

Satellite Imagery Analysis System

1. Core Concept

System for analyzing changes between two satellite images to detect deforestation and afforestation.

2. Technical Implementation

2.1 Core Functions

```
def load_image(image_path):  
    # Loads and converts BGR to RGB  
    return img_rgb  
  
def register_images(img1, img2):  
    # Validates matching dimensions  
    return img1, img2  
  
def change_detection(img1, img2, threshold_deforestation=-20,  
                    threshold_afforestation=20, kernel_size=5):  
    # Detects changes using HSV color space  
    return deforestation_mask, afforestation_mask  
  
def analyze_changes(deforestation_mask, afforestation_mask):  
    # Calculates change percentages  
    return percent_deforestation, percent_afforestation
```

2.2 Change Detection Parameters

- `threshold_deforestation` : -20 (brightness decrease)
- `threshold_afforestation` : 20 (brightness increase)
- `kernel_size` : 5x5 (morphological operations)

2.3 Visualization Components

Six-panel output showing:

1. Original image (Time 1)
2. Original image (Time 2)

3. Change overlay
4. Deforestation mask
5. Afforestation mask
6. Contour annotation

3. Usage Example

```
# Load images
img1 = load_image("2009.png")
img2 = load_image("2019.png")

# Detect changes
deforestation, afforestation = change_detection(img1, img2)

# Get statistics
defo_pct, affo_pct = analyze_changes(deforestation, afforestation)
print(f"Deforestation: {defo_pct:.2f}%")
print(f"Afforestation: {affo_pct:.2f}%")
```

4. Technical Requirements

- Python 3.7+
- OpenCV
- NumPy
- Matplotlib

5. Limitations

- Requires pre-aligned images
- Uses fixed thresholds
- Limited to RGB imagery