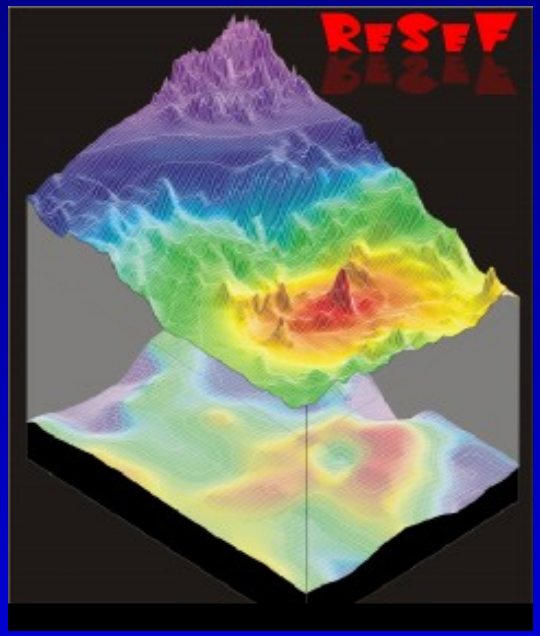
RESEF - un tool informatico per la gestione di dati telerilevati



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Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS

RESEF

REmote SEnsing Framework

Ambiente per lo sviluppo di applicativi che utilizzano dati telerilevati registrati da fotocamere, sensori iperspettrali e laser aerei o terrestri mobili

Perchè?

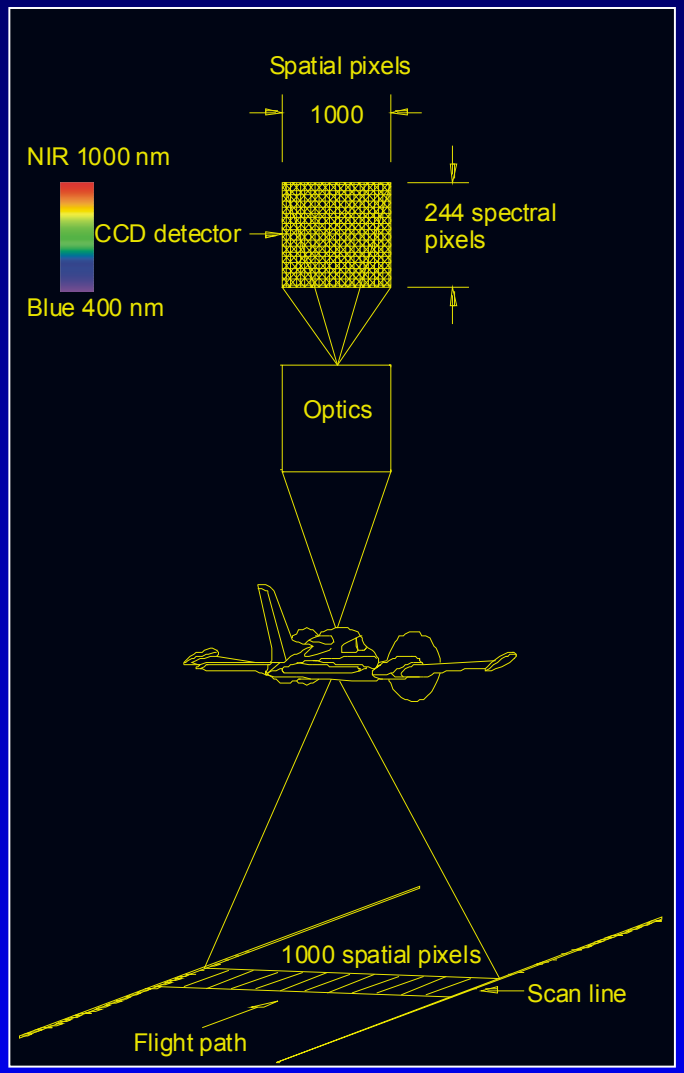
- Gestione e visualizzazione di immagini raster di grandi dimensioni (decine di Gb) generate da sensori pusbroom

- Gestione e visualizzazione di dati laser (caratterizzati da decine di milioni di punti) registrati da veicoli mobili (es. Lynx) in full 3D

- Sviluppare algoritmi specifici (calibrazione, geocodifica, estrazione features, ecc) per i sensori a nostra disposizione

- Unire le informazioni ricavate dai diversi sensori (data fusion) per ottenere dati più ricchi

Sensori Pushbroom



- Il sistema è una camera che registra immagini nell'intervallo fra 400 e 1000 nm (dal violetto all'IR vicino)
- Ha una risoluzione di 1000 pixel spaziali che significa una risoluzione di 36 cm @ 1000 m di quota
- Sfruttando il moto del velivolo genera una copertura bidimensionale del terreno

Sensori Pushbroom

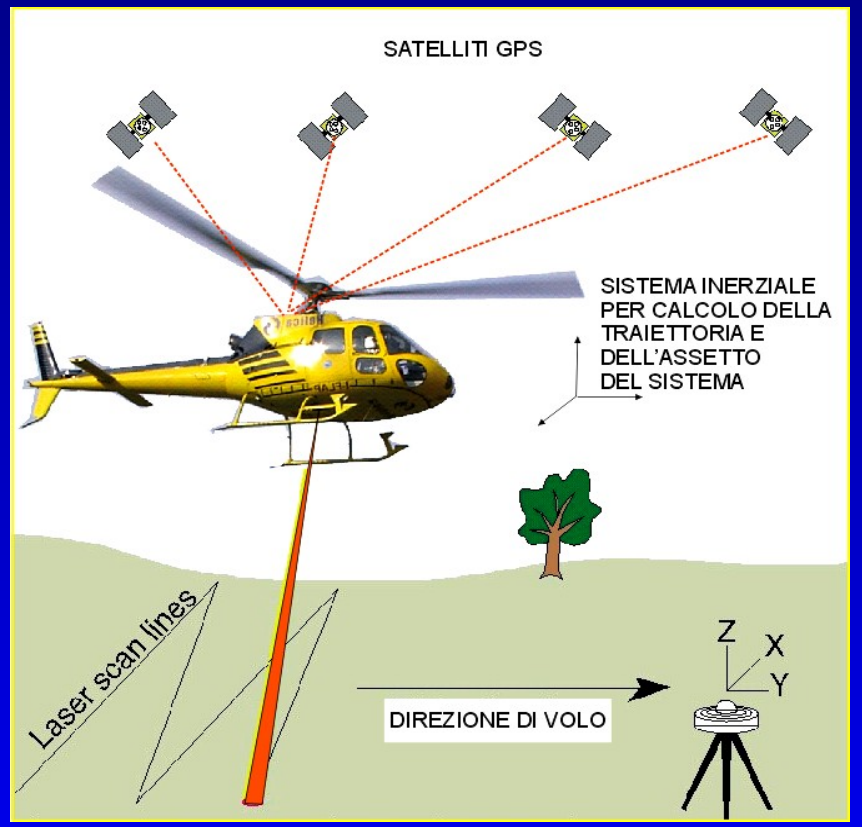
Sensori Pushbroom

Lidar

LIDAR (*Light Detection and Ranging*; o *Laser Imaging Detection and Ranging*) è una tecnica di telerilevamento per determinare la distanza di un oggetto con un impulso laser.

