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A Generative Adversarial Network Based Framework For Unsupervised Visual Surface Inspection

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Research Status

1. structural-based method
2. statistical-based method
3. filter-based method

Challenges

1. Develop a unified framework for various surfaces. Different workpieces have various surfaces.
2. How to extract effective features to describe normal surface texture.
3. Existing surface inspection datasets are not sufficient to support and evaluate deep learning based research

Architecture and Contribution

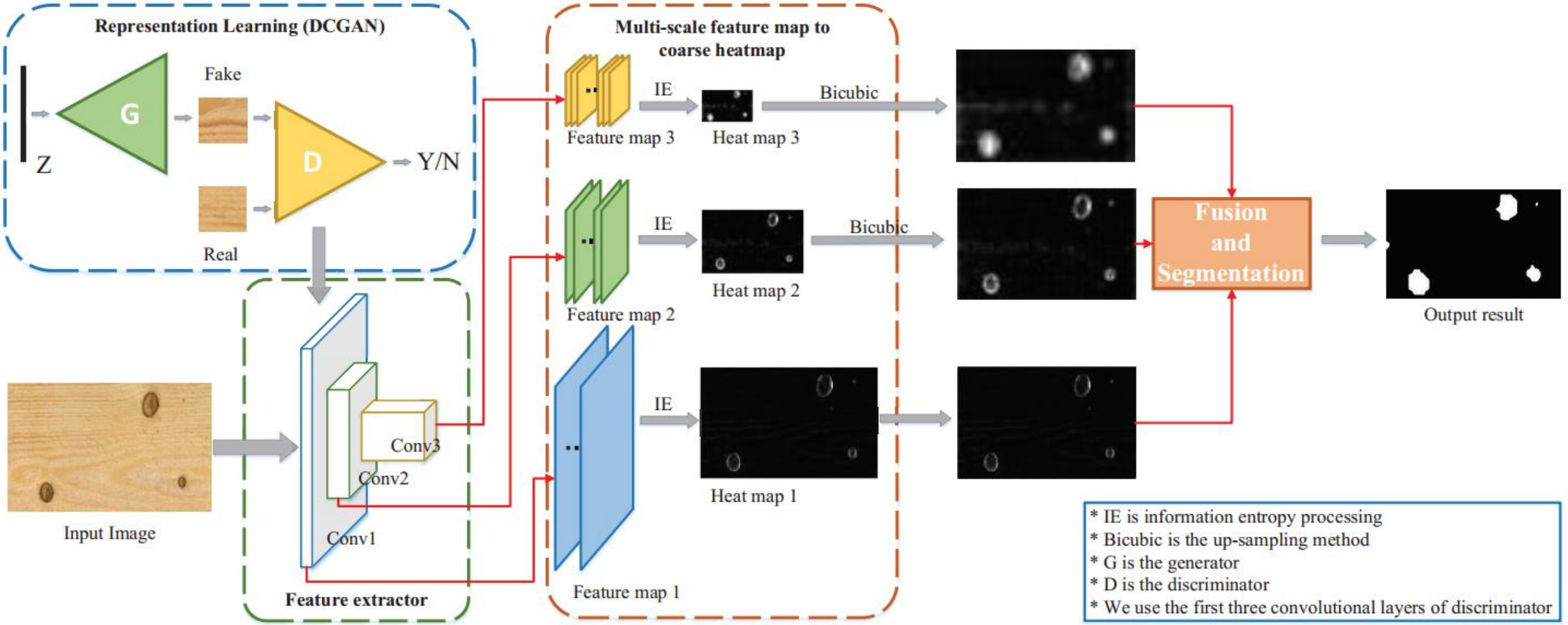
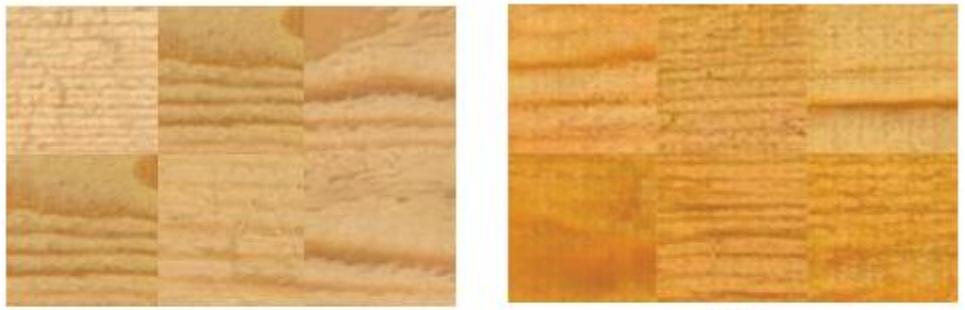


Fig. 1. The overall architecture of our proposed method for visual surface inspection.

