

# Shadow removal for forest ground images

SCC5830 – Image Processing

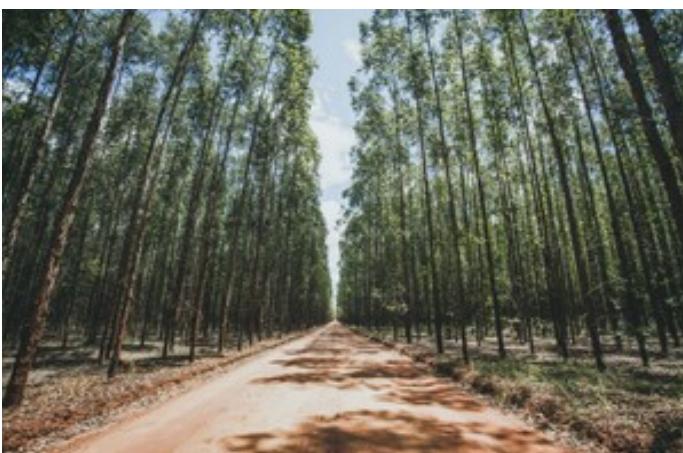
Luiz Alberto Hiroshi Horita – nº USP 6882704

Msc. Candidate

# Motivation and objective

- In real life application, one of the main causes of **environment noise is shadow**, which distort both image intensity (luminance) and color (chrominance).
- This work aims to remove the shaows from a scene of eucalyptus forest, so the objects on it become clearer for segmentation

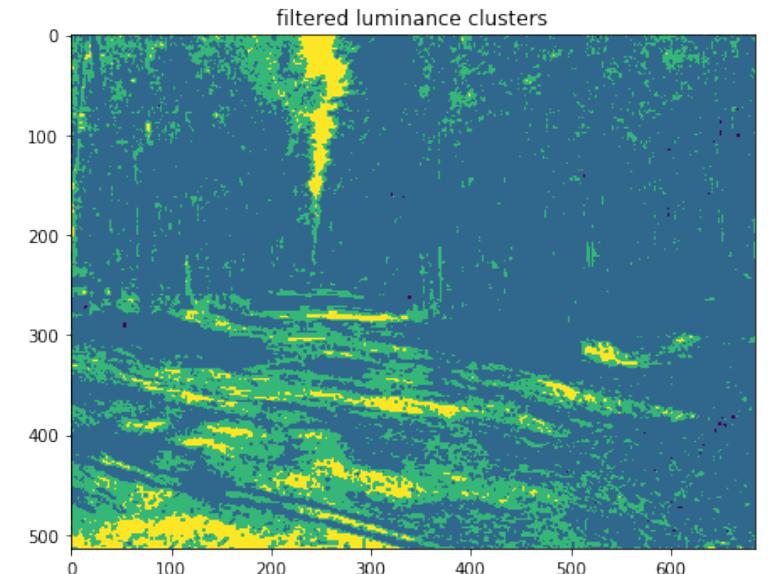
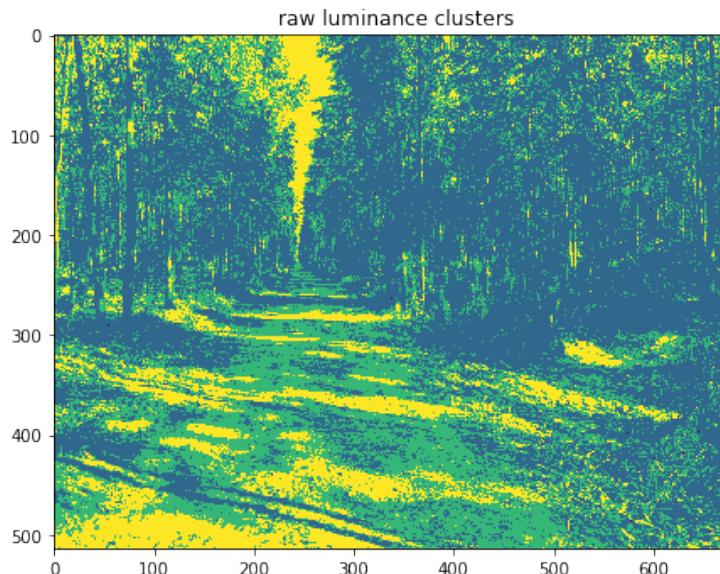
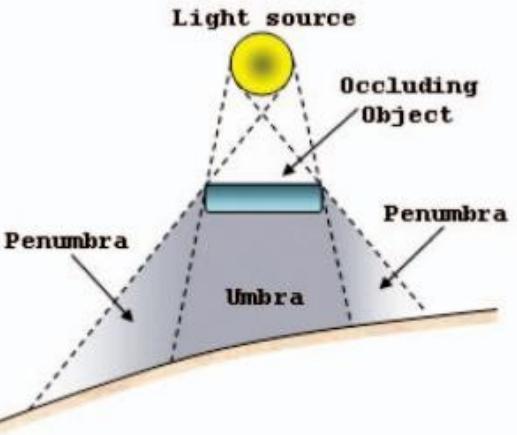
# Motivation and objective