Integra quattro unità principali:

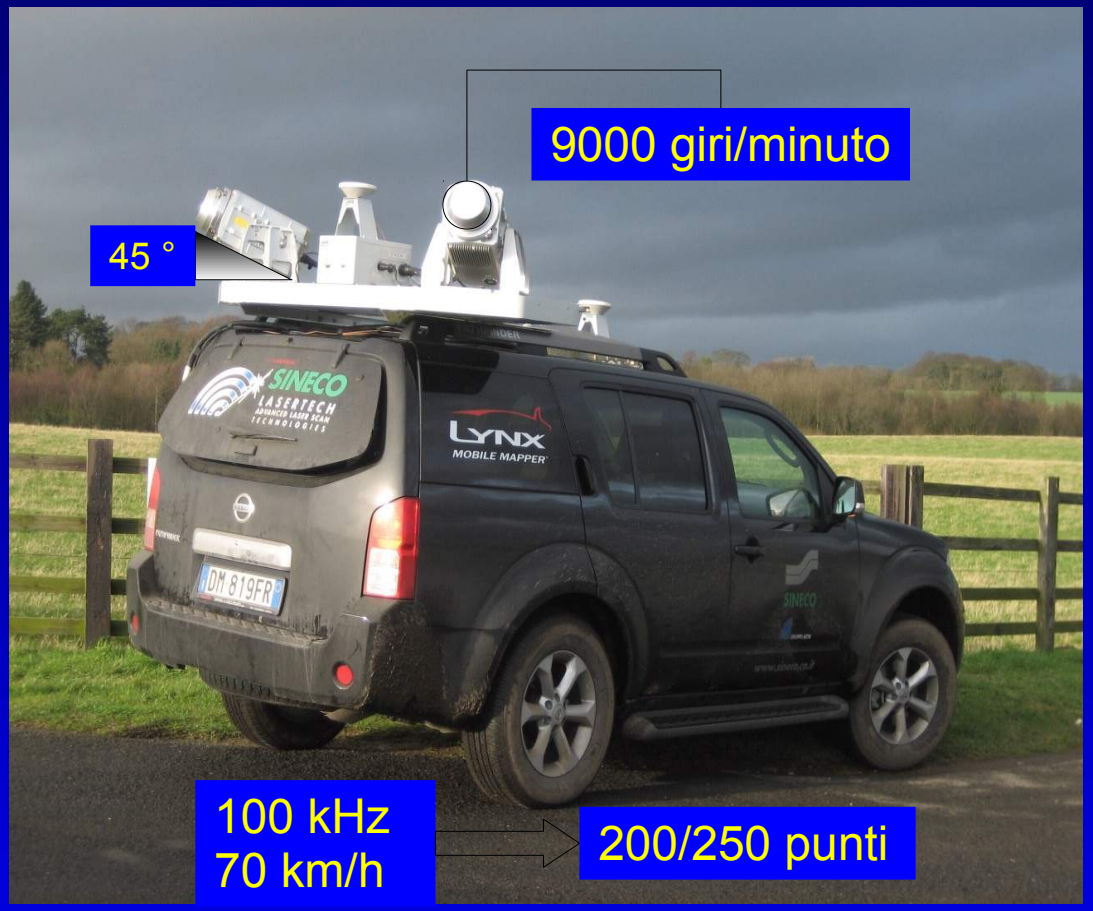
- Un laser ranger
- Un sistema di posizionamento GPS
- Una unità inerziale
- Un computer di bordo per l'acquisizione dei dati



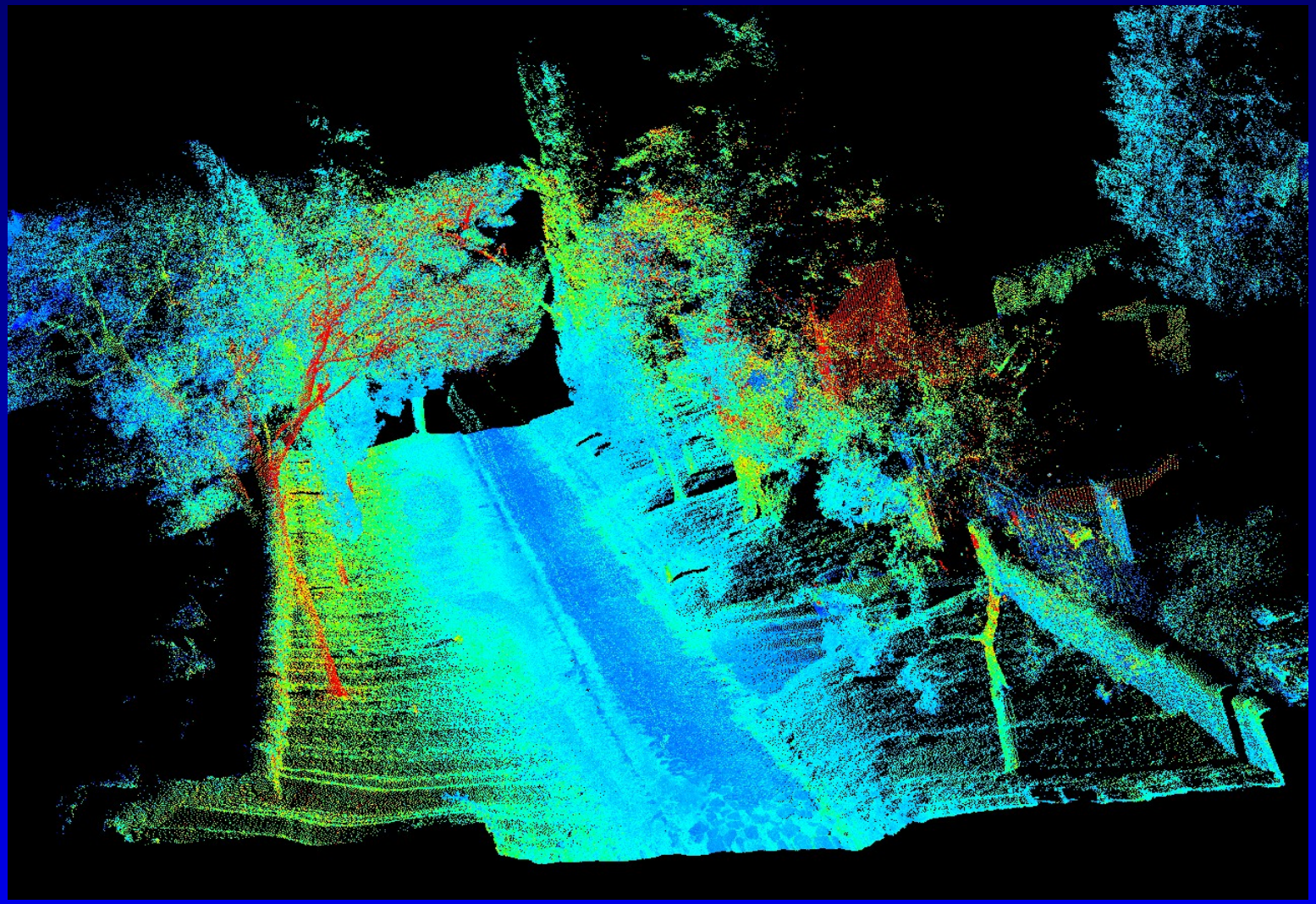
Lynx

E’ un sistema laser-scan mobile composto da:

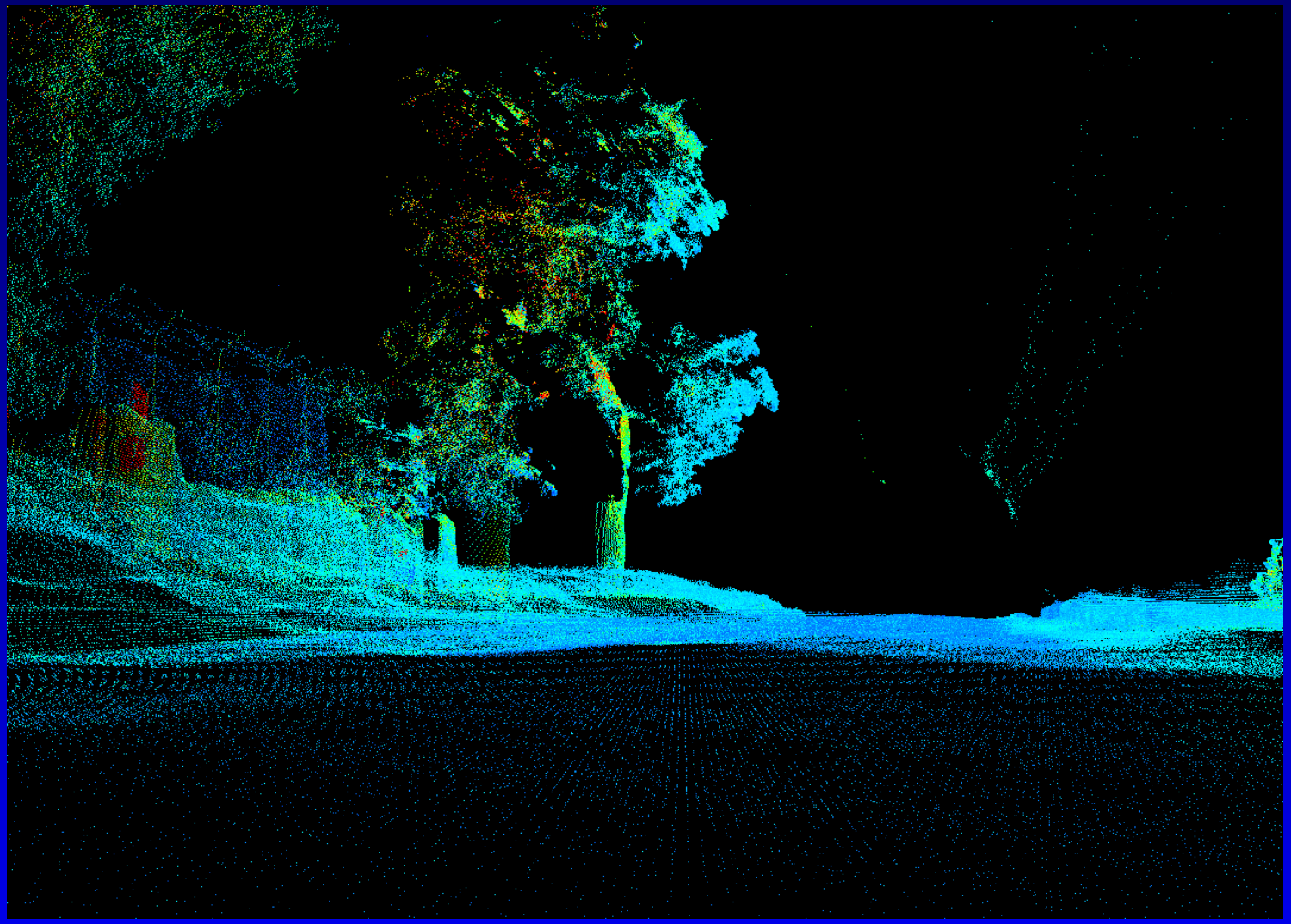
- 2 laser ranger
- Sistema di posizionamento Gps
- Unita’ inerziale IMU
- Odometro
- Computer per la registrazione dei dati