DCGAN for feature representation learning



(a) (b)

Fig. 2. (a) Real images. (b) Fake images generated by GAN.

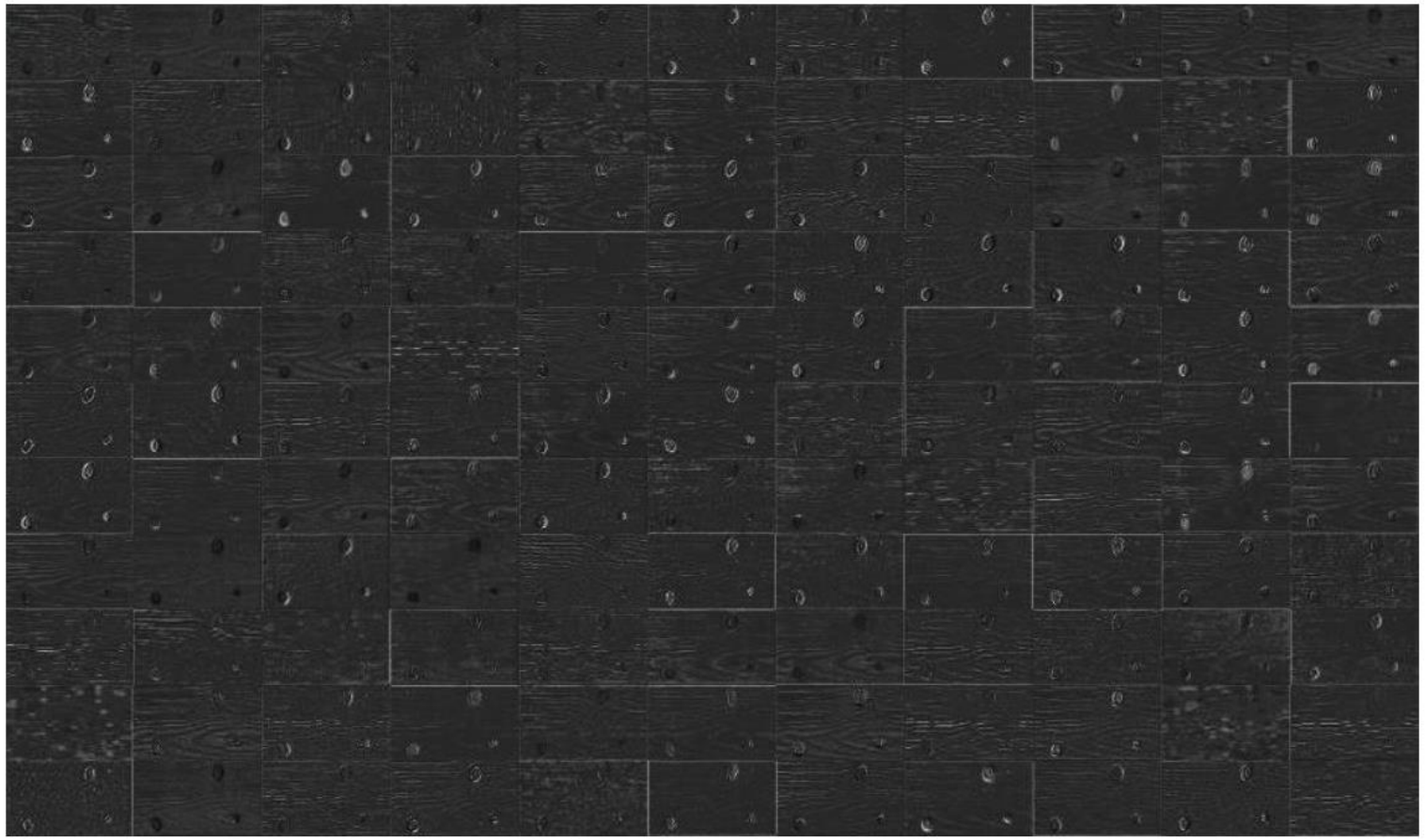
$$\min_G \max_D V(G,D) =$$

$$\mathbb{E}_{\mathbf{x}\sim p_{data}(\mathbf{x})}[log(D(\mathbf{x}))] + \mathbb{E}_{\mathbf{z}\sim p_z(\mathbf{z})}[log(1\text{-}D(G(\mathbf{z})))].$$