# Methodes

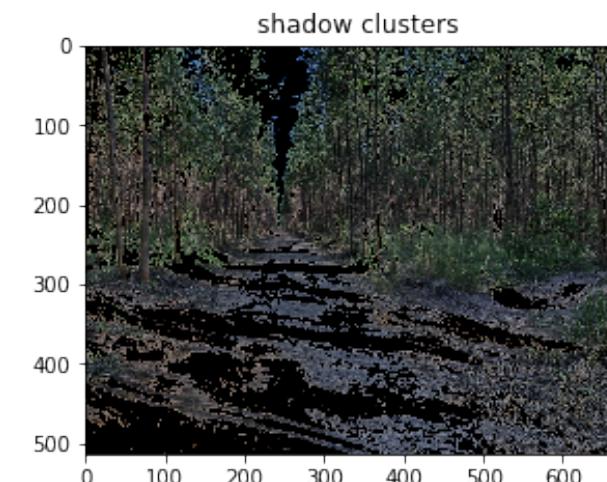
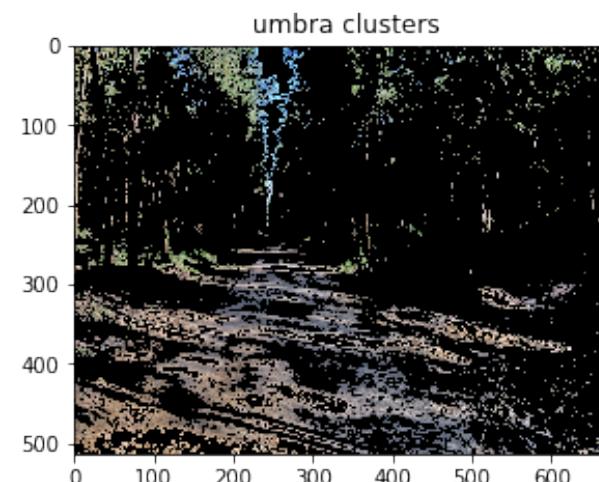
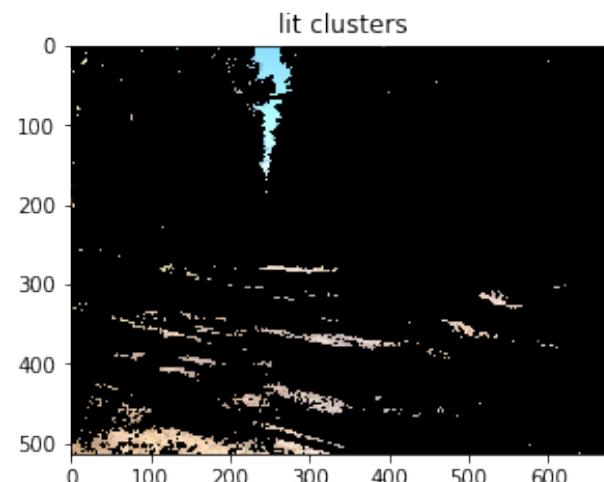
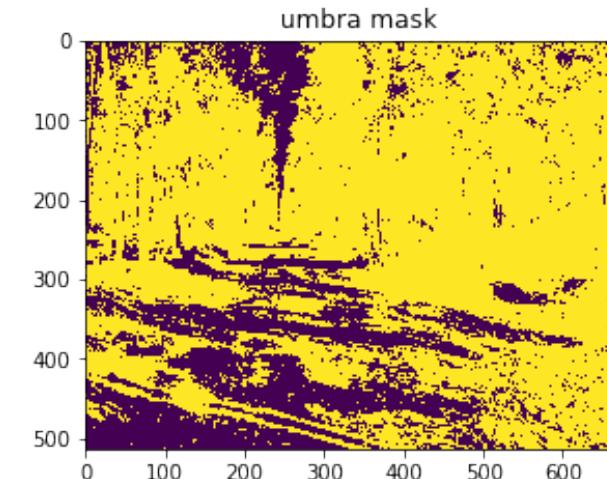
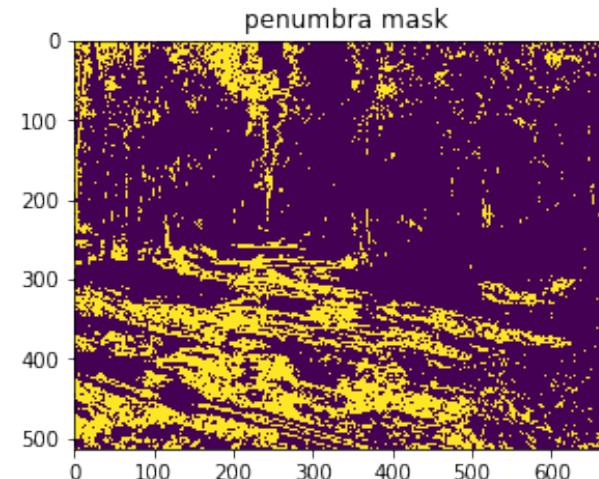
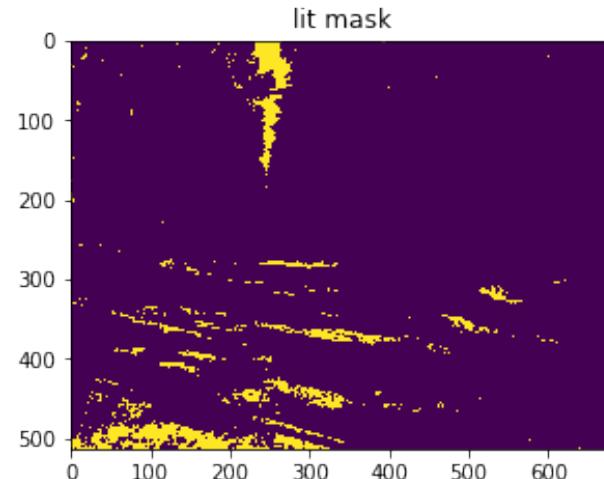
1. Shadow detection
  - 1.1. Color spaces analysis
  - 1.2. Separating lit, penumbra and umbra regions
  - 1.3. Filtering noise
2. Subgroups clustering based on colors
3. Removing shadows with local histogram enhancement

