SERVEI DE SISTEMES
D'INFORMACIÓ GEOGRÀFICA
I TELEDETECCIÓ
Universitat de Girona

EXTRACTION OF URBAN PARAMETERS FROM 3D POINT-CLOUD WITHIN GRASS

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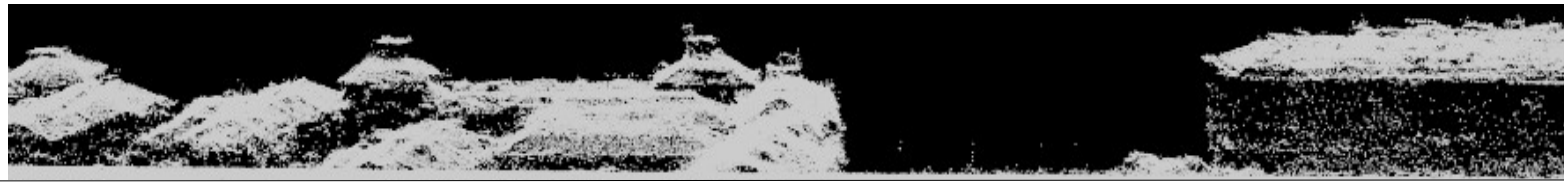
Faculdade de Ciências Sociais e Humanas . Universidade Nova de Lisboa

Research Centre for Geography and Regional Planning,
FCSH, Universidade Nova de Lisboa



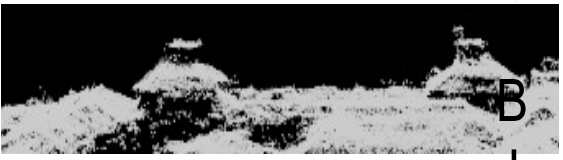
OBJECTIVES

3D POINT CLOUDS – TECHNOLOGIES

CHALLENGES

METHODOLOGY

DISCUSSION



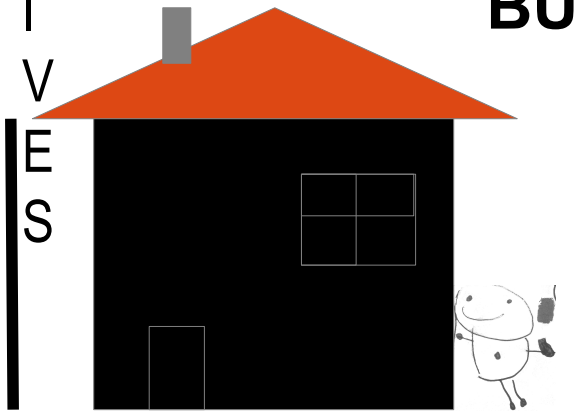
OBJECTIVES

EVALUATE the extraction of the urban parameter

BUILDING FAÇADE HEIGHT

ALÇADA DE LA FAÇANA
DE L'EDIFICI

Roof Eave
(ràfecs de la
teulada)



Base Building
Elevation (pis)

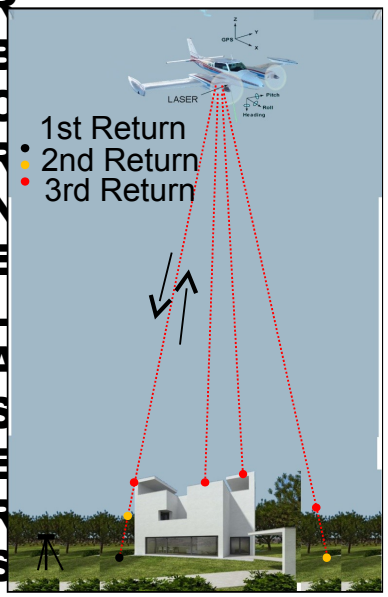
using 3D point cloud (UAS)

and 2D/3D vector data (acquired by traditional photogrammetry)

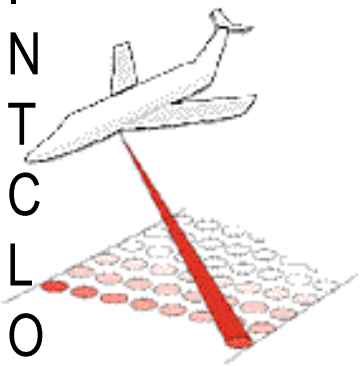
open source GRASS v6.4.2 and ***R***.

3D POINT CLOUDS(“Airborne Acquisition”)

AIRBORNE LASERS



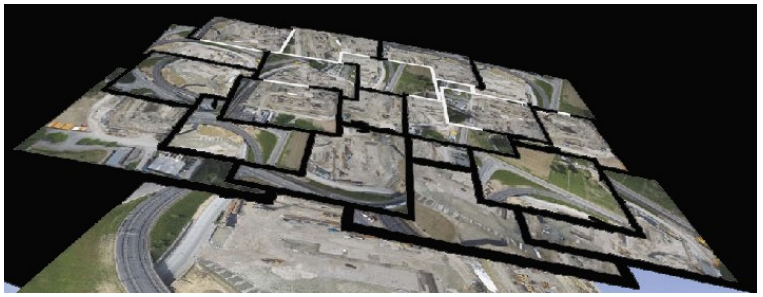
3D POINT CLOUDS



X,Y,Z, INTENSITY, RETURN
(Information of points data)

Z is direct of pulse(Acquisition)

AIRBORNE DIGITAL IMAGE

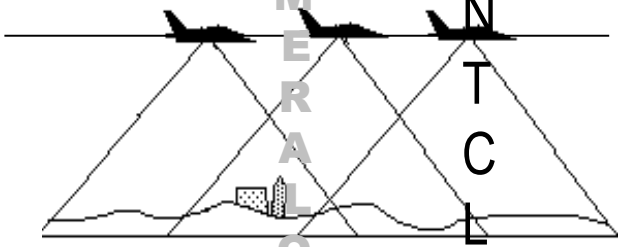


X,Y,Z, R,G,B
(Information of points data)

Dense stereo aerial image matching processing (Acquisition)

UAS (UNMMANED AERIAL SYSTEM)

(vehicles aeris no tripulats)



~90%

FLIGHT (High overlap)

