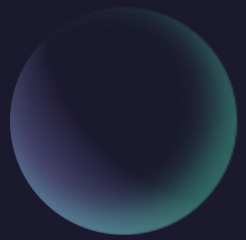
More research on anomaly detection

Case study

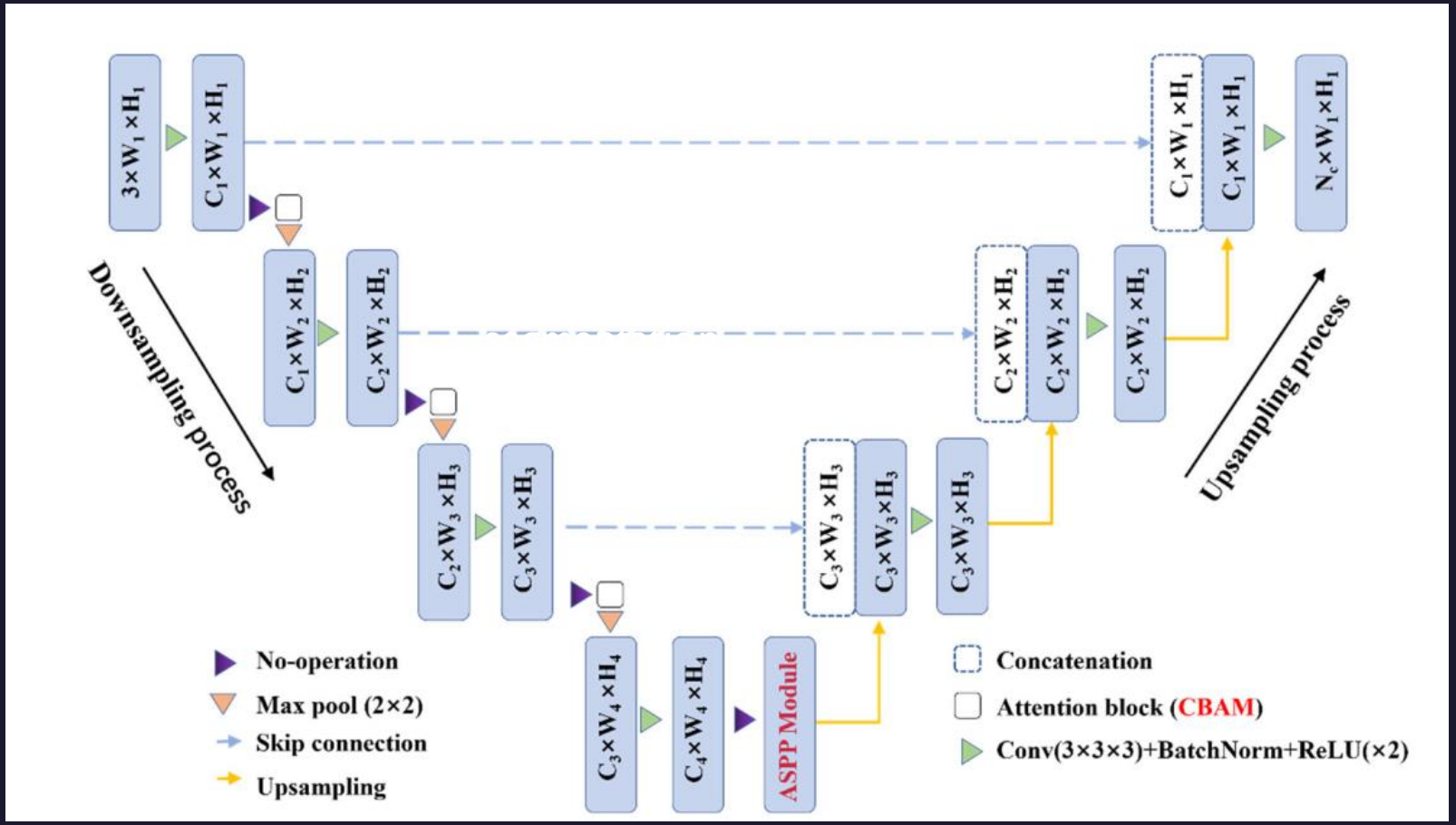
- Surface Defects Detection in Chrome plating
- Characteristics:
  - High reflection
  - Challenging image acquisition