# 1. Shadow detection

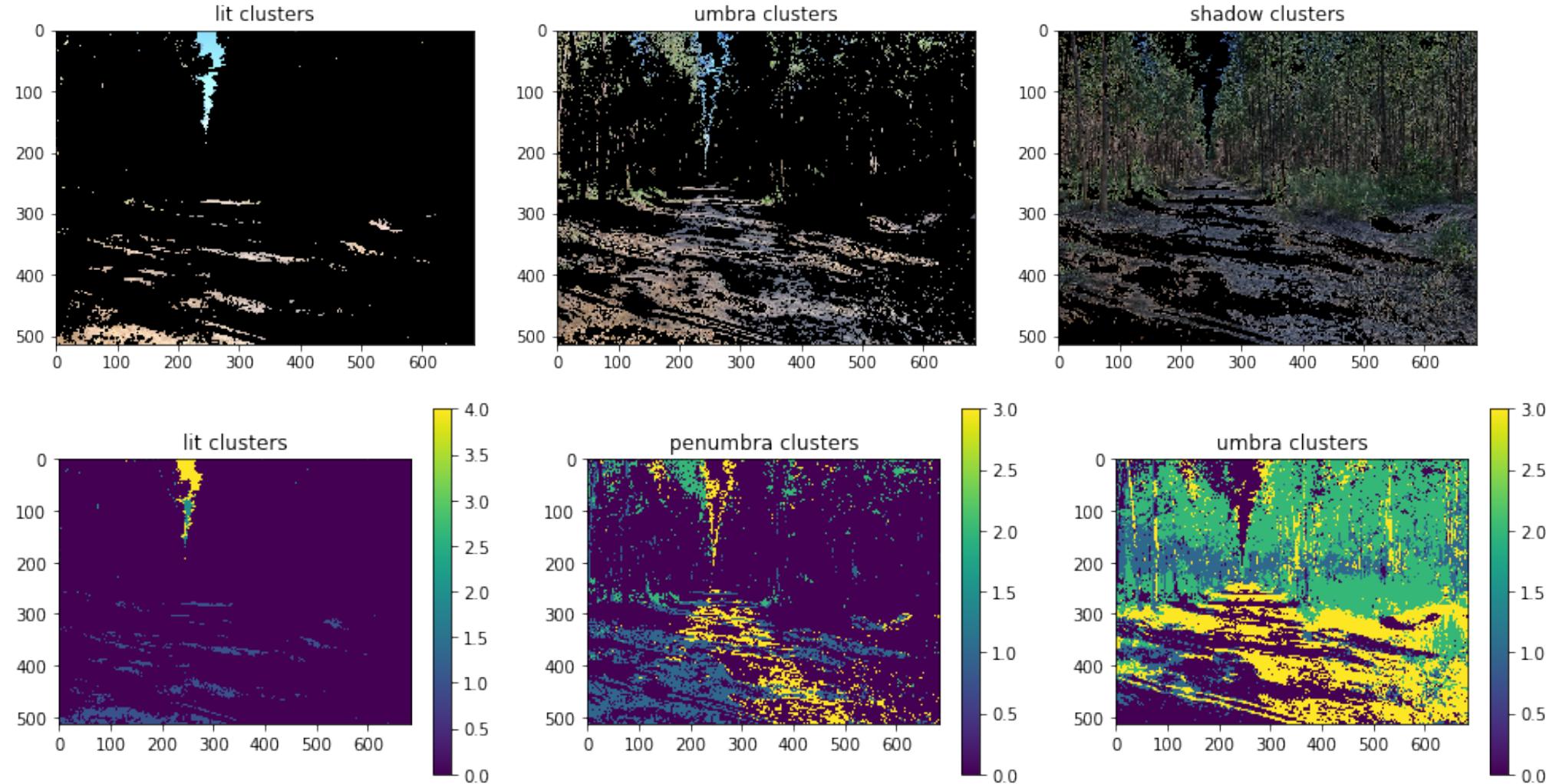


Filtering the result of luminance clustering using **adaptive filter**.

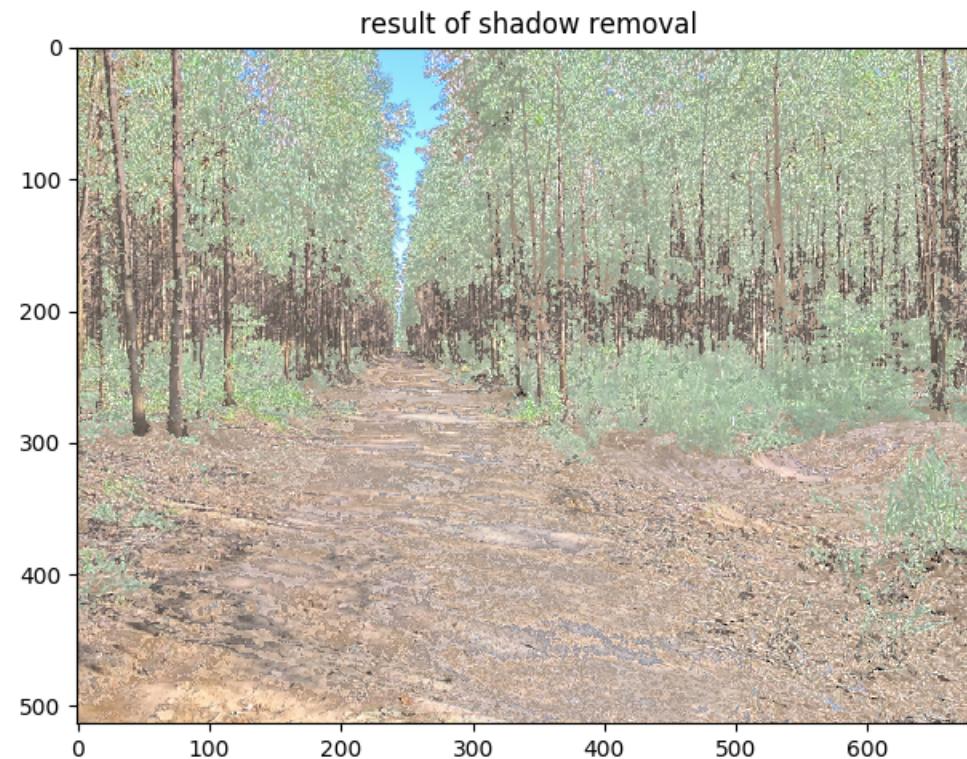
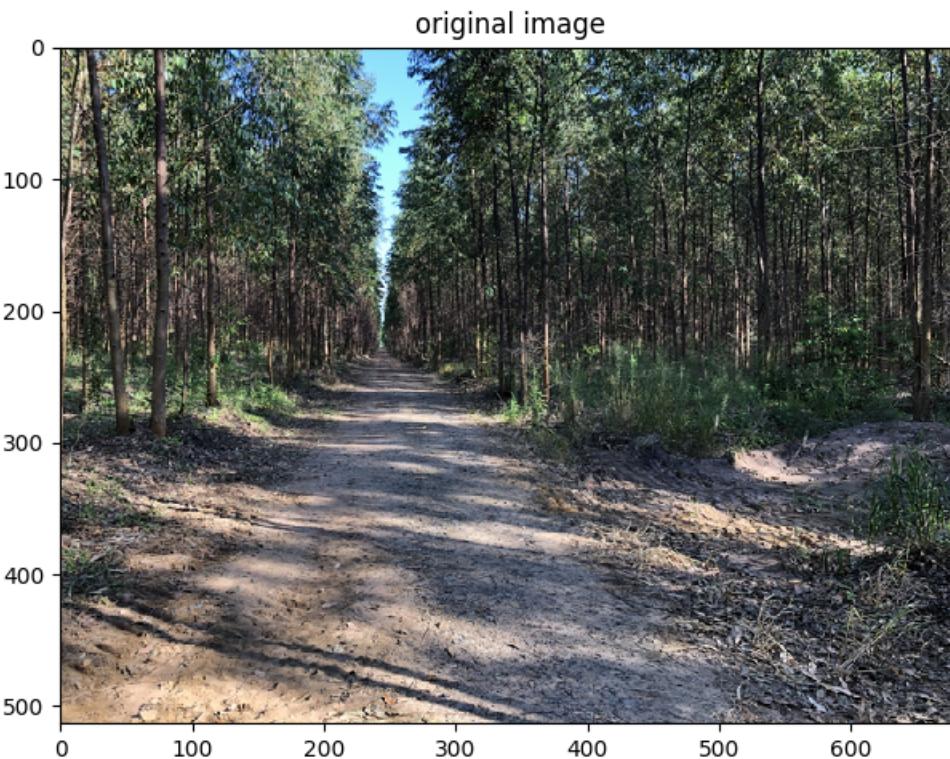
# 1. Shadow detection