DIGITAL CAMERA LOW FORMAT

SI 3D POINT CLOUDS -

Low cost system and ultra-light

High spatial Resolution (Low altitude)

Useful for acquisiton of 3D points in Small Urban Areas

High differences in image tilts

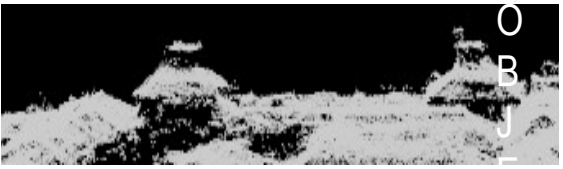
Moderate Wind and rain conditions

3D POINT CLOUD(**8,864,031pts**)

3DPOINTCLOUDS-

Video


O
B
J



GRASS

REFERENCE DATA

LAYER buildings reference with true façade height value

Selection: STUDY(IES)

AREA from original point cloud data

GRASS

SELECT POINTS UAS

Points UAS Top Building Elevation

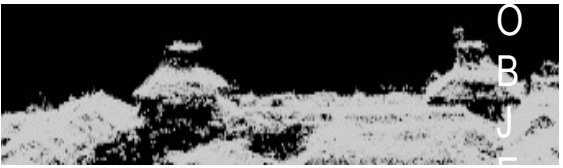
Points UAS Base Building Elevation

R

EVALUATION

Building façade height UAS (BFH UAS) for each building

VERTICAL ERROR = BFH Reference- BFH UAS



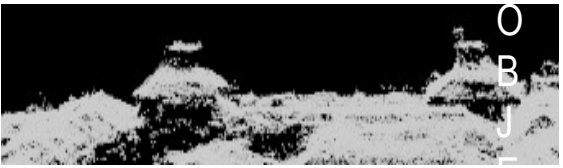
2D/3D Vector Data Reference

- Ortophoto
- Buildings Footprint
- 3D point roof eave
- 3D point base building

Acquired by traditional **photogrammetry**

Reference of Building Façade Height

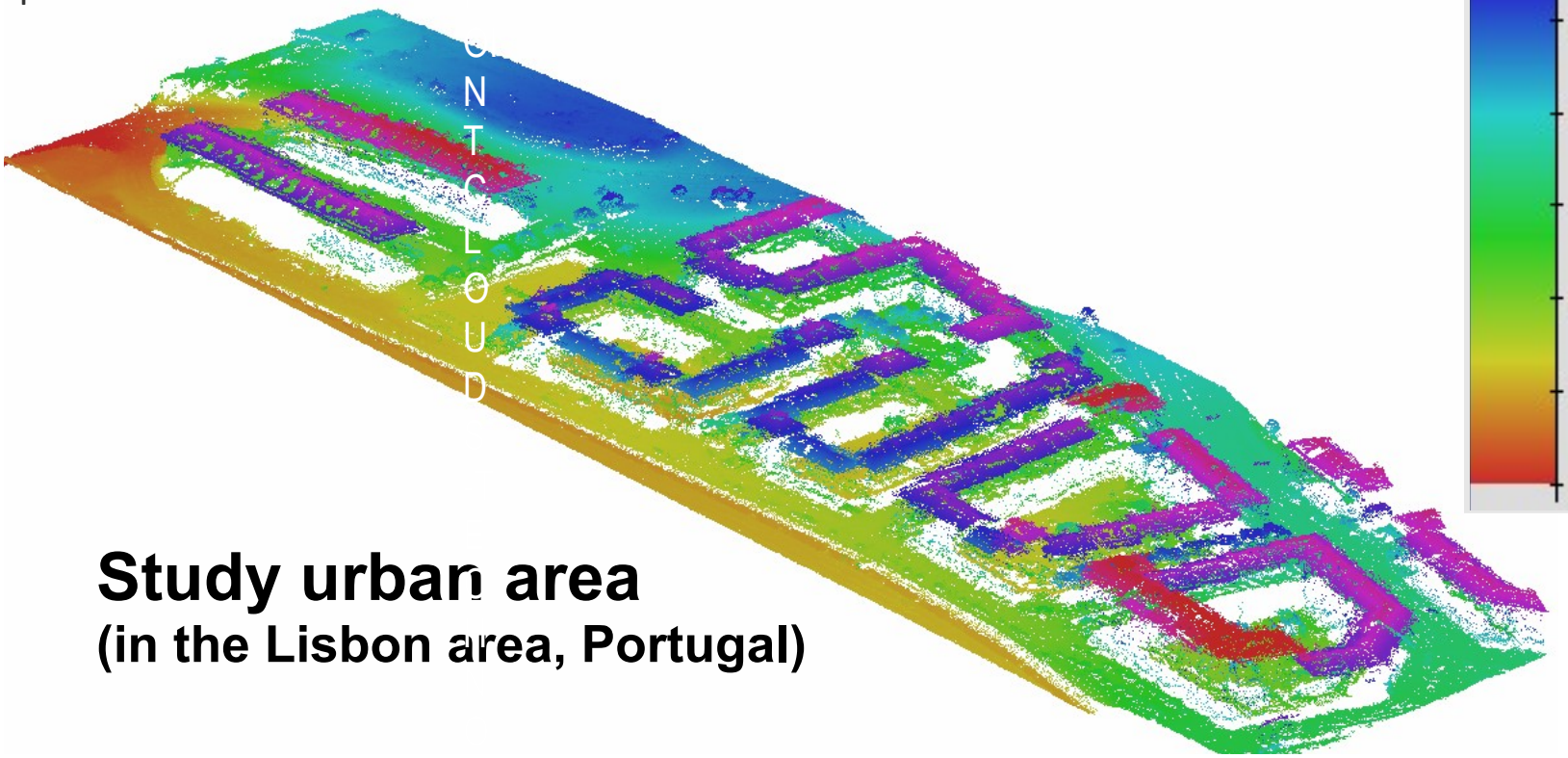
Visual Inspection Methodology



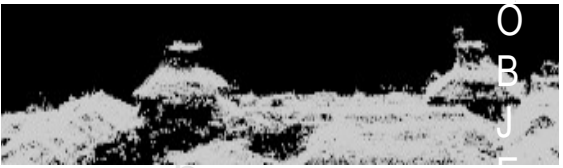
Select STUDY AREA from ORIGINAL POINT CLOUD