Baru-Net

- Supervised learning method
- Localize the defective parts
- Multi-class Classification
- Based on Unet
  - Widely used in defect segmentation
  - Need small amount of data



Baru-Net network structure

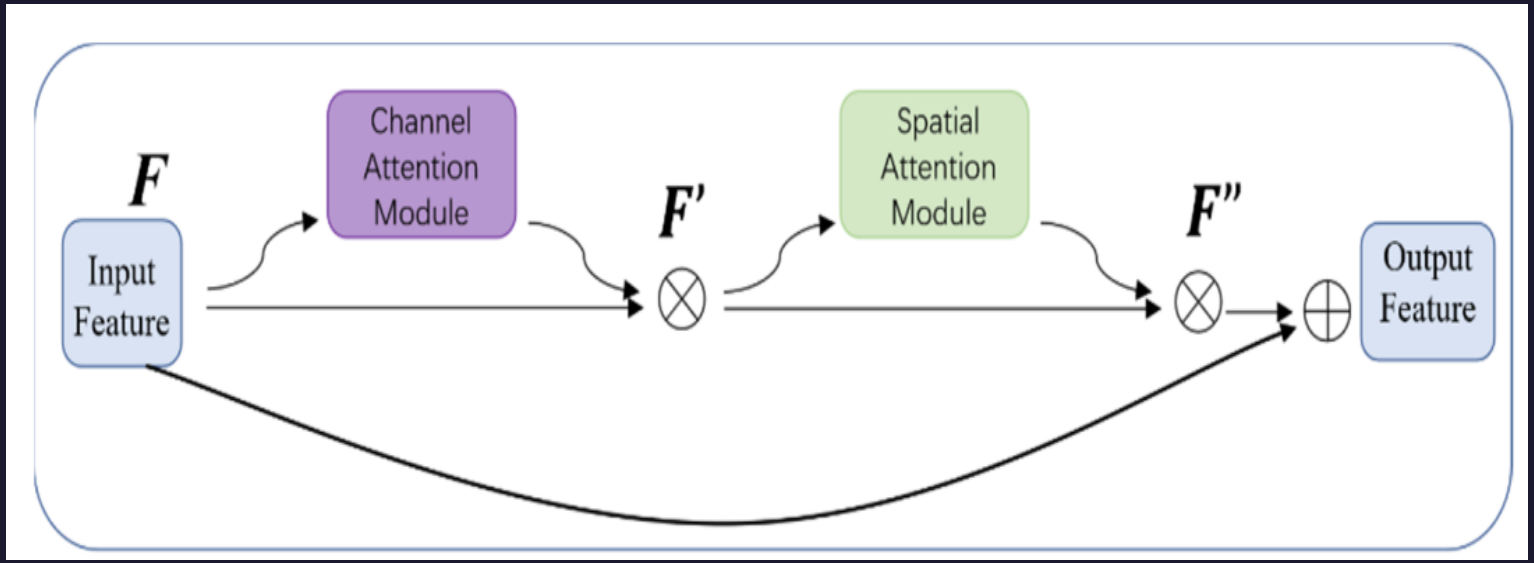


Changes compared to Unet

- Bilinear interpolation in upsampling
  - Fast calculation
  - Fast running speed
  - Strong ability to retain image details
- CBAM
- ASSP