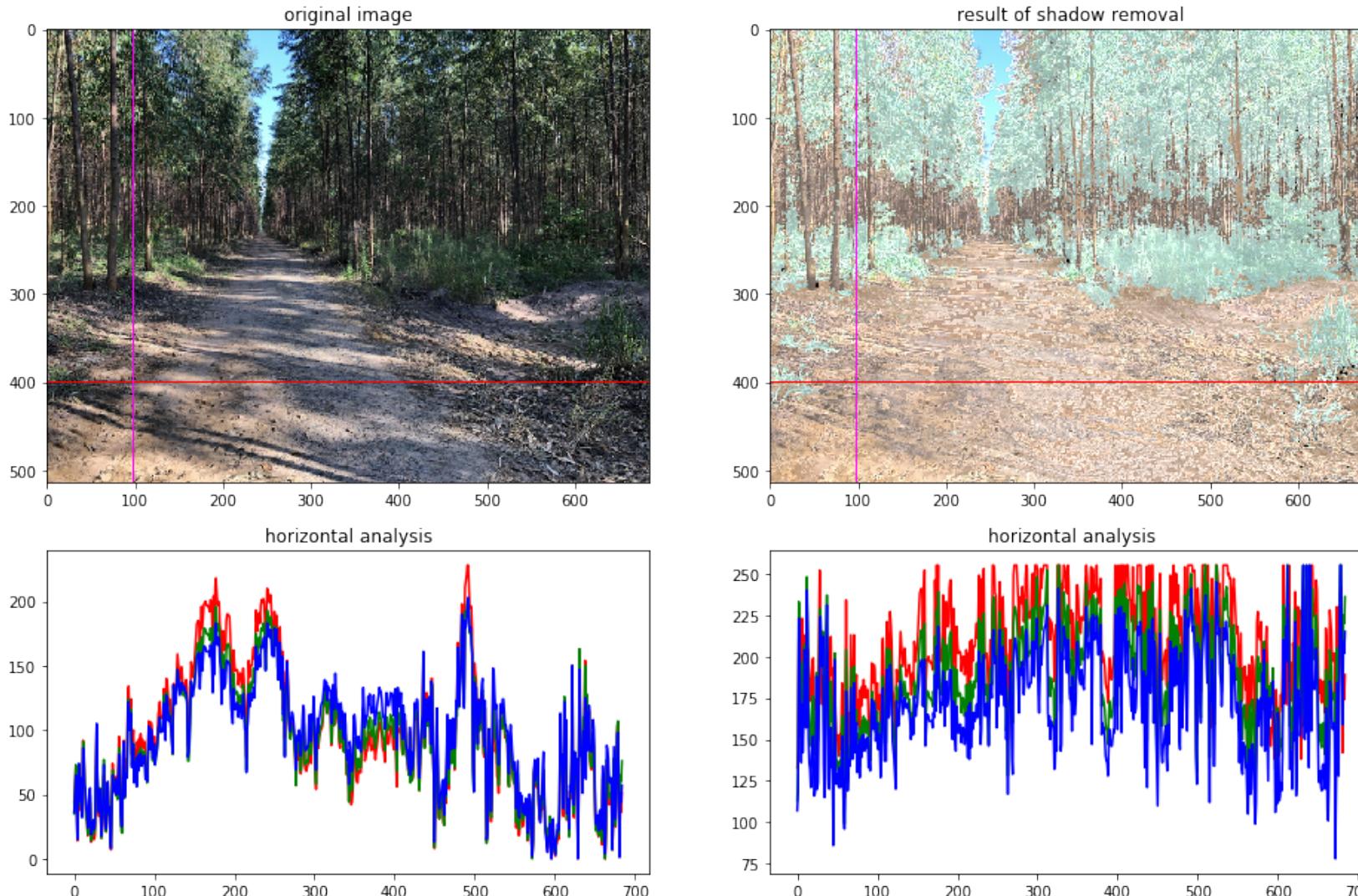
## 2. Subgroups clustering based on colors