Generation of inspection map with GAN's discriminator

(a)

(c)



(b)

Fig.3. (a)Input image. (b)Feature maps of conv_2 in discriminator. (c)Inspection map calculated by information entropy

Generation of inspection map with GAN's discriminator

$$f_{(x,y)} = [F(x,y,1), F(x,y,2)...F(x,y,m_k)]^T.$$

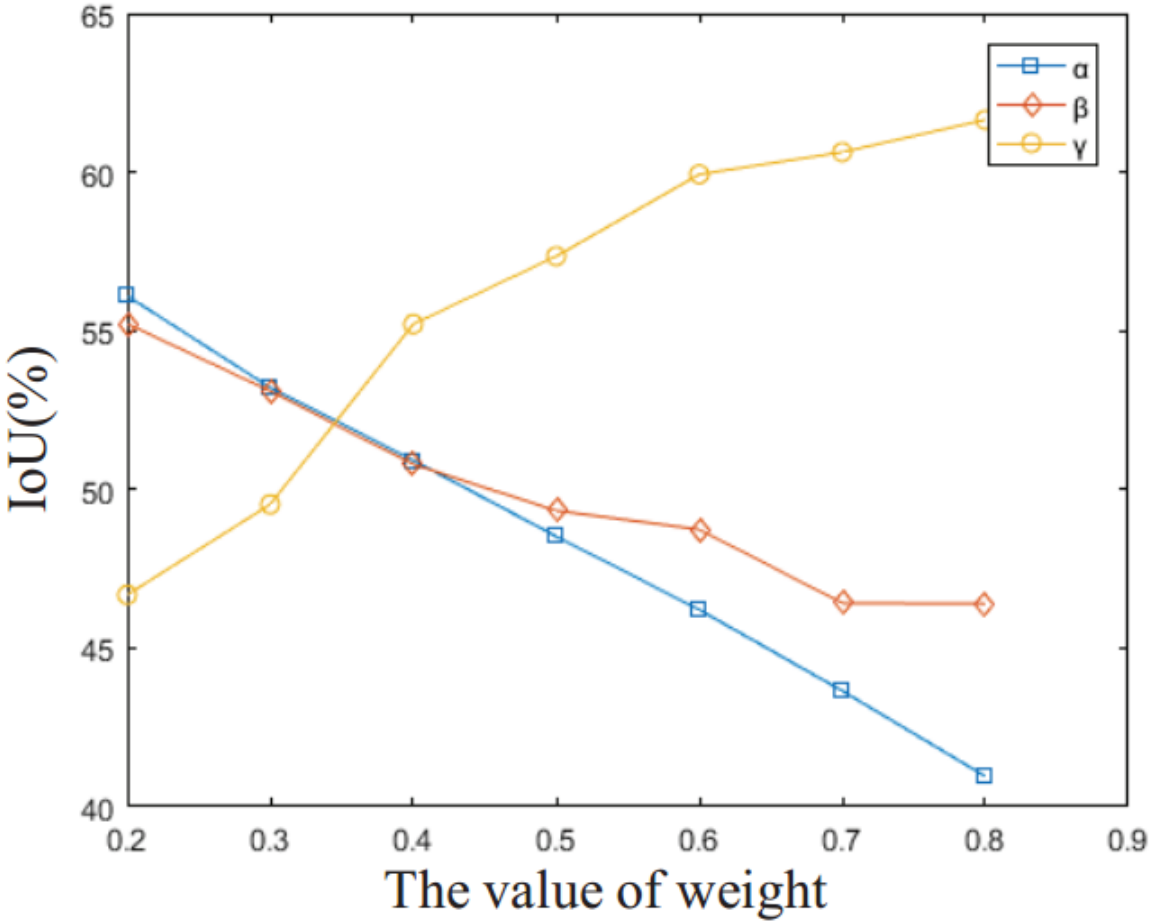
$$H_{(x,y)} = \sum_{m_k}^{i} f^i_{(x,y)} * log f^i_{(x,y)}.$$