CBAM(Convolutional Block Attention) Module

Feature map pass into CBAM after each stage of down-sampling

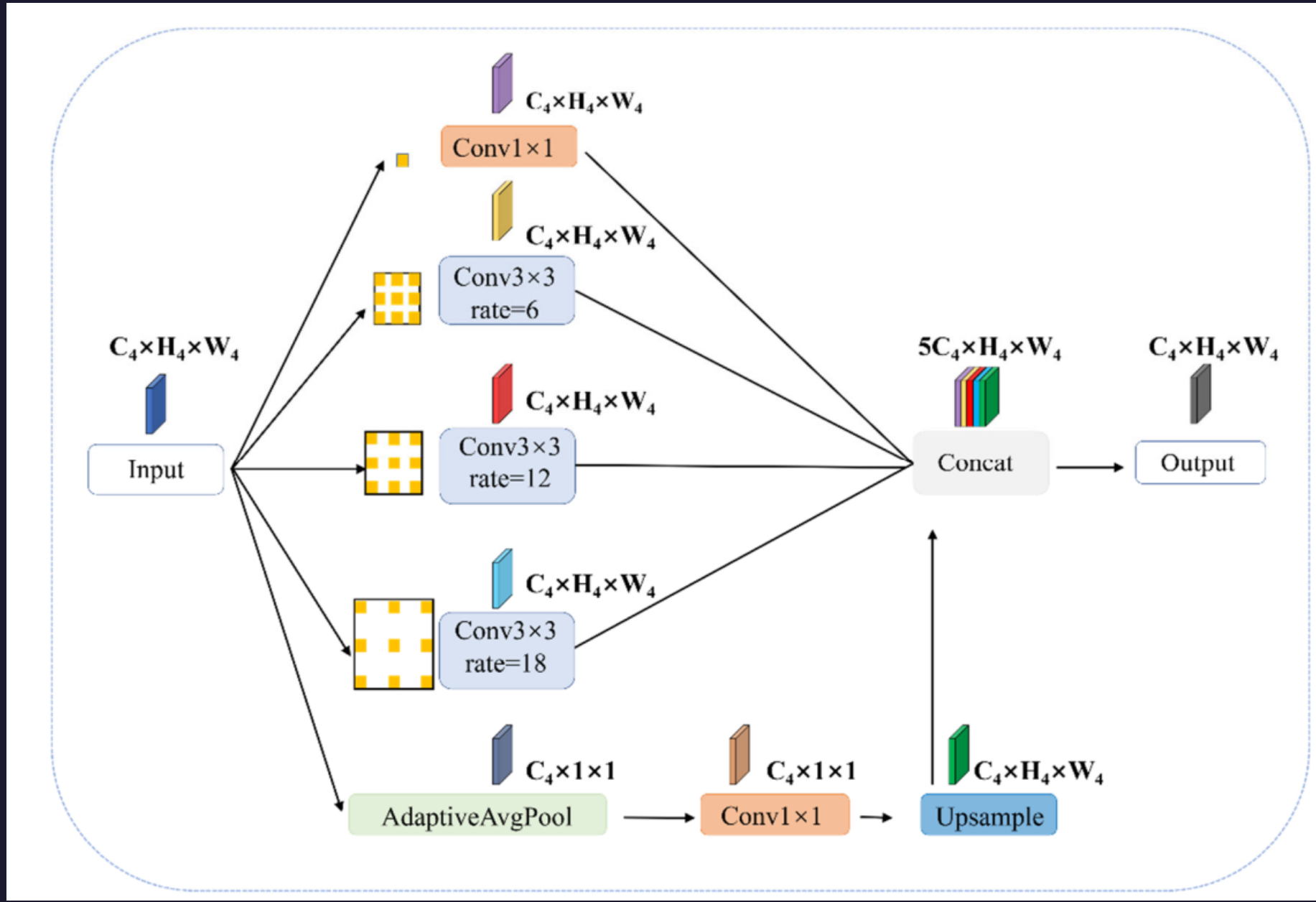


Two sub-modules:

- CAM (Channel Attention Module):
  - focuses on important feature map
- SAM (Spatial Attention Module)
  - focuses on important spatial regions