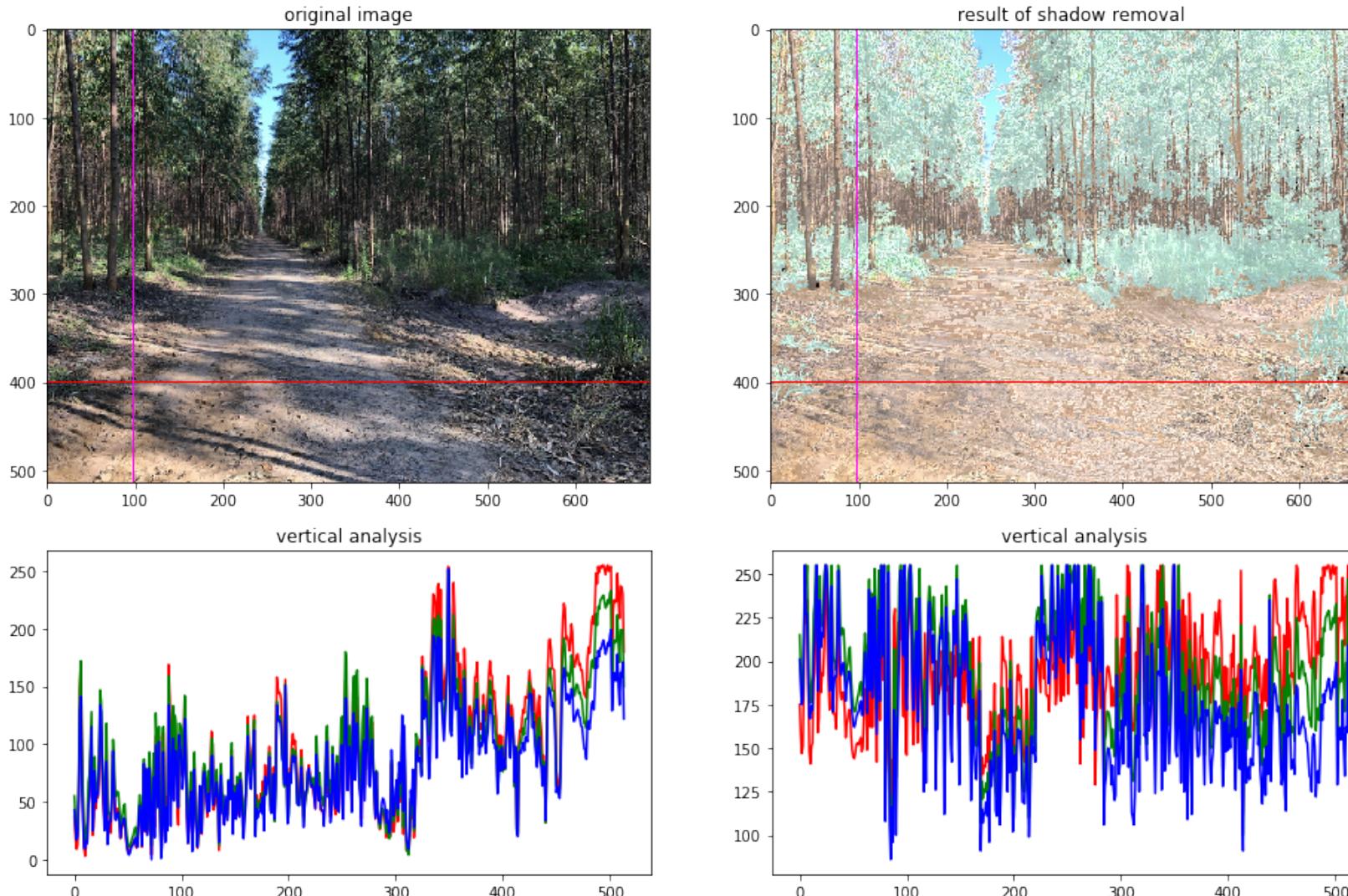
# 3. Removing shadow



# Results and discussion



# Results and discussion



# Algorithm applied on unseen scenes

## Unseen image 1

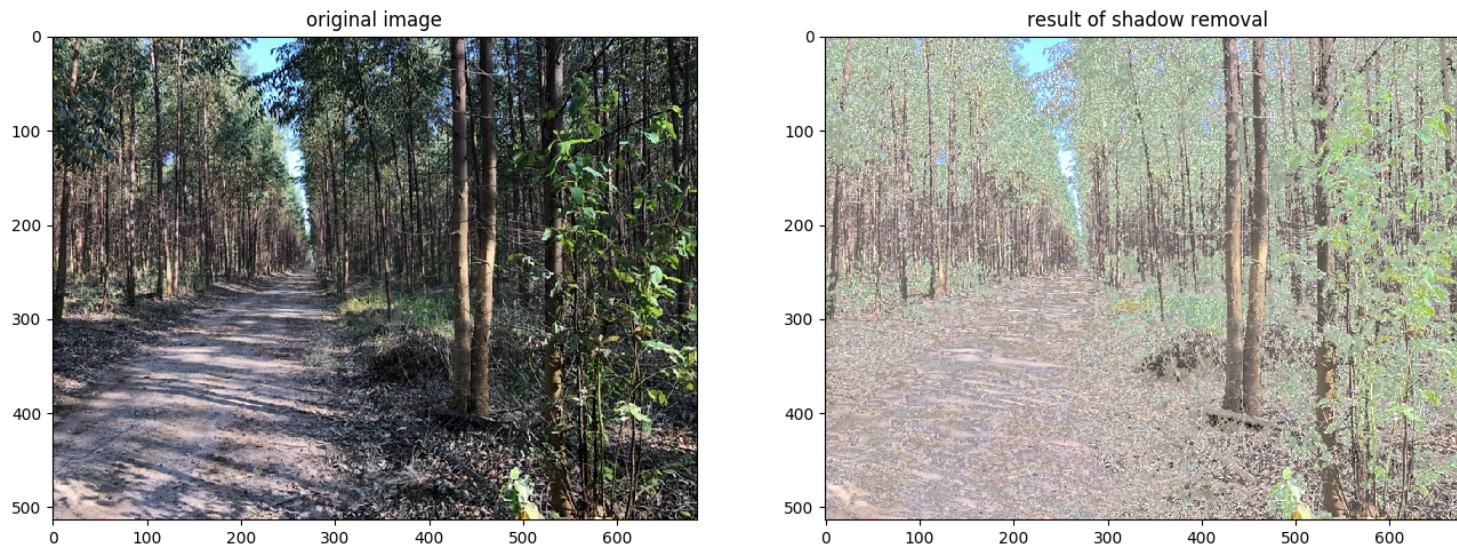
Image captured by  
the [same camera](#)  
used to capture  
the image used on  
this work  
development.