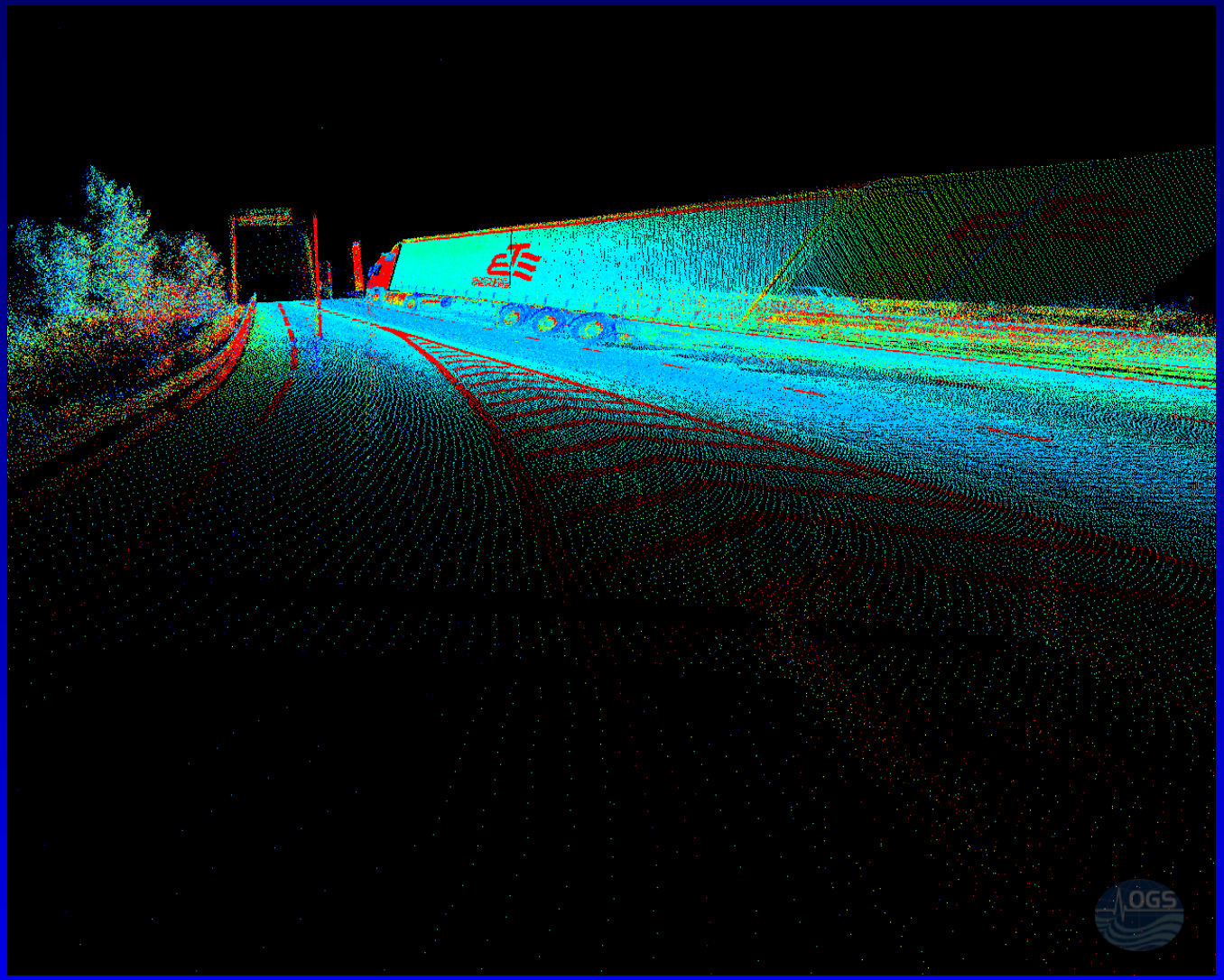
Lynx



Lynx



Lynx



Ortofoto

Dati

- Raster
- Nuvole di punti (Laser)
- Vettori
- Mesh (TIN)

Progetto

Sviluppare strumenti per utilizzare efficientemente grandi volumi di dati

Budget = 0 €

Linguaggi noti:

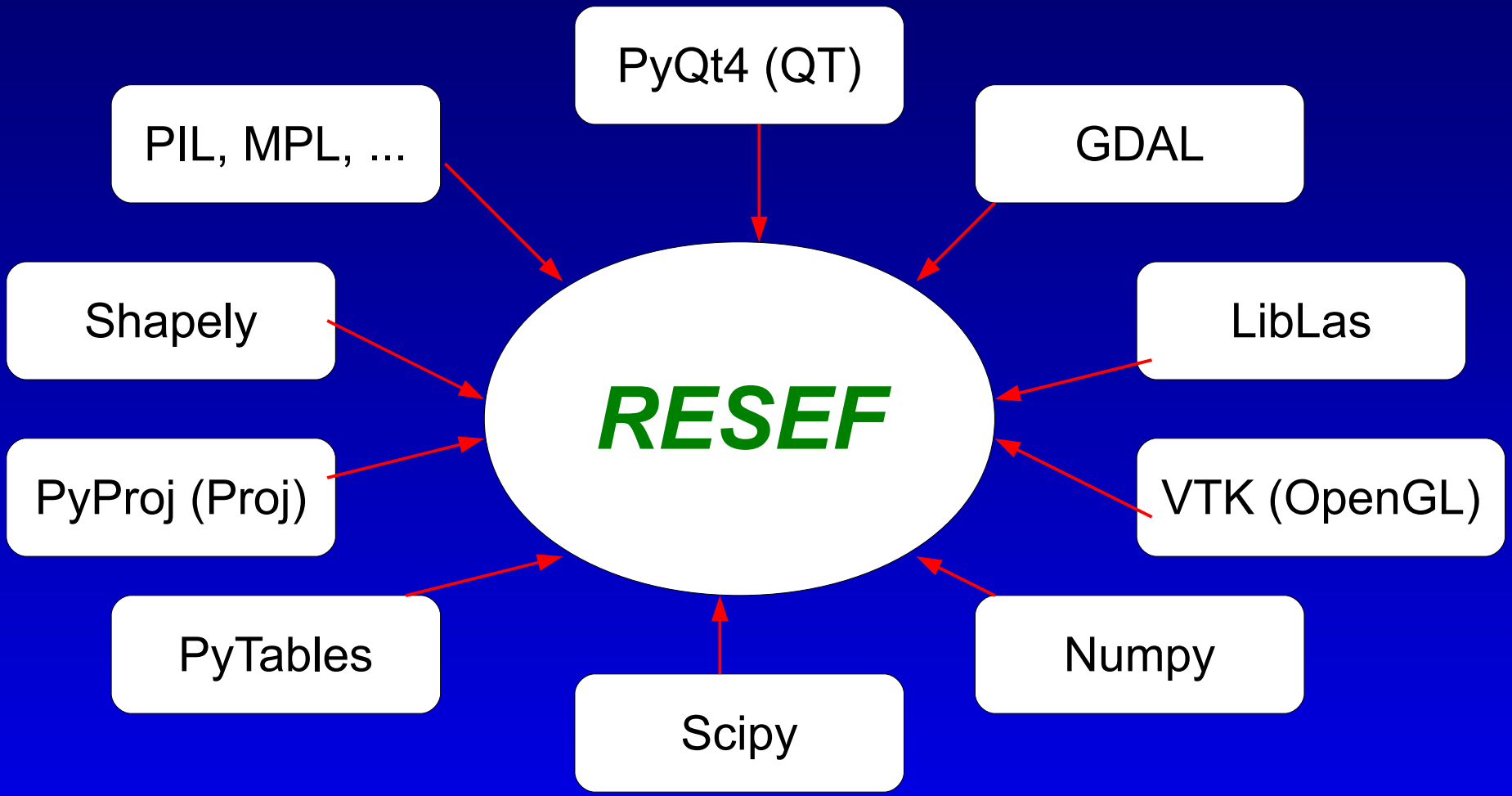
- Fortran (veloce, povero per le gui)
- C (veloce, povero per le gui)
- Matlab/Octave (veloce, gui limitata, ha problemi con grandi dataset)
- Python (??)