ASPP Module

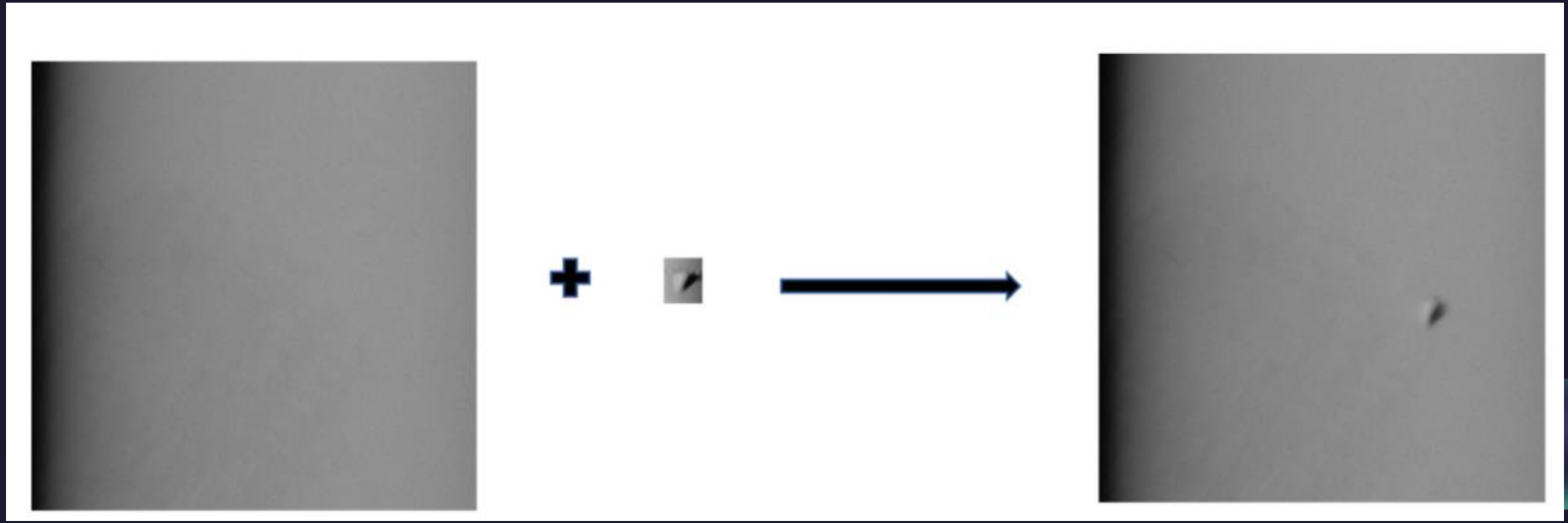
- In segmentation having a large receptive field is crucial
- The Idea is use multiple parallel convolutions
- Pass the final downsapling layer of Unet to ASPP for further processing:
  - Multi-scale Feature Extraction(three convolutions)
  - Combine convolutions output to have multi-scale information
  - Dimensionality Reduction to use the feature map as the input for the next layer
- ASPP capture features at different scales


$C_4 \times H_4 \times W_4$
Conv1×1
$C_4 \times H_4 \times W_4$
Conv3×3
rate=6
$C_4 \times H_4 \times W_4$
Conv3×3
rate=12
$C_4 \times H_4 \times W_4$
Conv3×3
rate=18
$C_4 \times H_4 \times W_4$
Input
$5C_4 \times H_4 \times W_4$
Concat
$C_4 \times H_4 \times W_4$
Output
$C_4 \times 1 \times 1$
AdaptiveAvgPool
$C_4 \times 1 \times 1$
Conv1×1
$C_4 \times H_4 \times W_4$
Upsample

