Generative adversarial network for road damage detection

In this paper, a progressive growing generative adversarial network with Poisson blending for artificially generating road damage images in improving performance was proposed. The paper claimed if the number of original images is small, then using that method F1 score can be improved by 5% and 2% for relatively large sample numbers.

Also, the authors updated the Road Damage Dataset 2018 (Maeda et al., 2018) to the Road Damage Dataset 2019 and made it available publicly. They show that this study improves pothole detection accuracy.

Generative Adversarial Network:

Generative modeling is an unsupervised learning task in machine learning that can imitate a given data.

A Generative Adversarial Networks (GAN) is composed of two parts:

i. Generator: It generates new data.
ii. Discriminator: It discriminates fake from real data.

Here's a picture of the whole system:

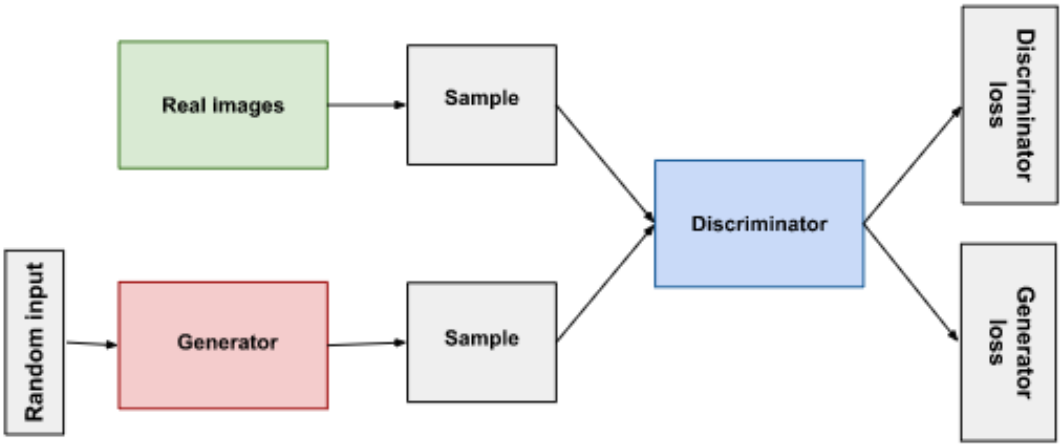

Figure 1. Generative Adversarial Network

Progressive growing generative adversarial network:

It is an extension of the more traditional GAN that incrementally grows the generated image's size while training. It stables the training and growth of GAN models, which can generate large-high-quality images.

Poisson blending:

It is a technique by which image processing operators let the user seamlessly blend an object or texture from a source image into a target image.

Figure 2. Poisson Blending

This study shows that their PG-GAN with Poisson blending can improve the F1 score on detecting pothole on roads.

		Available data (images)		
		1,200	**800**	**400**
Additional data	0%	0.39	0.33	0.32
	50%	**0.41**	**0.37**	**0.37**
	100%	0.28	0.34	0.34

Note: The numbers in bold denote the highest *F*-measure in each case when using 50% additional data.

Figure 3. F-measure for each dataset (SSD MobileNet)

TABLE 6 *F*-measure for each dataset (SSD Resnet50)

		Available data (images)		
		1,200	**800**	**400**
Additional data	0%	**0.64**	**0.61**	0.56
	50%	0.61	**0.61**	0.58
	100%	0.61	**0.61**	**0.60**

Note: The numbers in bold denote the highest *F*-measure in each case when using 50% additional data. The improvement was confirmed only when the available data were 400 images.

Figure 4. F-measure for each dataset (SSD Resnet50)

Generative Adversarial Network has some drawbacks as well.

i. It's harder to train. User needs to give various kinds of data uninterruptedly to verify if it is working accurately or not.

ii. Optimizing the loss function is very difficult.

References:

[1] Maeda, H., Kashiyama, T., Sekimoto, Y., Seto, T., & Omata, H. Generative adversarial network for road damage detection. Computer-Aided Civil and Infrastructure Engineering.