1.066.171 millions of points
density~11pts/m2

planimetric resolution:0.3 m



Study urban area
(in the Lisbon area, Portugal)



Selection studies areas

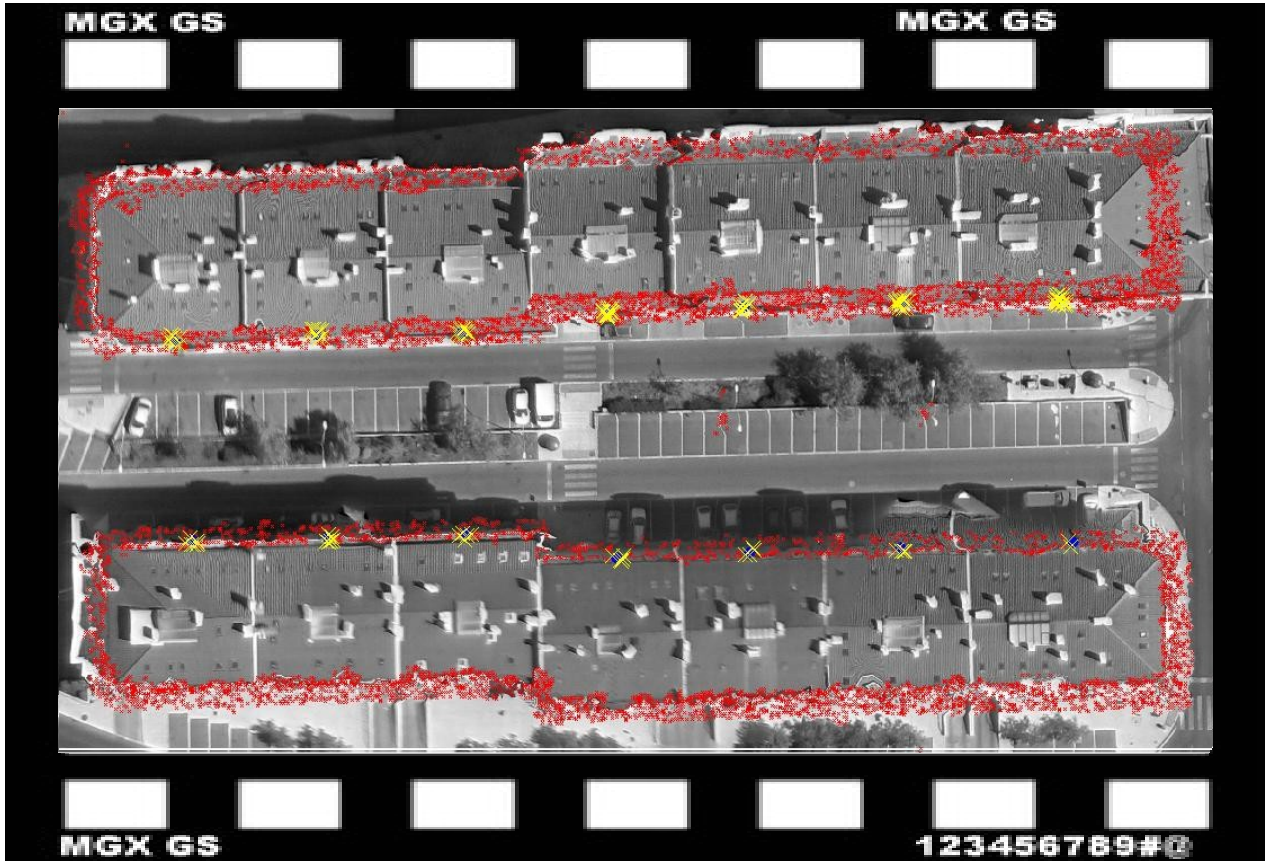
~ 3

~ 4

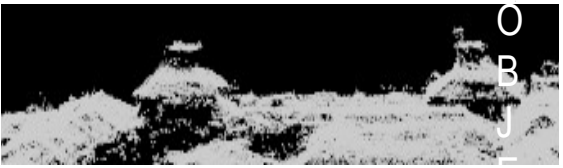
~ 2

AREA A

Points UAS of Roof Eave Building Elevation

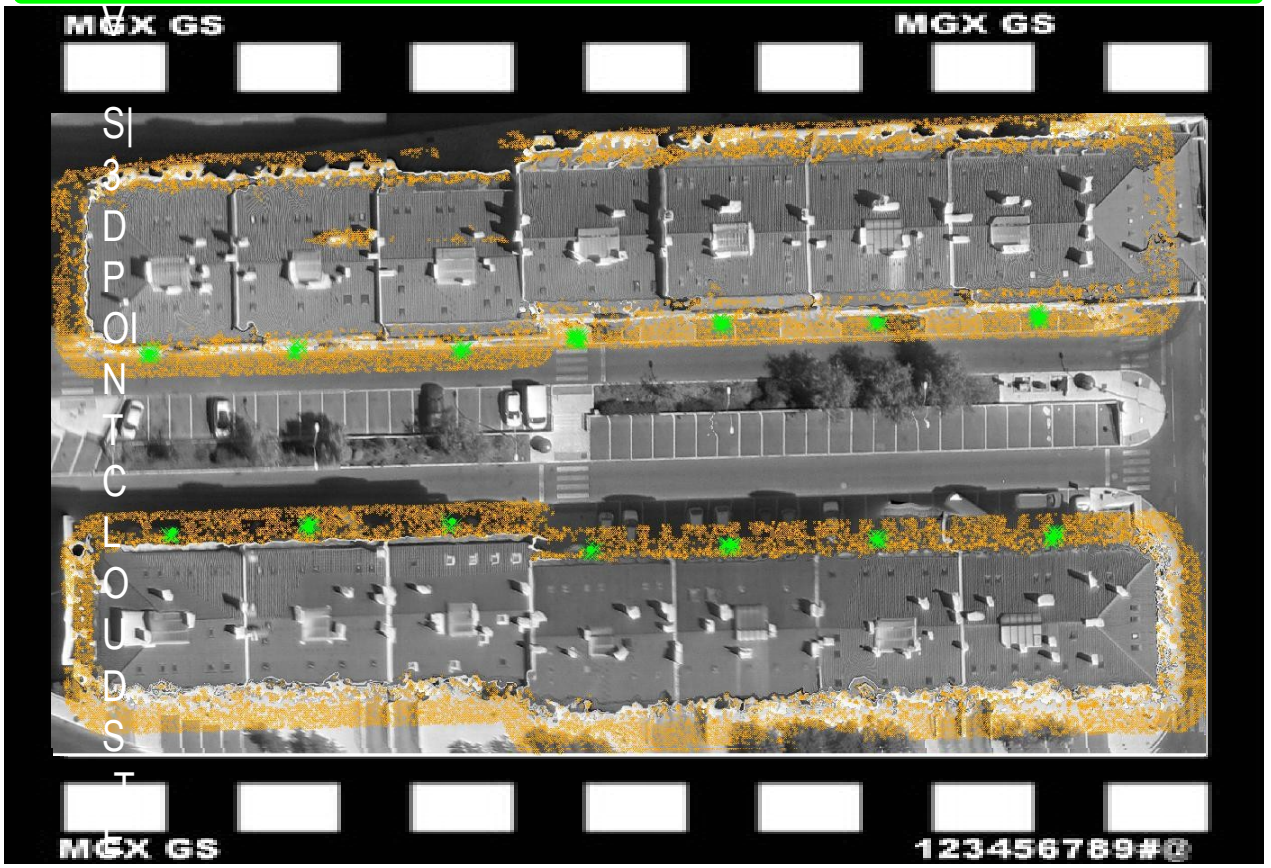


UAS points of roof eave

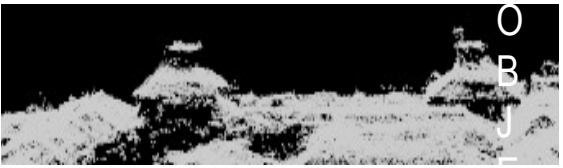


AREA A

Points UAS of Base Building Elevation

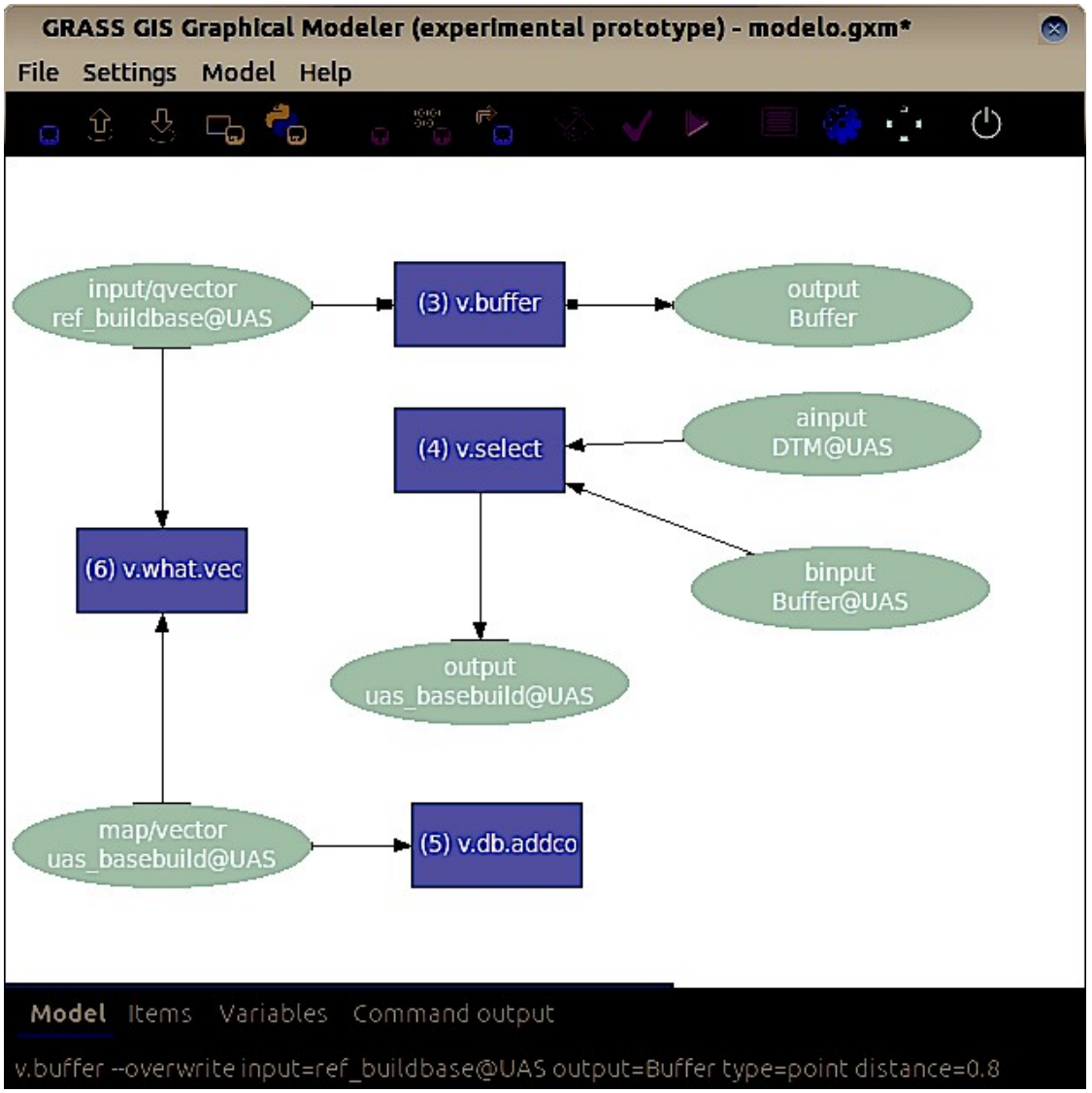


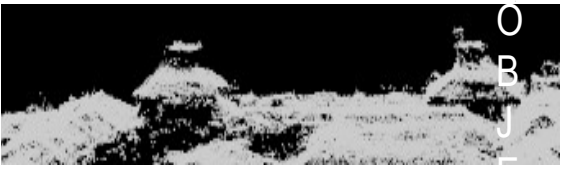
UAS points of base building



Points UAS
Base Building Elevation

in graphical modeler





EVALUATION

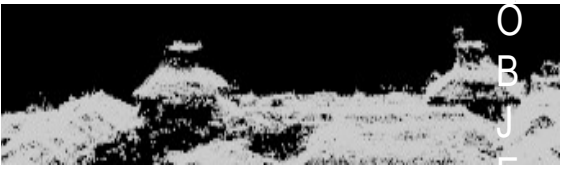
```r
#beirado (input: conj pontos UAV beirado T304_TM.csv).
zzb <- rownames(tapply(data1$z,data1$idpt,mean))
aa <- as.numeric(tapply(data1$z,data1$idpt,mean))