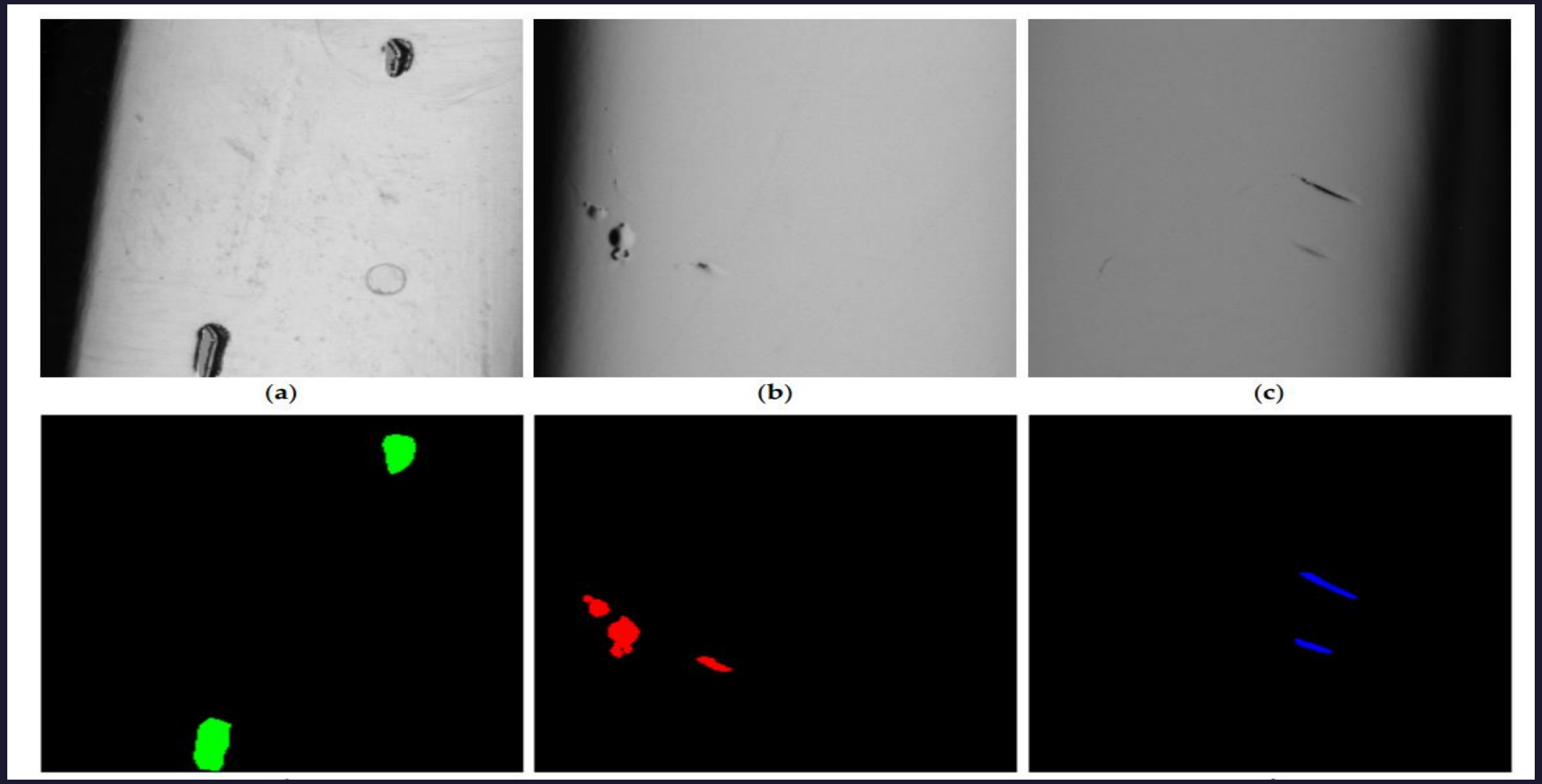
Dataset

- Use Labelme software
- Expand Dataset with photoshop
- copy the defect areas from the original images and paste them into the non-defect image
- No combination of multiple defects
- increase dataset size with:
  - random rotation, cropping, shifting
- Size:
  - Totall 1000
  - Original 100
  - Artificial detected 300
  - Data enhanced 600