Studiare altri linguaggi (C++, Java) ?

Python

- E' un linguaggio interpretato
- La comunità di utenti è molto attiva
- Molte librerie incapsulano codice C o C++ molto efficiente
- E' possibile aggiungere estensioni scritte in C o C++ per velocizzare il codice
- Altamente produttivo
- La maggior parte delle librerie sono open source
- Esistono molte librerie grafiche per costruire GUI

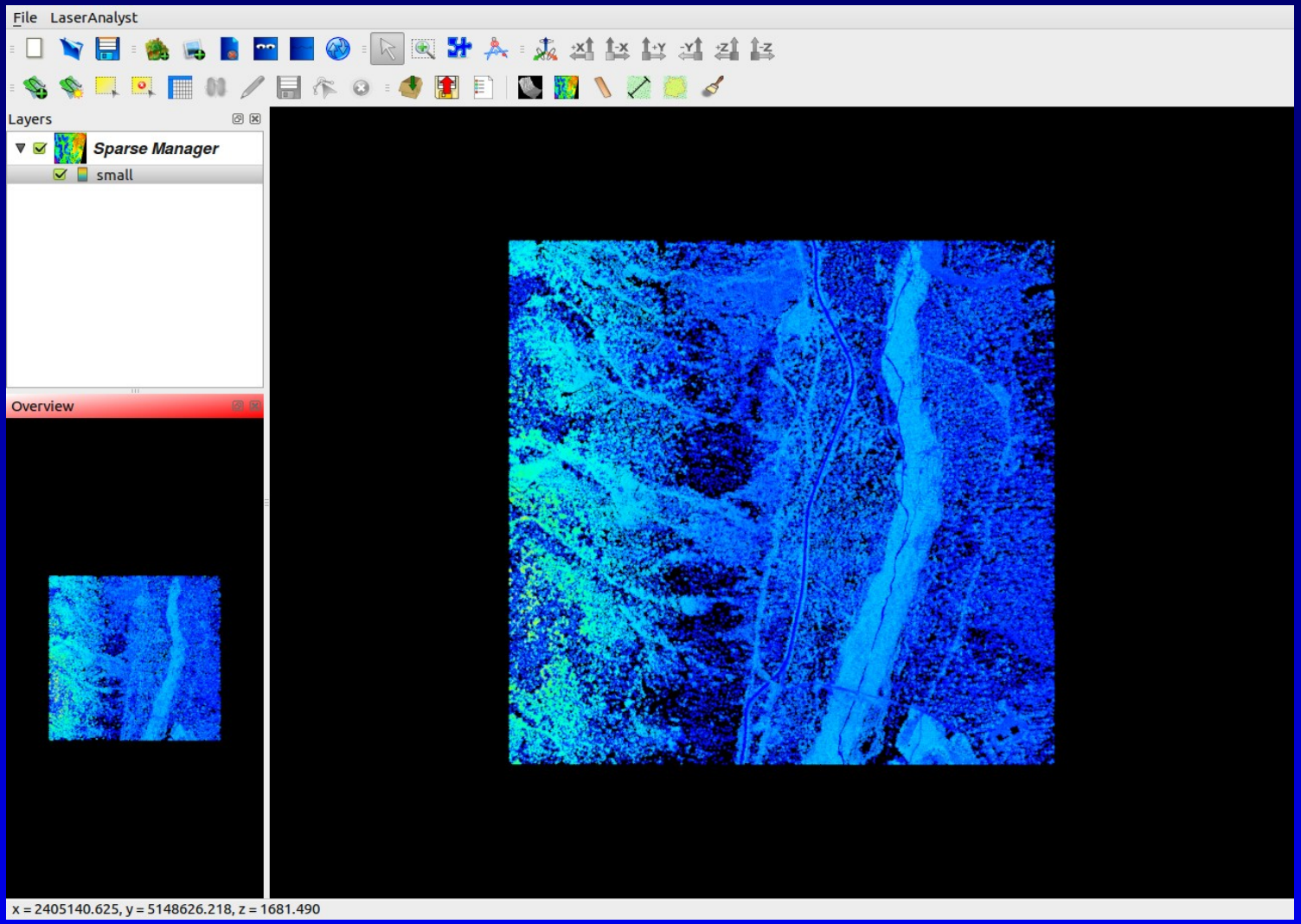
Librerie


PyQt4 (QT)
PIL, MPL, ...
GDAL
Shapely
LibLas
RESEF
PyProj (Proj)
VTK (OpenGL)
PyTables
Numpy
Scipy