# Algorithm applied on unseen scenes

## Unseen image 2

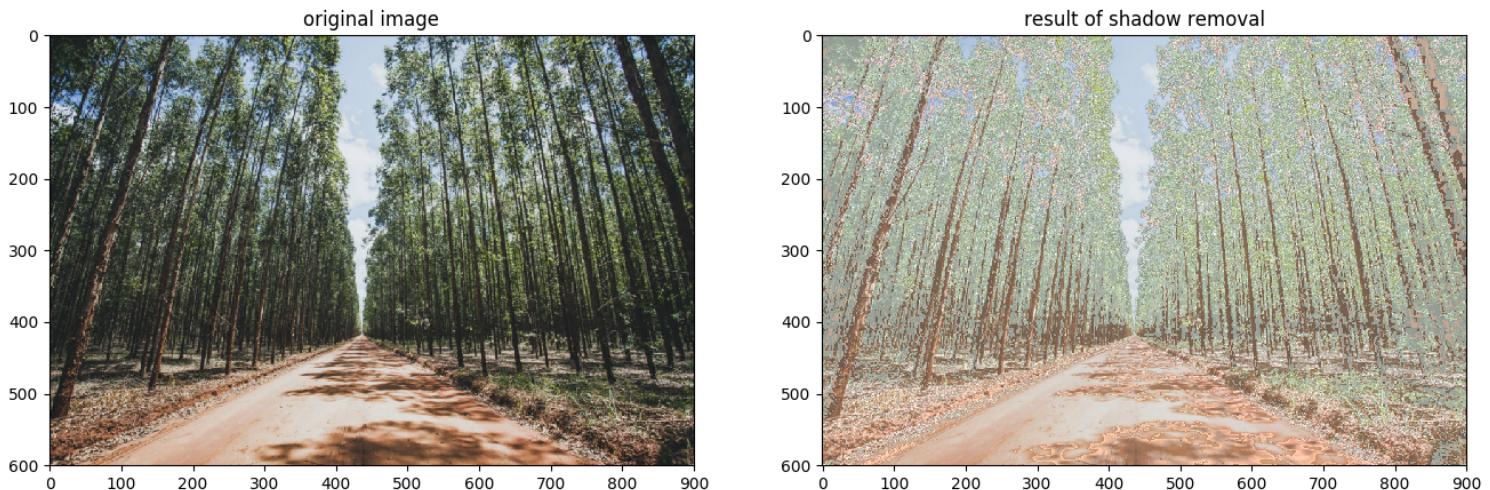
Image captured by the [same camera](#) used to capture the image used on this work development.



# Algorithm applied on unseen scenes

## Unseen image 3

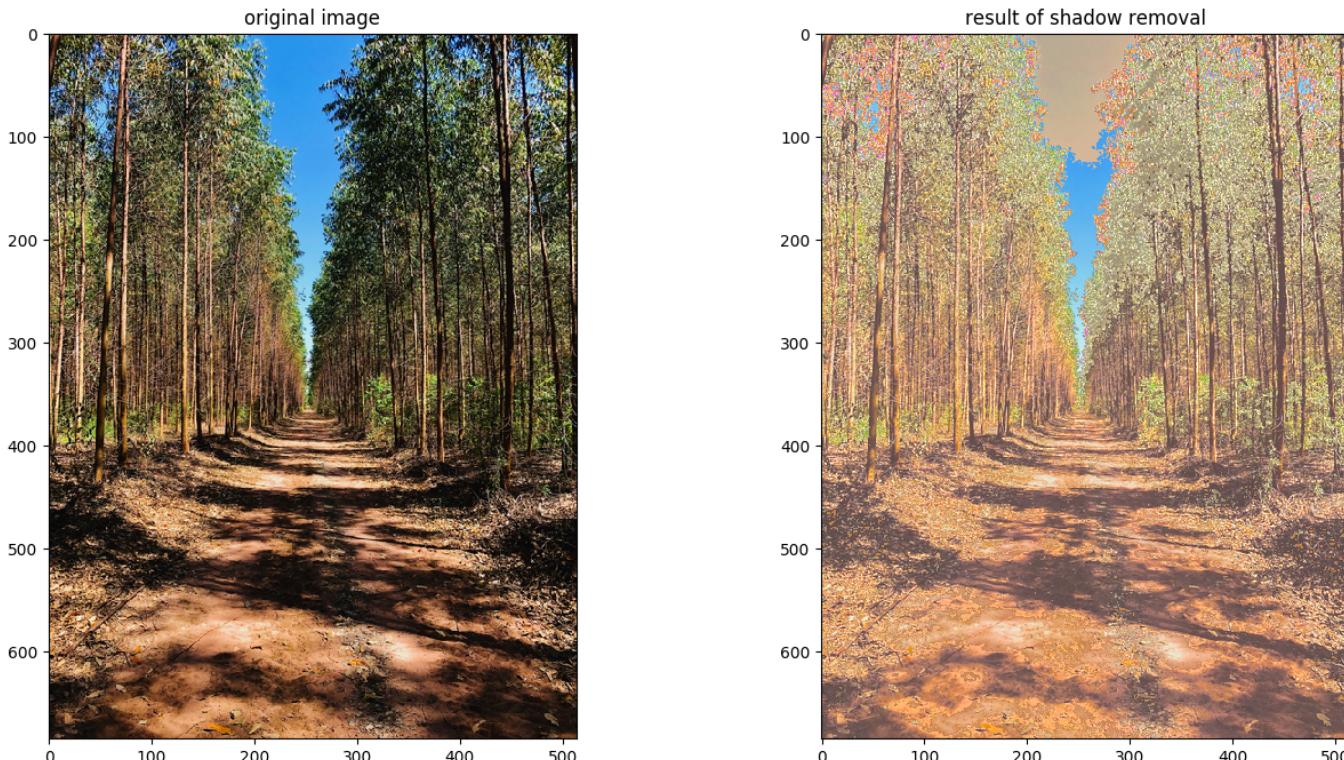
Image captured by the **different camera** used to capture the image used on this work development.