bb <- as.numeric(tapply(data1$z,data1$idpt,median))
cc <- as.numeric(tapply(data1$z,data1$idpt,FUN = function(x)mean(x, trim=.4)))
dd <- as.numeric(tapply(data1$z,data1$idpt,min))
ee <- as.numeric(tapply(data1$z,data1$idpt,max))
resultsB <- data.frame(zzb,aa,bb,cc,dd,ee)
colnames(resultsB) <- c("edif","mediab","medianab","mediab_t0.4","minb","maxb")

#Pavimento
zzp <- rownames(tapply(data1p$z,data1p$idpav,mean))
aap <- as.numeric(tapply(data1p$z,data1p$idpav,mean))
bbp <- as.numeric(tapply(data1p$z,data1p$idpav,median))
ccp <- as.numeric(tapply(data1p$z,data1p$idpav,FUN = function(x)mean(x, trim=.2)))
ddp <- as.numeric(tapply(data1p$z,data1p$idpav,max))
eep <- as.numeric(tapply(data1p$z,data1p$idpav,min))
resultsP <- data.frame(zzp,aap,bbp,ccp,ddp,eep)
colnames(resultsP) <- c("edif","mediap","medianap","mediap_t0.2","maxp","minp")

resultsm1 <- merge(resultsB,resultsP, by.x = "edif", by.y = "edif") #MERGE (pavimento / beirado)