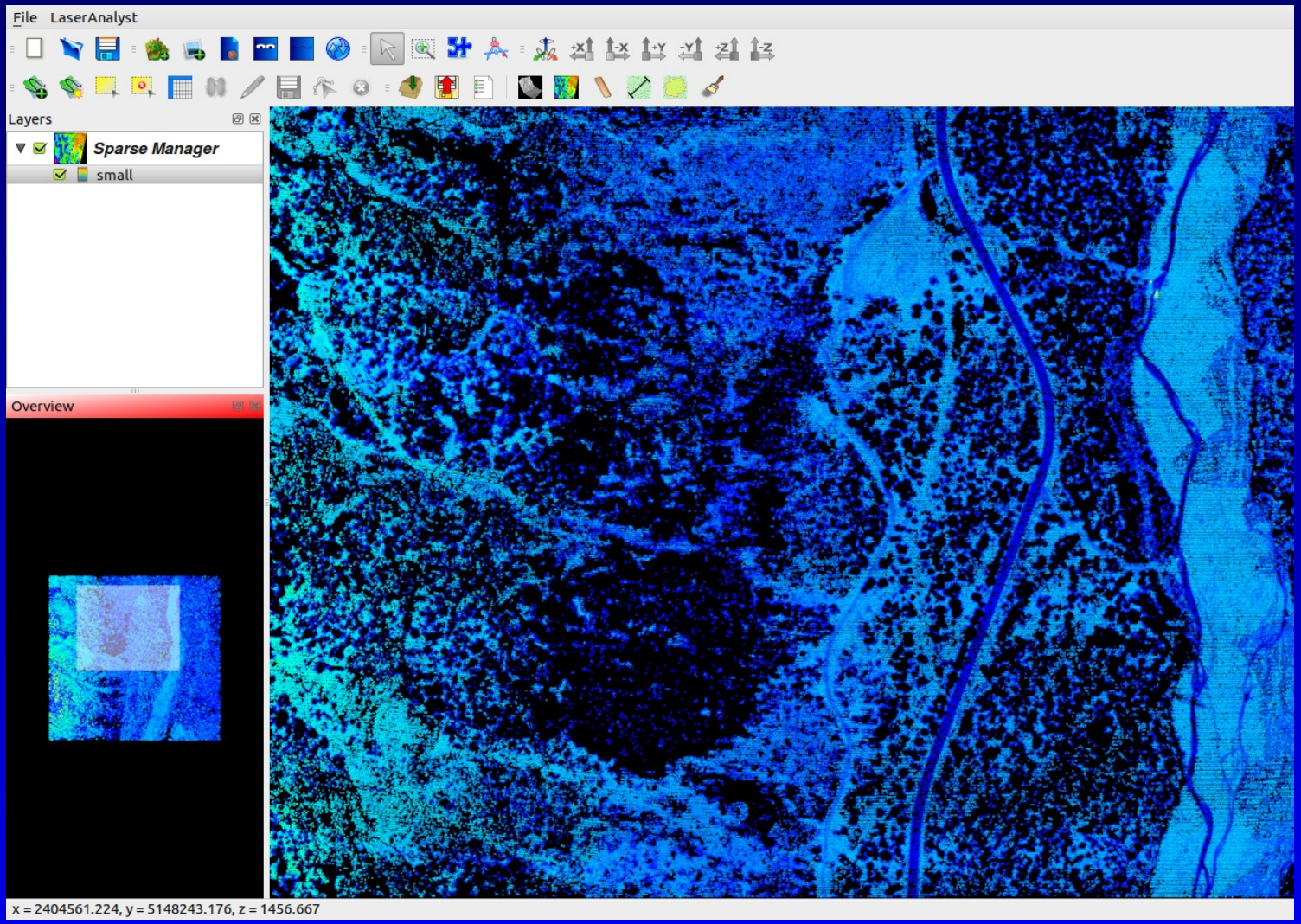
Caratteristiche

- Classica GUI a dock
- Visualizzazione full 3D OpenGL
- Sistema di gestione dei dataset a livelli
- Estensione delle funzionalità mediante plugin
- Minimo utilizzo di memoria
- Sviluppato sotto piattaforma Linux-Ubuntu
- Data la portabilità di Python lo stesso applicativo funziona sotto piattaforme Windows e Mac

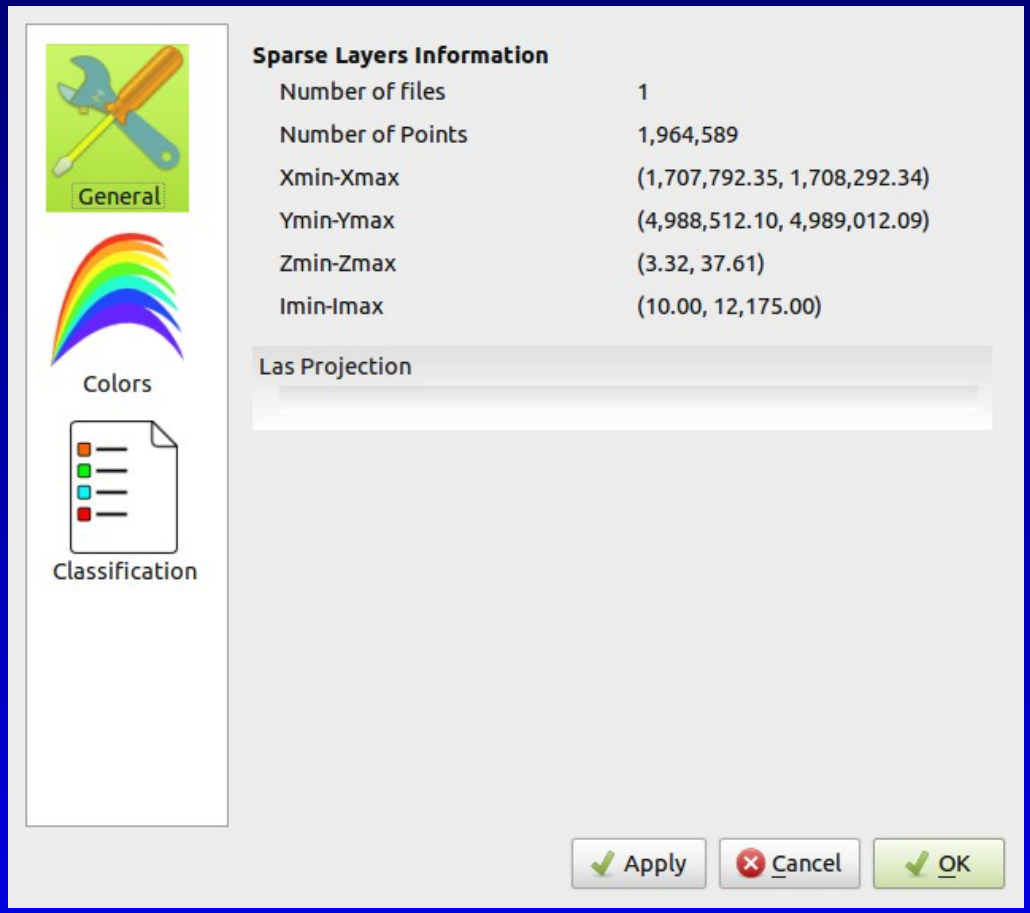
GUI

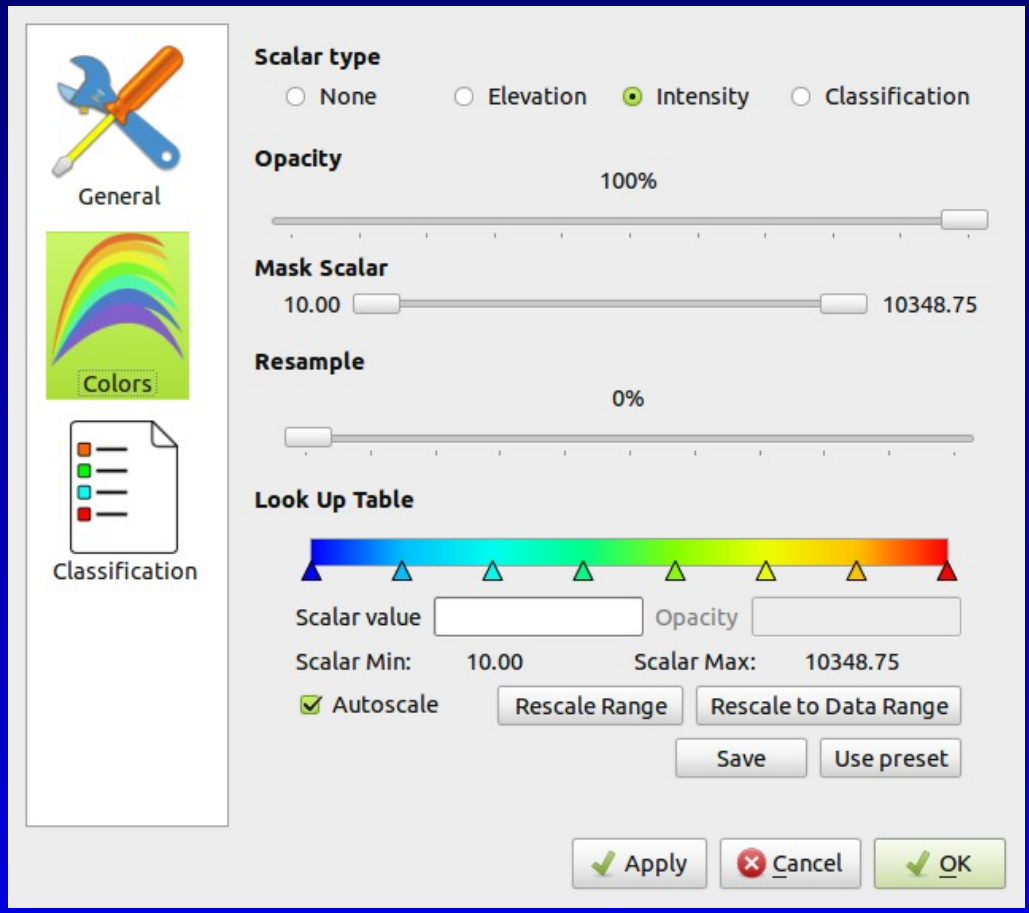

File LaserAnalyst
Layers
Sparse Manager
small
Overview
x = 2405140.625, y = 5148626.218, z = 1681.490