# 4.2. Algorithm applied on unseen scenes

## Unseen image 4

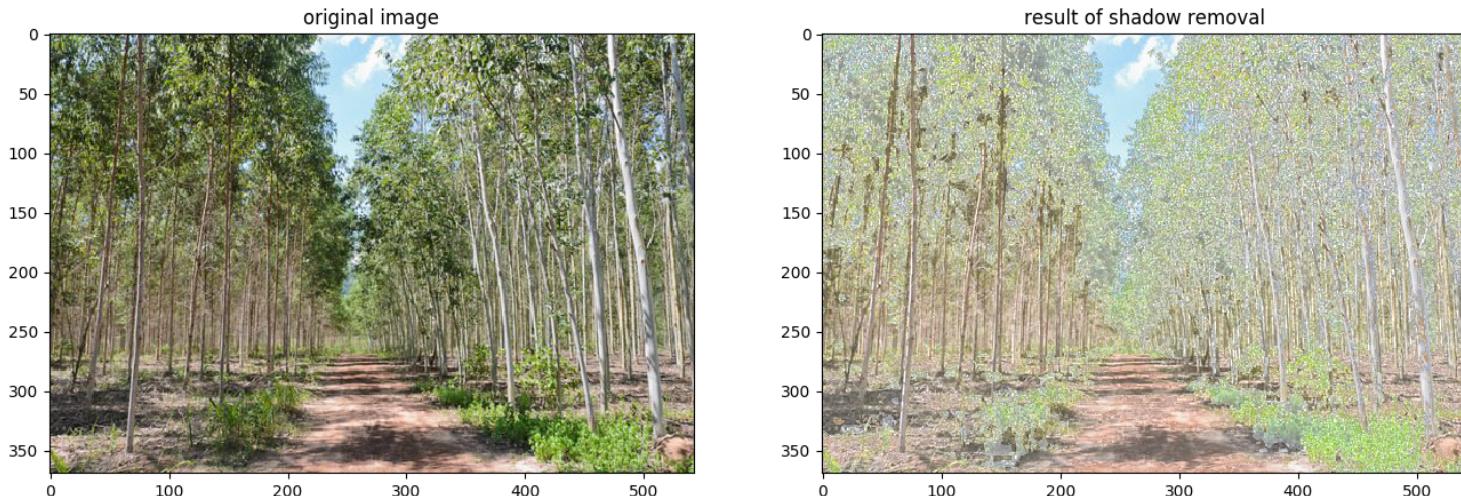
Image captured by the **different camera** used to capture the image used on this work development.



