OPTICAL IMAGE SYNTHESIS FOR CLOUD REMOVAL WITH GENERATIVE ADVERSARIAL NETWORKS

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Introduction

Remote sensing data:

- Cost-effective solution for many applications,
  - Agricultural mapping
  - Urban planning
  - Disaster management
  - Weather forecasting,
  - etc.
- More satellites with higher spatial resolution and lower revisiting time.
  - Landsat 8
  - Sentinel 1
  - Sentinel 2
  - etc.
- These applications can be affected by the presence of clouds in optical imagery from passive sensors.
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Optical imagery is affected by the presence of clouds.

Figure. *Campo Verde* municipality, Mato Grosso, Brazil.
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Solutions ? ...
Solutions

- Use of images from active sensors, like Synthetic Aperture Radar (SAR).
  - They almost do not depend on the atmospheric conditions neither on the solar illumination.
  - The information captured by them is less descriptive and more complex to interpret than in optical images.

- Use reconstruction techniques for cloud removal,
  - There is still no method able to completely solve this problem.
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Conditional Generative Adversarial Networks (cGANs) have been broadly used in different image generation tasks,

Figure. Examples of some application of cGANs. Image taken from [Isola et al., 2016]
Motivation

Based on,

- SAR images are almost not affected by clouds.
- The capability of cGANs for image translation.
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**SAR to Optical Image Synthesis for Cloud Removal with cGANs**
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- **Objective:**

  Learn nonlinear mapping function that maps SAR images to optical cloud-free images.
Proposed Method

Figure. Proposed methodology for cloud removal in optical satellite images.
Proposed Method

Results:

(a) SAR
(b) Real
(c) Generated

(d) SAR
(e) Real
(f) Generated
Proposed Method

Results:

Figure. Result for monotemporal image classification in term of OA.
Proposed Method

Results:

**Figure.** Result for monotemporal image classification in term of AA.
Proposed Method: Multitemporal

Figure. Proposed multitemporal methodology for cloud removal in optical satellite images.
Proposed Method: Multitemporal

(a) Real Optical

(b) Monotemporal

(c) Multitemporal
References