GUI

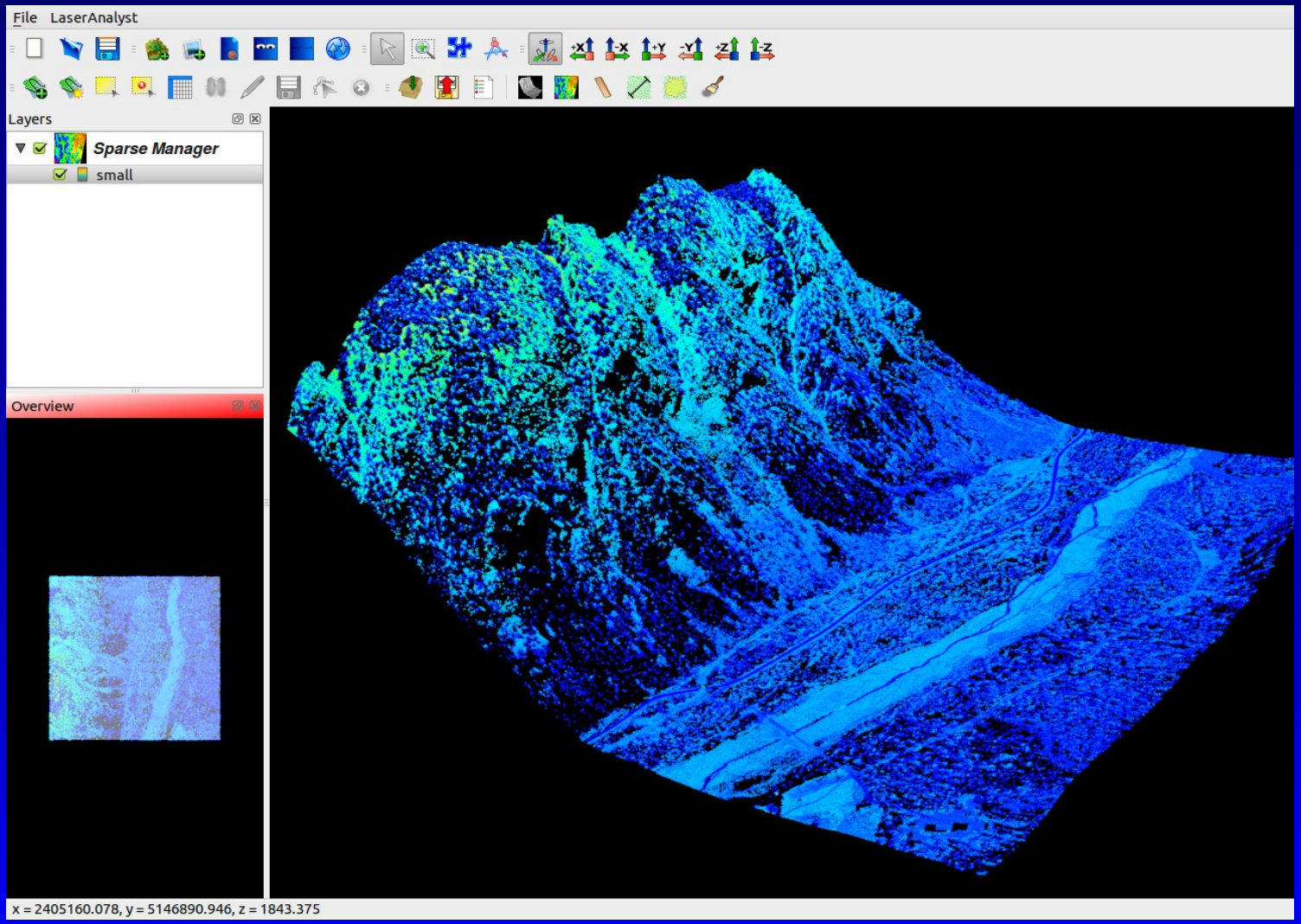

File LaserAnalyst
Layers
Sparse Manager
small
Overview
x = 2404561.224, y = 5148243.176, z = 1456.667

GUI

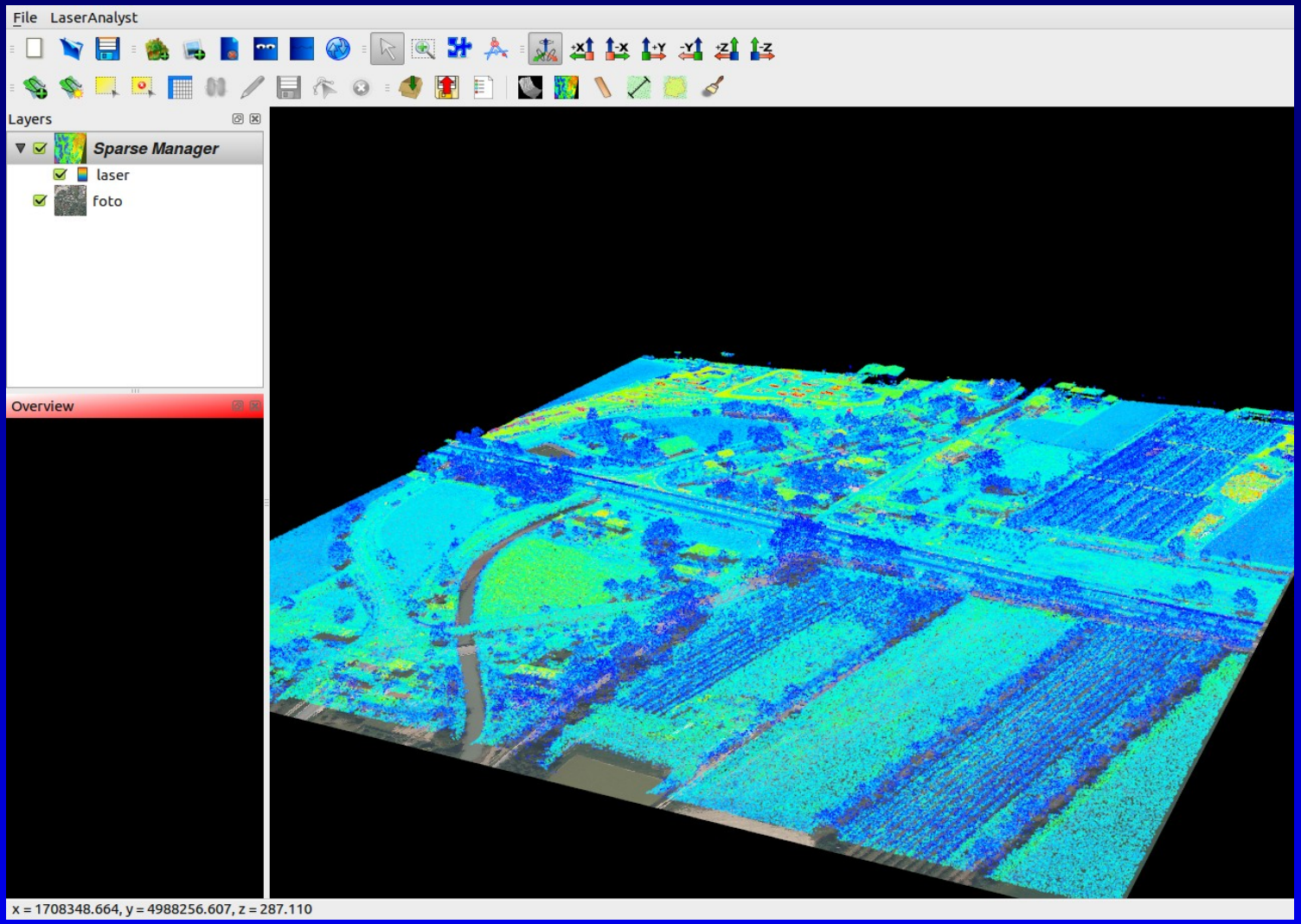

General
Colors
Classification
Sparse Layers Information
Number of files 1
Number of Points 1,964,589
Xmin-Xmax (1,707,792.35, 1,708,292.34)
Ymin-Ymax (4,988,512.10, 4,989,012.09)
Zmin-Zmax (3.32, 37.61)
Imin-Imax (10.00, 12,175.00)
Las Projection
Apply
Cancel
OK