# Algorithm applied on unseen scenes

## Unseen image 5

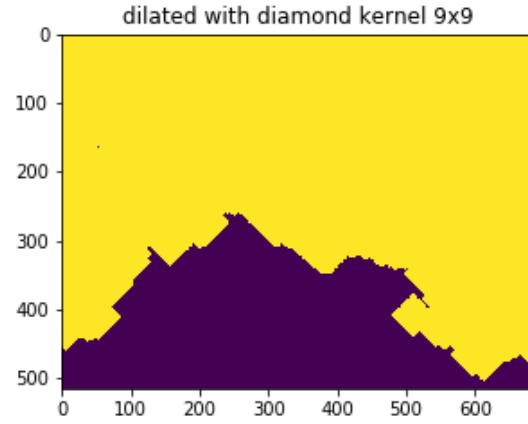
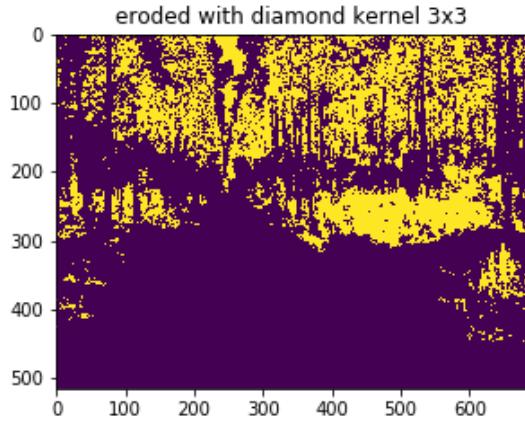
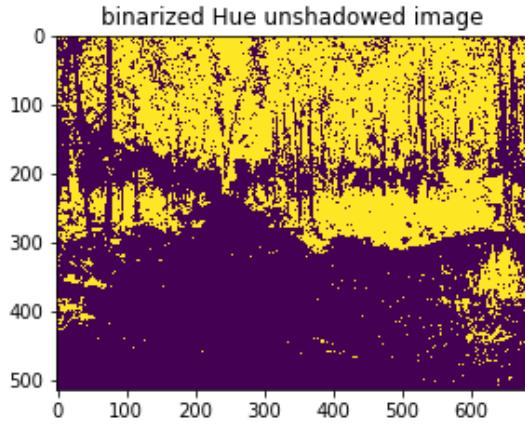
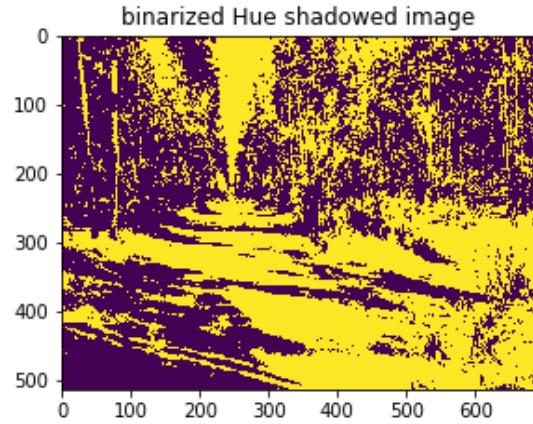
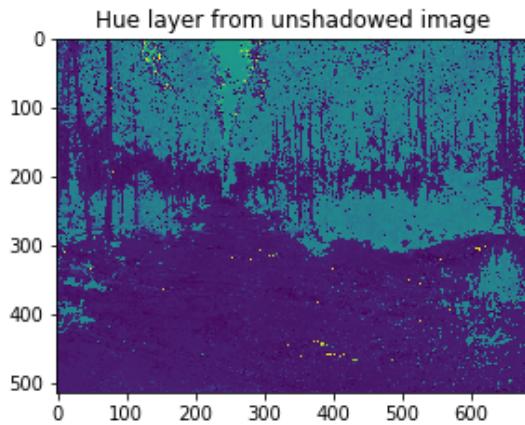
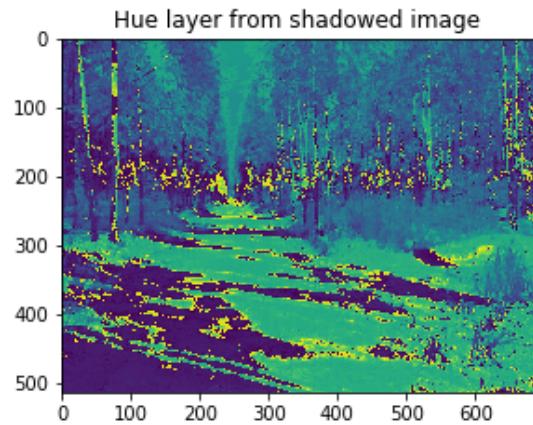
Image captured by the **different camera** used to capture the image used on this work development.



# Conclusion

- **Complex scenario;**
- The shadow removal was **not perfect**;
- **For segmentation** of road (navigable area) had **good results**;
- Limitations:
  - Works only for **same kind of scenario**;
  - Works only for images captured from **same câmera**;
  - It takes **long time to execute**.

# Conclusion

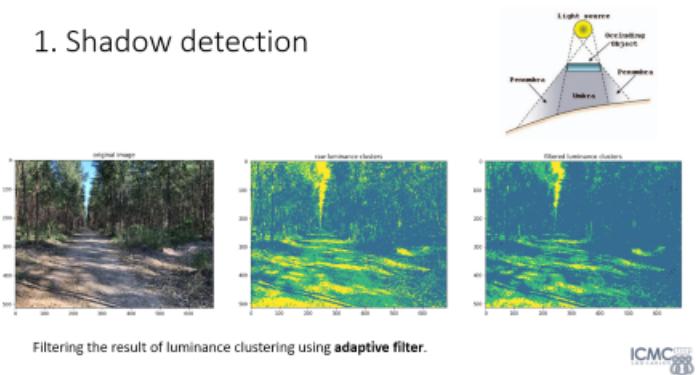


Comparing road detection before and after shadow removal.

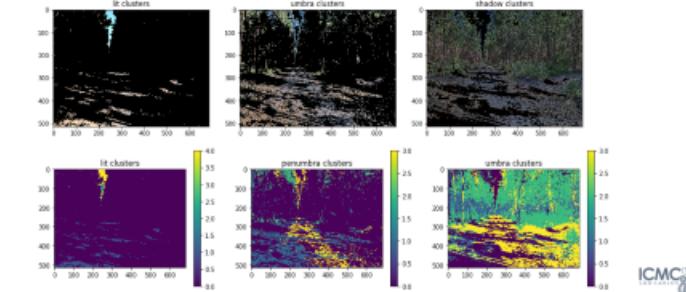
# Thank you!

## Any question?

### 1. Shadow detection

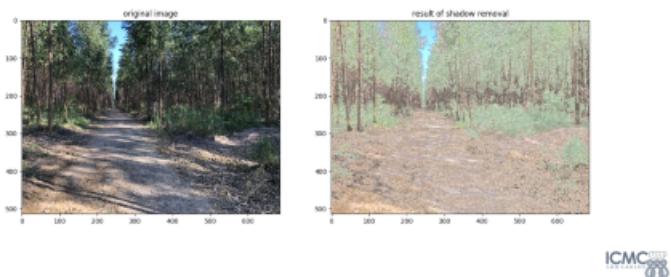


### 2. Subgroups clustering based on colors



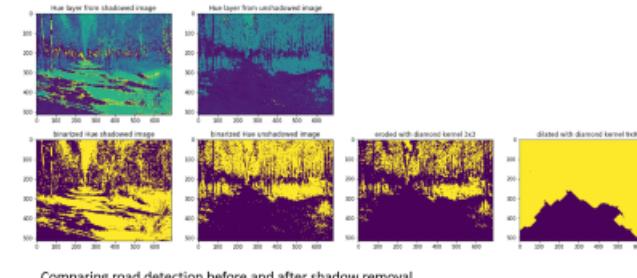
ICMC USP  
SÃO CARLOS

### 3. Removing shadow



ICMC USP  
SÃO CARLOS

### Conclusion



ICMC USP  
SÃO CARLOS