resultsm1$HfachadaUAV <- resultsm1$mediab_t0.4 - resultsm1$mediap_t0.2 #Cálculo da altura da fachada
(UAS)

allTile2034 <- merge(dataref,resultsm1, by.x = "predioid", by.y = "edif") #merge

allTile2034$residuoHF <- allTile2034$HFachada - allTile2034$HfachadaUAV #erro vertical
```

Estimation of **roof eave** value for each building

Estimation of **base building** value or each building

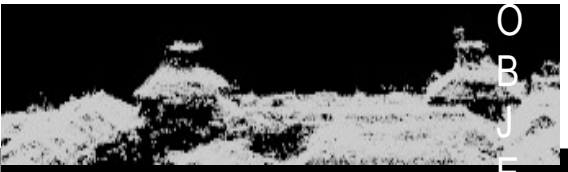
Building Façade Height UAS value

Vertical error



Working with Big Data | TIME OF PROCESSING

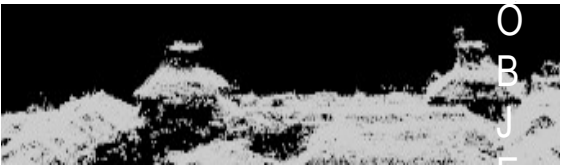
action	description	function	time processing
Import Original point cloud	8,864,031pts	v.in.ascii	~70 m
Study area (total)	1,066,171 pts	v.select	~30 m
Area 2 (record X,Y,Z values)	406,000 pts	v.out.ply + v.in.ply	1m 30s
Area 2		v.lidar.edgedetection	53min