General
Colors
Classification
Scalar type
None
Elevation
Intensity
Classification
Opacity
100%
Mask Scalar
10.00
10348.75
Resample
0%
Look Up Table
Scalar value
Opacity
Scalar Min: 10.00
Scalar Max: 10348.75
Autoscale
Rescale Range
Rescale to Data Range
Save
Use preset
Apply
Cancel
OK

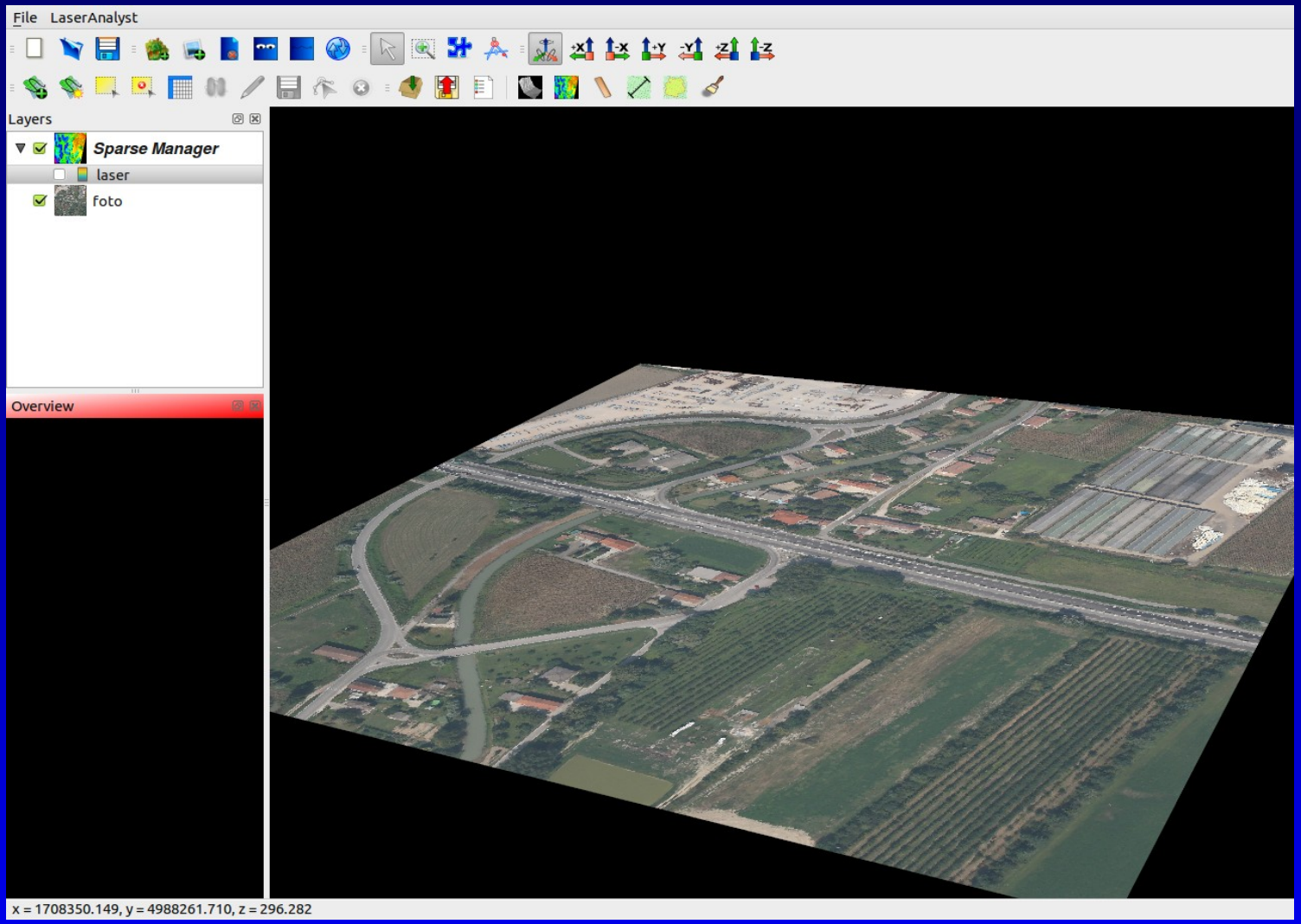
3D


File LaserAnalyst
Layers
Sparse Manager
small
Overview
x = 2405160.078, y = 5146890.946, z = 1843.375

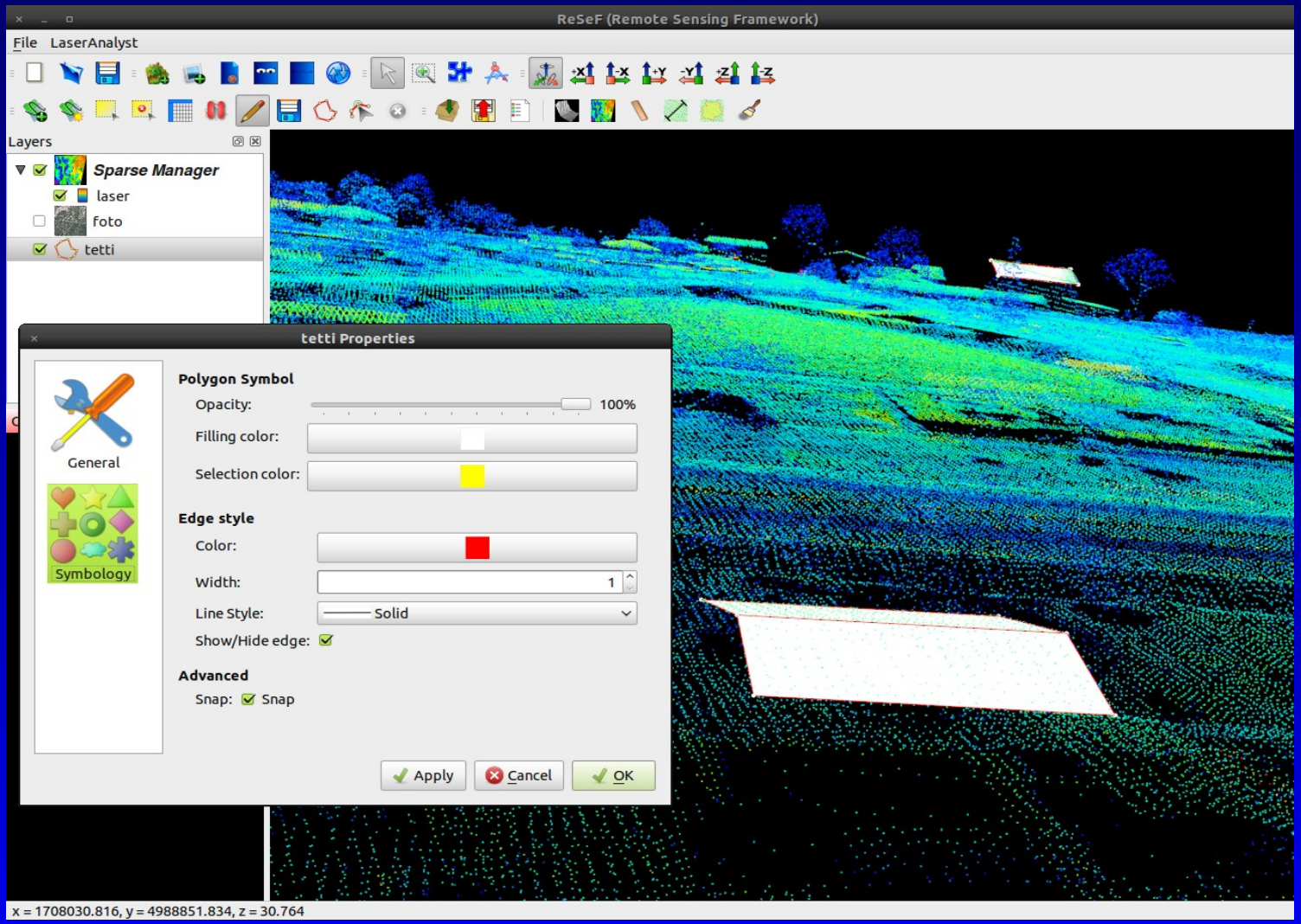
3D


File LaserAnalyst
Layers
Sparse Manager
laser
foto
Overview
x = 1708348.664, y = 4988256.607, z = 287.110