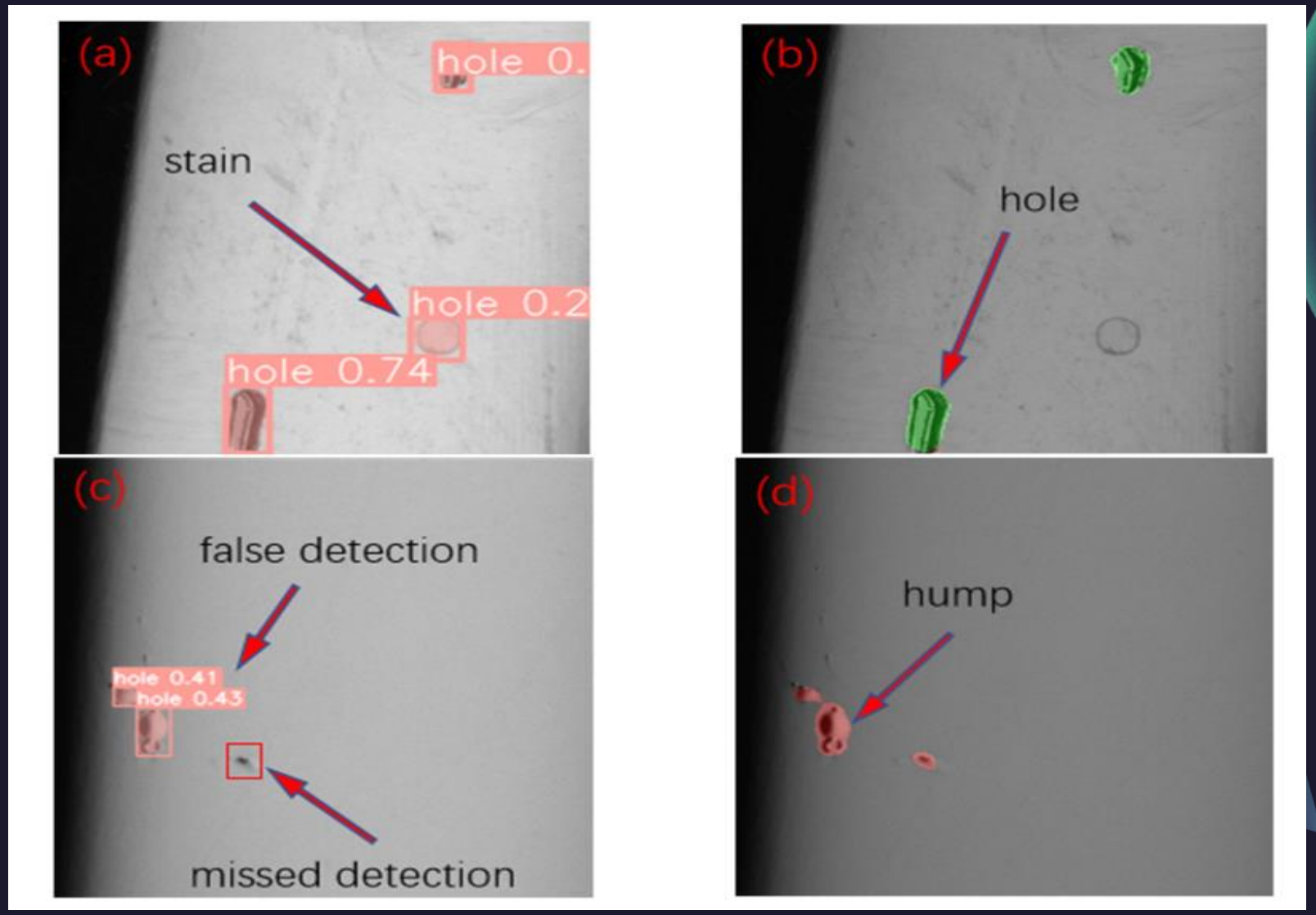
Data enhanced



Example



Baru-Net VS YOLO-8



Accuracy result

Table 2. Accuracy of different network models.

Model	Accuracy (%)	Macro-F1 (%)
UNet++	96.1	89.9
UNet	91.4	89.4
AttentionUNet	97.8	90.1
Res_UNet	89.3	88.4
Baru-Net	98.3	91.3