Multi-scale fusion and abnormal segmentation

Fusion function:

$$R = \alpha H_1 + \beta H_2 + \gamma H_3.$$

Multi-scale fusion and abnormal segmentation



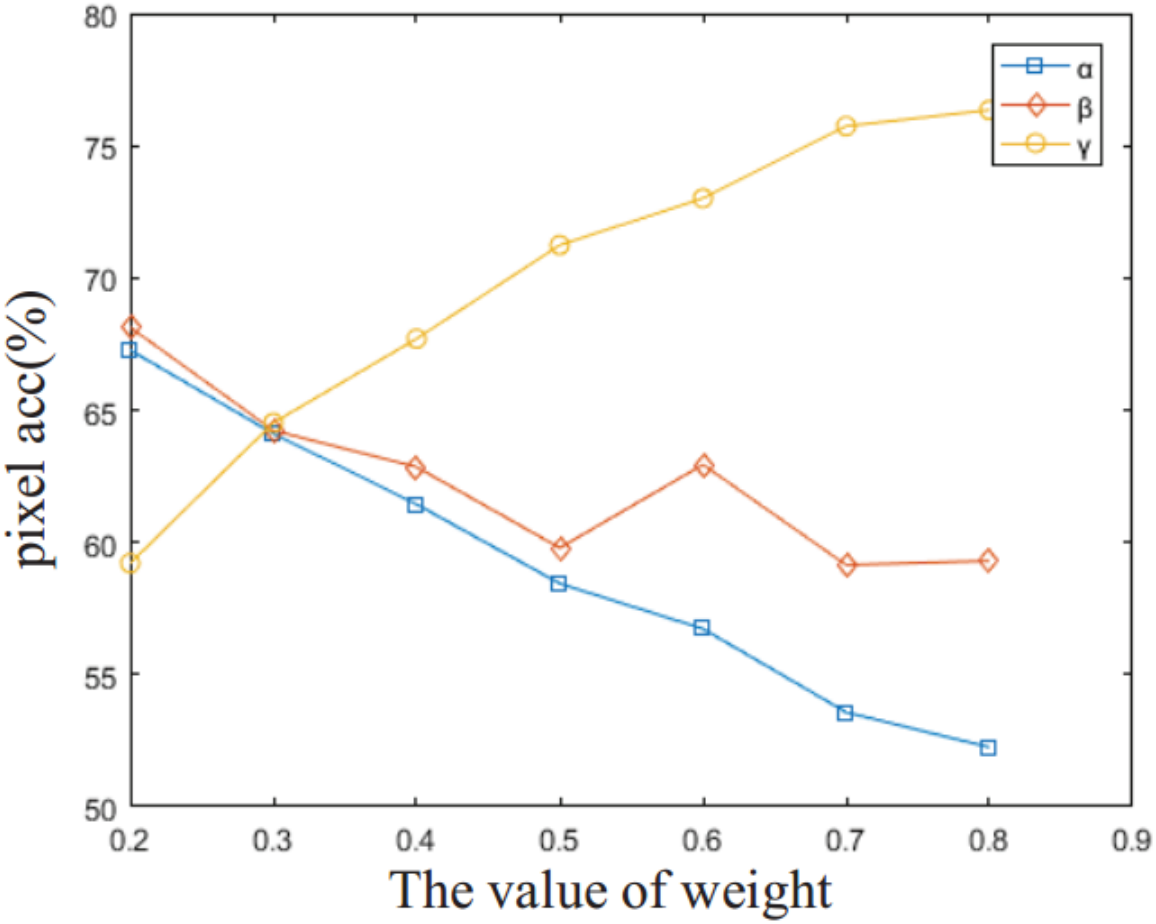


Fig. 4. The influence of changing weight values α, β and γ.

