



## ESRGAN Approach for Earth Imaging Super Resolution

Elisa Maiettini

Jonas Gonzalez

Alexander Aroyo

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#### Who are we & Disclaimer





Elisa Maiettini PhD Student Humanoid Sensing and Perception



Jonas Gonzalez PhD Student Robotics, Brain and Cognitive Sciences



Alexander Aroyo Postdoc Fellow Cognitive Architecture for Collaborative Technologies





Idea



- Generative adversarial networks for SR (GANs)
- Enhanced Super-Resolution GAN (ESRGAN)
- Mid-Results
- Future directions

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## Generative Adversarial Networks (GANs) Discriminative and Generative models

**Discriminative** models find the conditional probability P(Y|X = x)**Generative** models generate samples from the joint probability distribution P(X, Y)



### GAN Architecture (Goodfellow'14)

- Generator  $G_{\theta} : \mathcal{L} \to \mathcal{D}$
- Discriminator  $D_{\phi}: \mathcal{D} \rightarrow [0, 1]$



Minimax (or zero-sum) game:

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

#### Generative adversarial networks (GANs)



Nvidia ThisPersonDoesNotExist

Nvidia GauGAN

#### Generative adversarial networks (GANs)

original



bicubic (21.59dB/0.6423)



SRResNet (23.44dB/0.7777)



SRGAN (20.34dB/0.6562)



(Ledig et al. 2016)

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### Enhanced Super-Resolution GANs (ESRGANs)

Residual Block (RB)

Residual in Residual Dense Block (RRDB)



- 1. Architectural improvements (remove BN and add RRDB)
- 2. Relativistic discriminator
- 3. Improvement of the perceptual loss

✓ Open Source✓ Won PIRM-SR Challenge'18

(Xintao Wang et al. 2018)

#### Enhanced Super-Resolution GANs (ESRGANs)



(Xintao Wang et al. 2018)

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#### Mid-Results

#### **Standard pre-processing**

- Mean
- Median
- Gaussian kernel
  to fill black pixels



#### Mid-Results



Ground truth



Generated validation image



LR\_images

#### Mid-Results – After the online meetup



#### Mid-Results – After the online meetup



Generated validation image

Ground truth

Generated validation image

Ground truth

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#### Future directions

- Modify the architecture to make it admit more than one input
- Take into account occluded pixels in the loss function of the Generator of the GAN

# Thank you!





Elisa Maiettini elisa.maiettini@iit.it

> Alexander Aroyo alexander.aroyo@iit.it