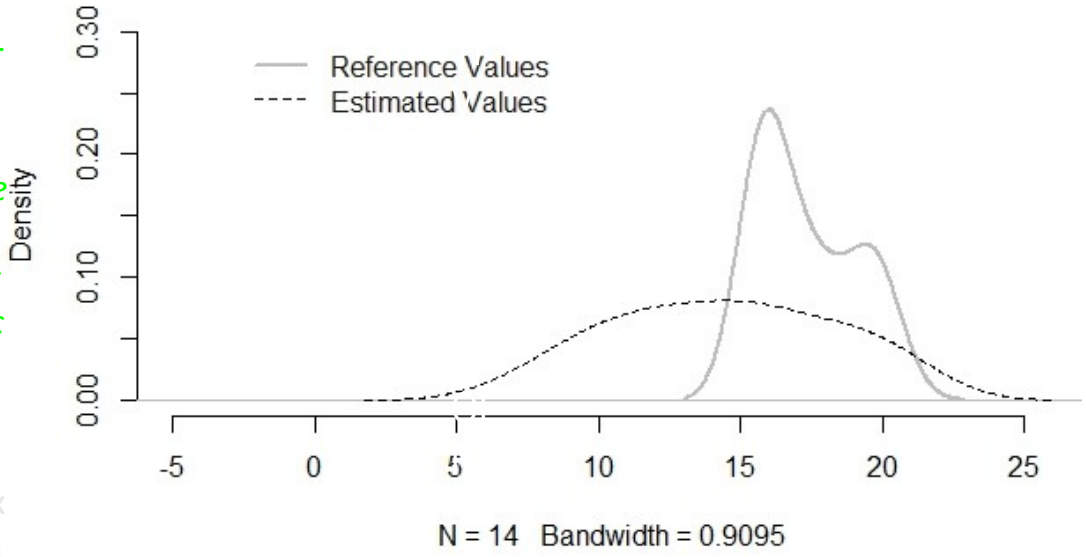
OBJECTIVES| 3D POINT CLOUDS-TECHNOL

URBAN MORPHOLOGY VS. ESTIMATED VALUE BUILDING FAÇADE HEIGHT

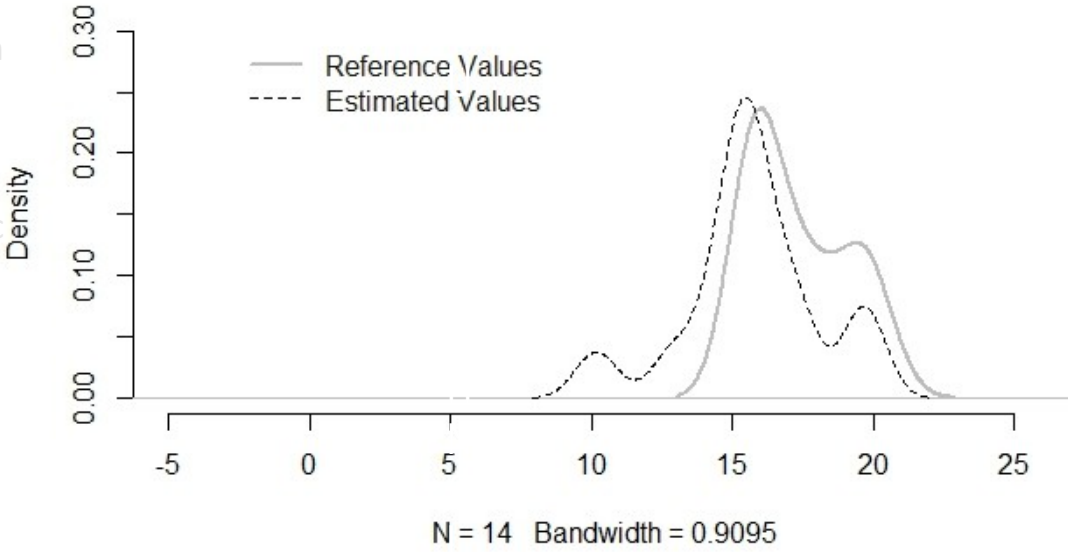
VERTICAL ERROR

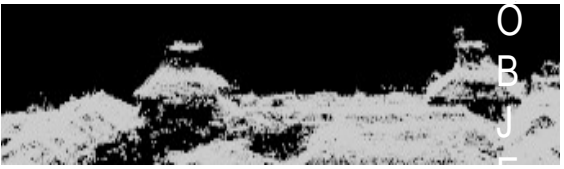


v.lidar.edgedetection

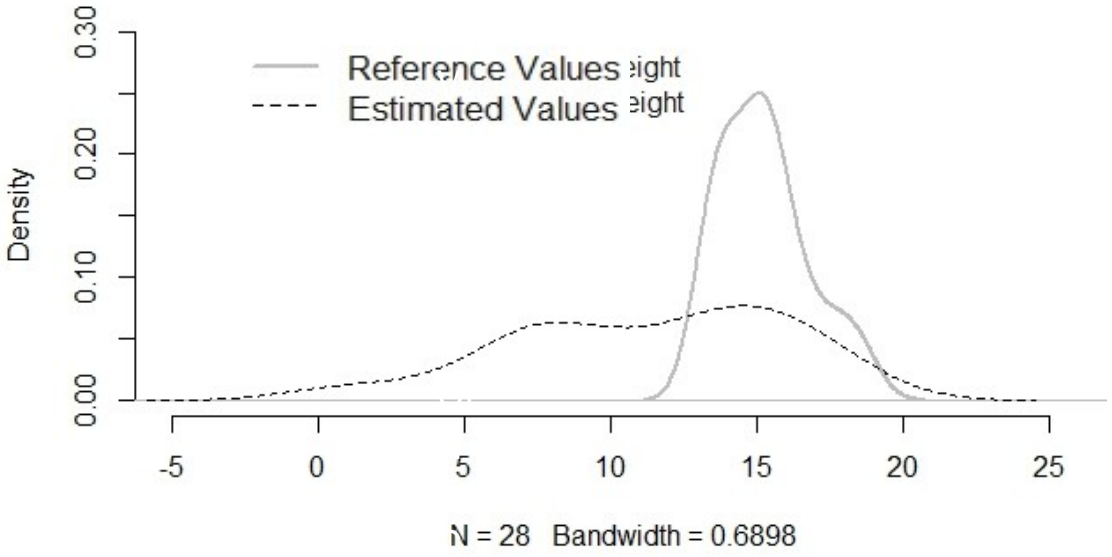


v.lidar.edgedetection

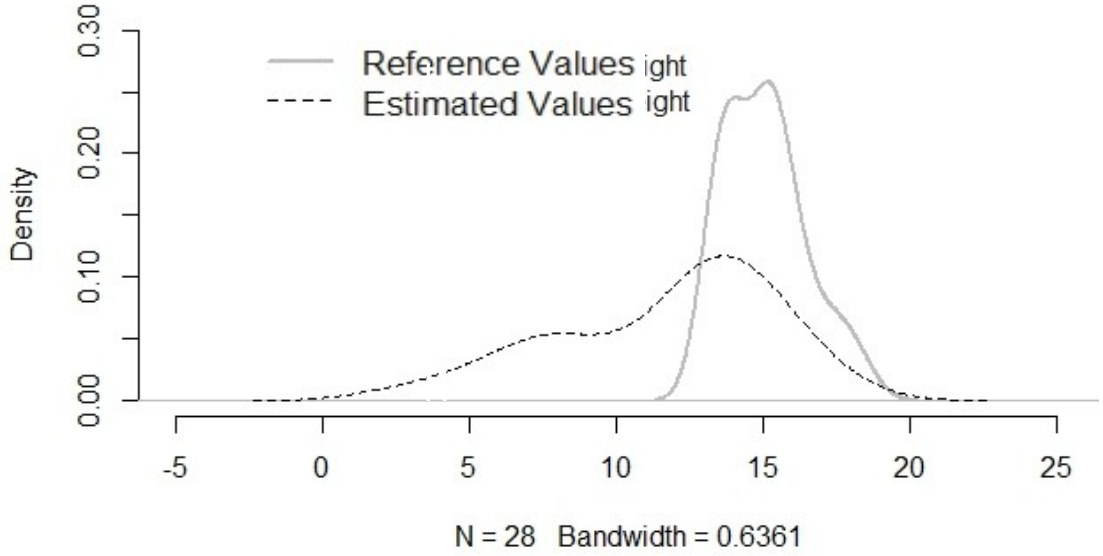


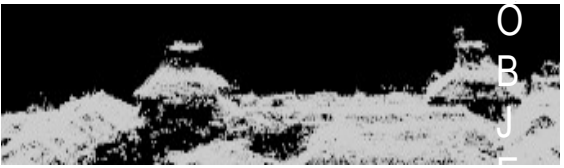


v.lidar.edge.detection

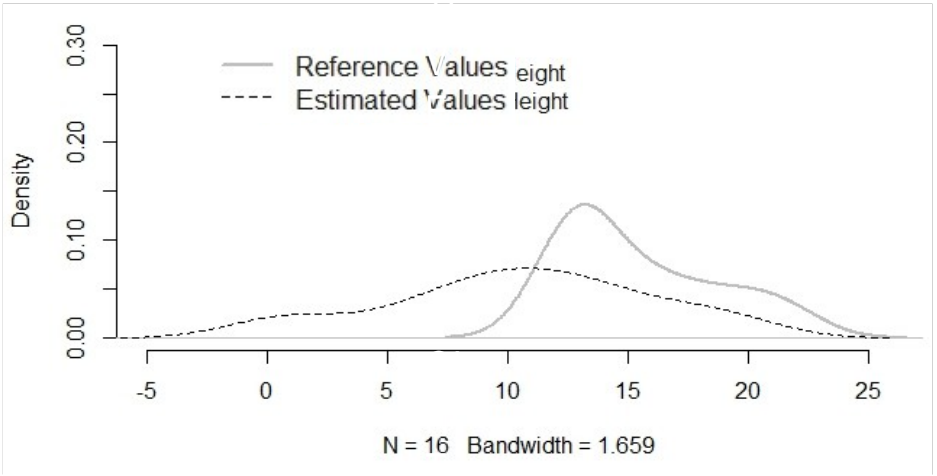


v.lidar.edge.detection

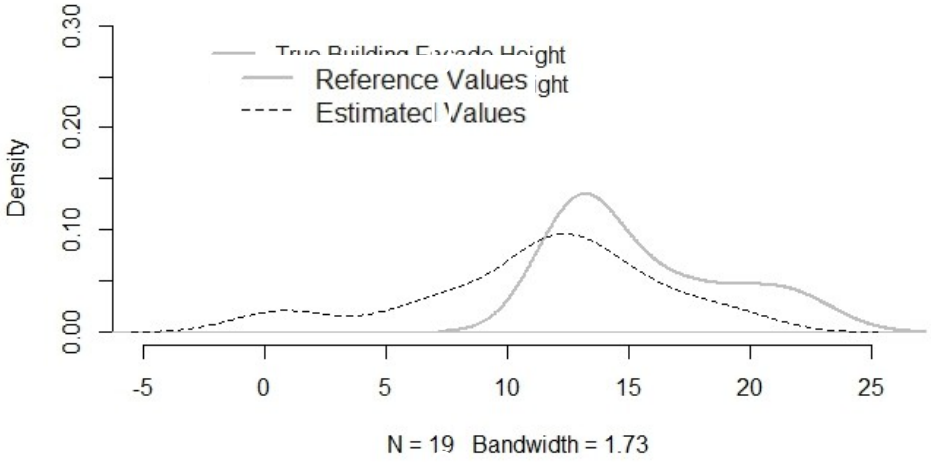


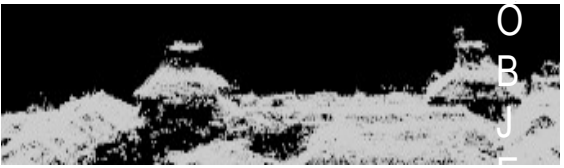


v.lidar.edge.detection

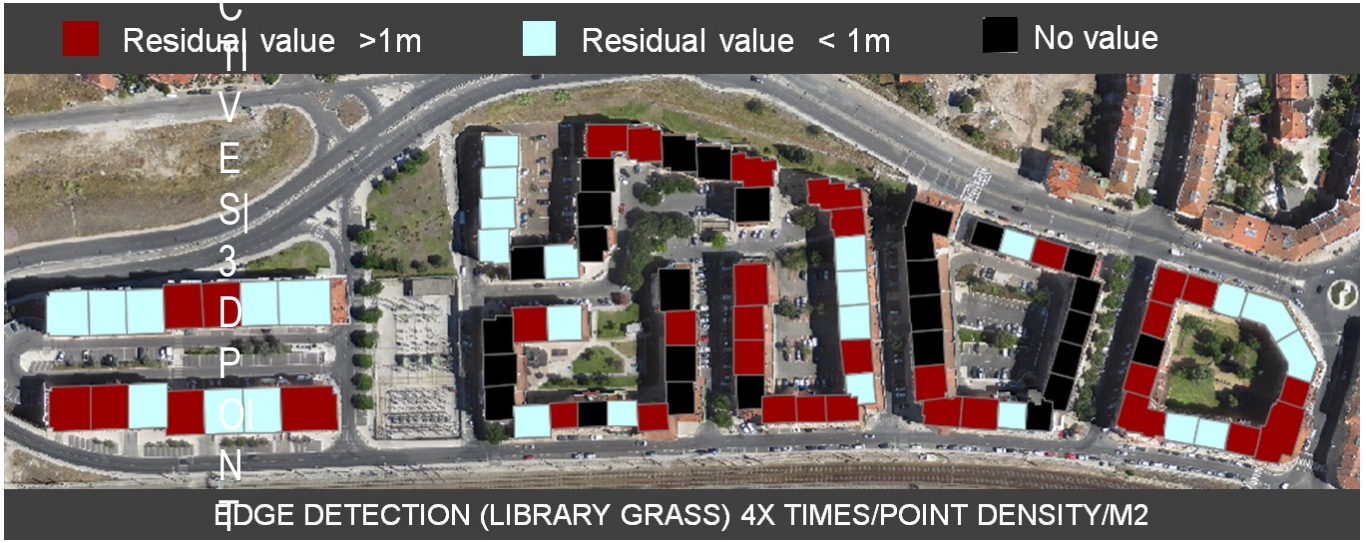


v.lidar.edge.detection

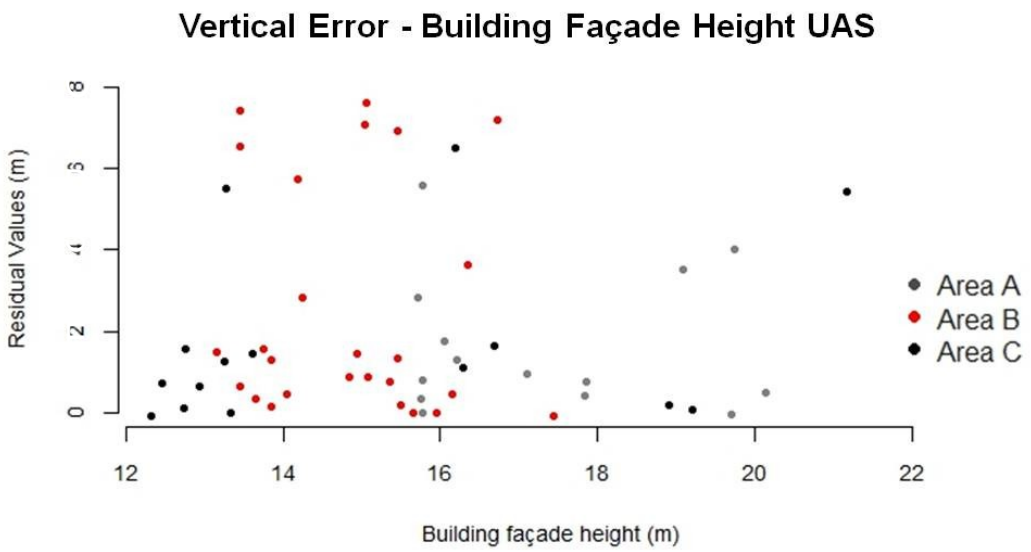


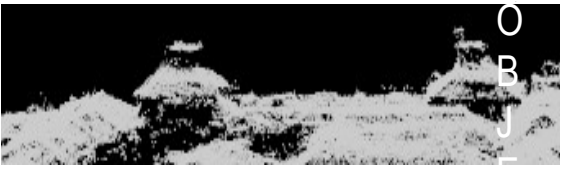


OBJECTIVES 3D POINT CLOUD



EDGE DETECTION (LIBRARY GRASS) 4X TIMES/POINT DENSITY/M2





GRASS GIS in use of POINT CLOUDS