Experiment

Compare method:

(1). Texture segmentation method (ICPR 2010)
(2). Object proposals method (ICCV 2013)
(3). Automated surface inspection method (TCYB 2017)

Experiment dataset:

(1). Wood Defect Database (WOOD)
(2). Road Crack Database (CRACK)

Evaluation indexes:

(1).Intersection over union (IoU)
(2). Pixel accuracy (pixel acc)

Experiment

Table 1. Quantitative comparisons. (IoU(%) / pixel acc(%))

	ICPR 2010 [17]	ICCV 2013 [18]	TCYB 2017 [6]	Ours
WOOD	25.02 / 41.51	33.89 / 47.80	57.16 / 70.20	**63.90 / 79.85**
CRACK	29.97 / 42.33	18.48 / 31.10	29.36 / 43.05	**42.19 / 58.82**

Experiment

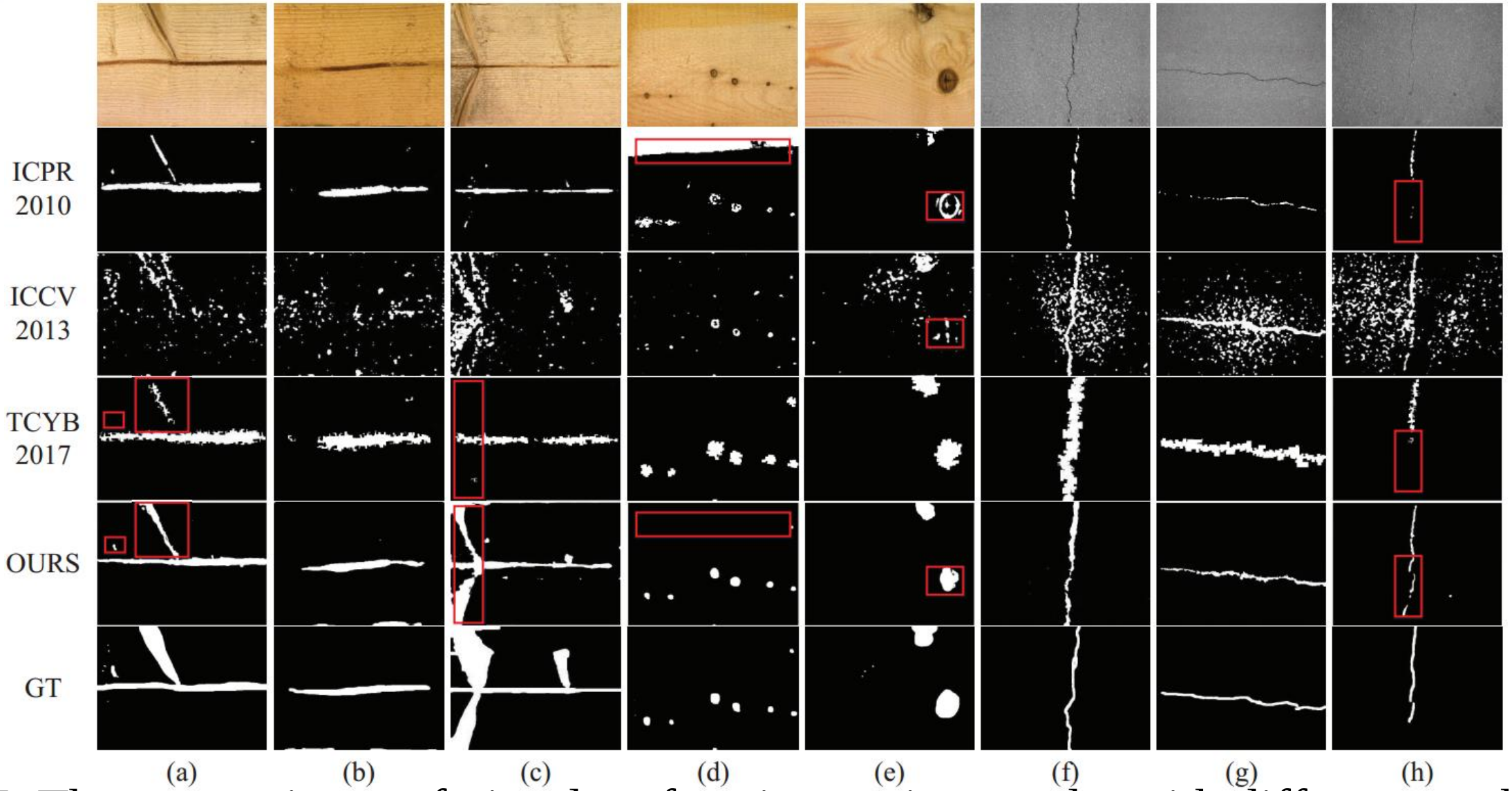


Fig.5. The comparisons of visual surface inspection results with different methods.

Thank you!