-**more suitable and more efficient** in the manipulation of these type of data (with higher density) when compared with proprietary software GIS;

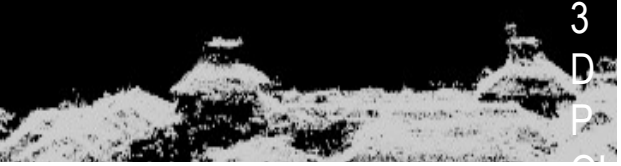
- **for recording the update attribute table X,Y,Z in a point cloud:** the new **module ply reduce the time processing of hours to minutes**

-**module LiDAR GRASS** was very useful in edge detection of buildings and in extraction of points near buildings that are classified as terrain in DTM.

However, the growing algorithm does not offer expected results because needs information of first and last pulse LiDAR.

In the future the methodology employed here should be tested in GRASS 7.0.

New algorithms are needed: to support the analysis and processing 3D cloud points with a higher density; to use the RGB and Infrared values on filtering of UAS data.



POINT CLOUDS for URBAN PLANNING

We **believe** that the **UAS technology** for acquisition of 3D point cloud at “low cost” can be very useful in urban planning.

This study **demonstrated** that there is a strong correlation between the urban morphology and the accuracy of height value of the building façade.

- more investigation is necessary for concerning the nature of these 3D point cloud in extraction of this urban parameter and the performance of UAS in recording 3D points during the flight.

GRÀCIES

ACKNOWLEDGEMENTS

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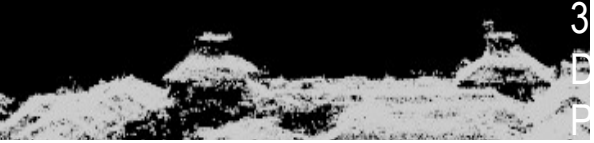
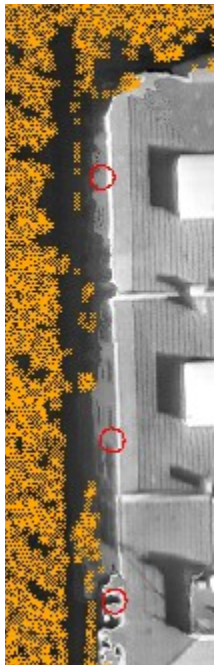


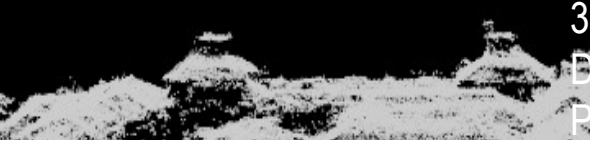
Points UAS of Base Building Elevation

AREA B

No Data
UAS Points



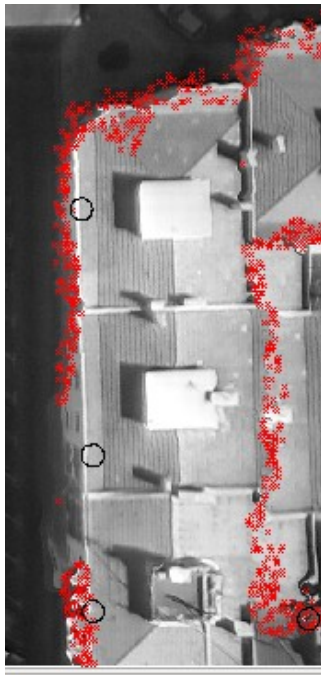
UAS points of Base Building



Points UAS of Roof Eave Building Elevation

AREA B

No Data
UAS Points



UAS points of roof eave