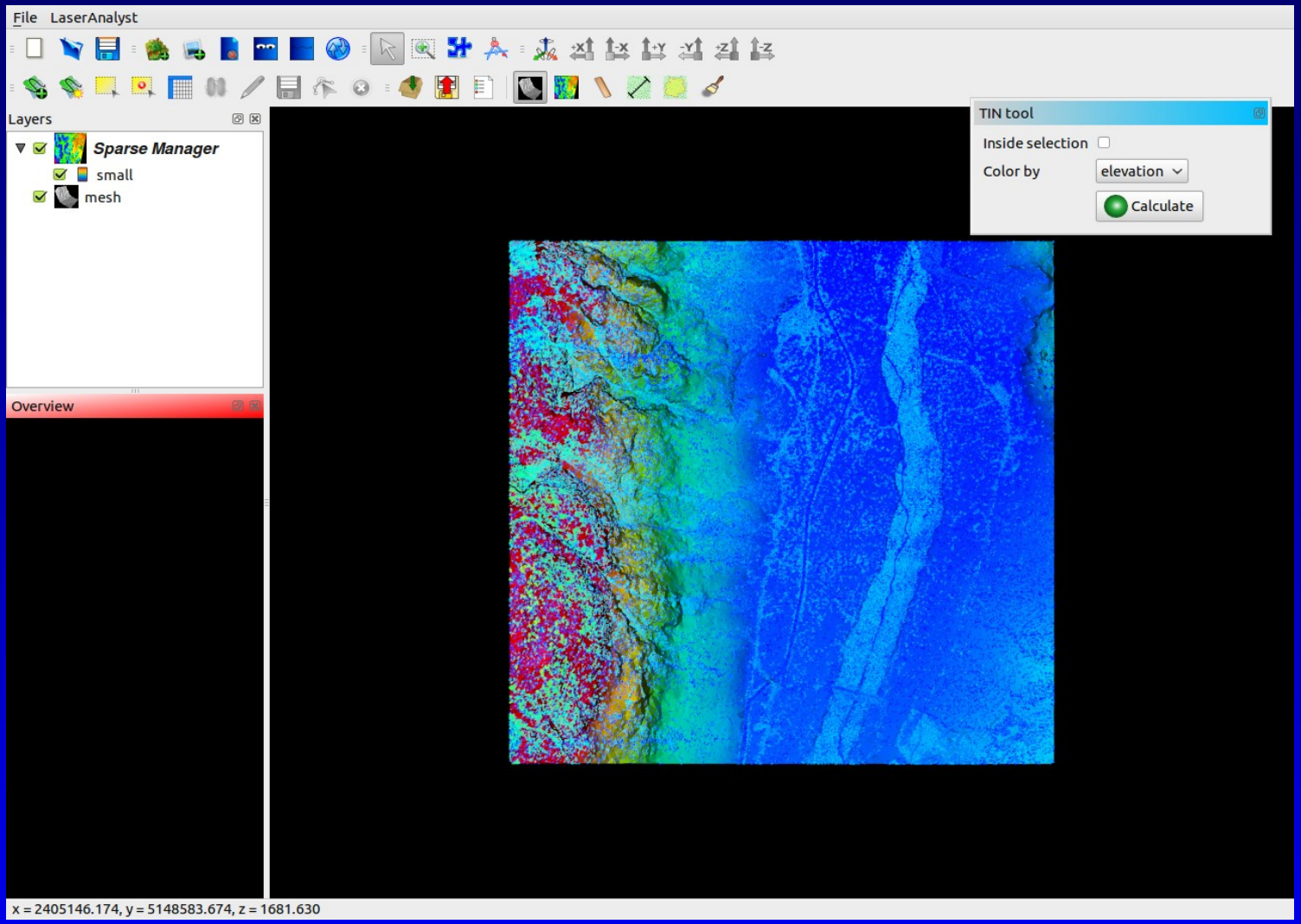
3D


File LaserAnalyst
Layers
Sparse Manager
laser
foto
Overview
x = 1708350.149, y = 4988261.710, z = 296.282

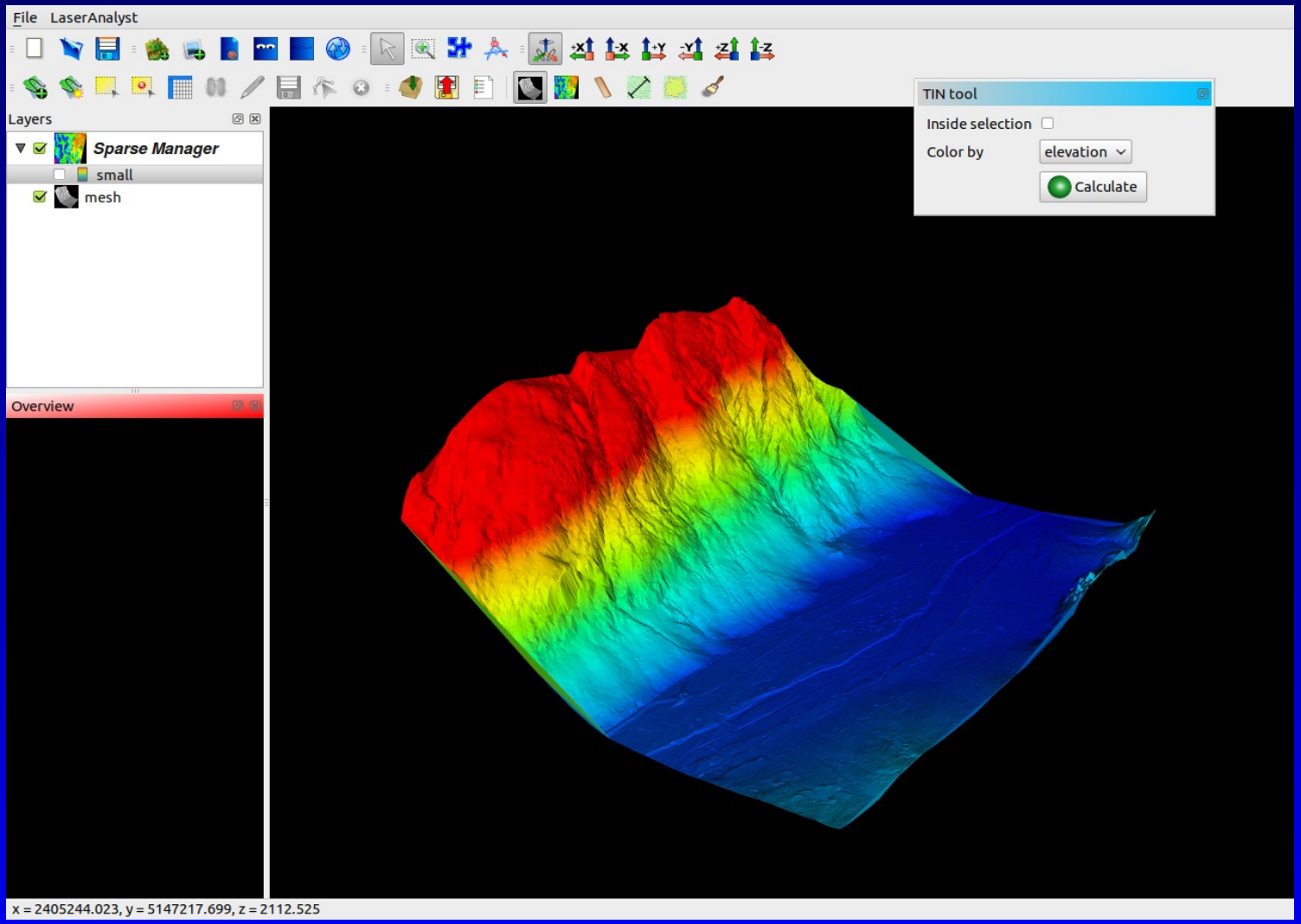
Vettori


ReSeF (Remote Sensing Framework)
File LaserAnalyst
Layers
Sparse Manager
laser
foto
tetti
tetti Properties
General
Symbology
Polygon Symbol
Opacity: 100%
Filling color:
Selection color:
Edge style
Color:
Width: 1
Line Style: Solid
Show/Hide edge:
Advanced
Snap: Snap
Apply
Cancel
OK
x = 1708030.816, y = 4988851.834, z = 30.764

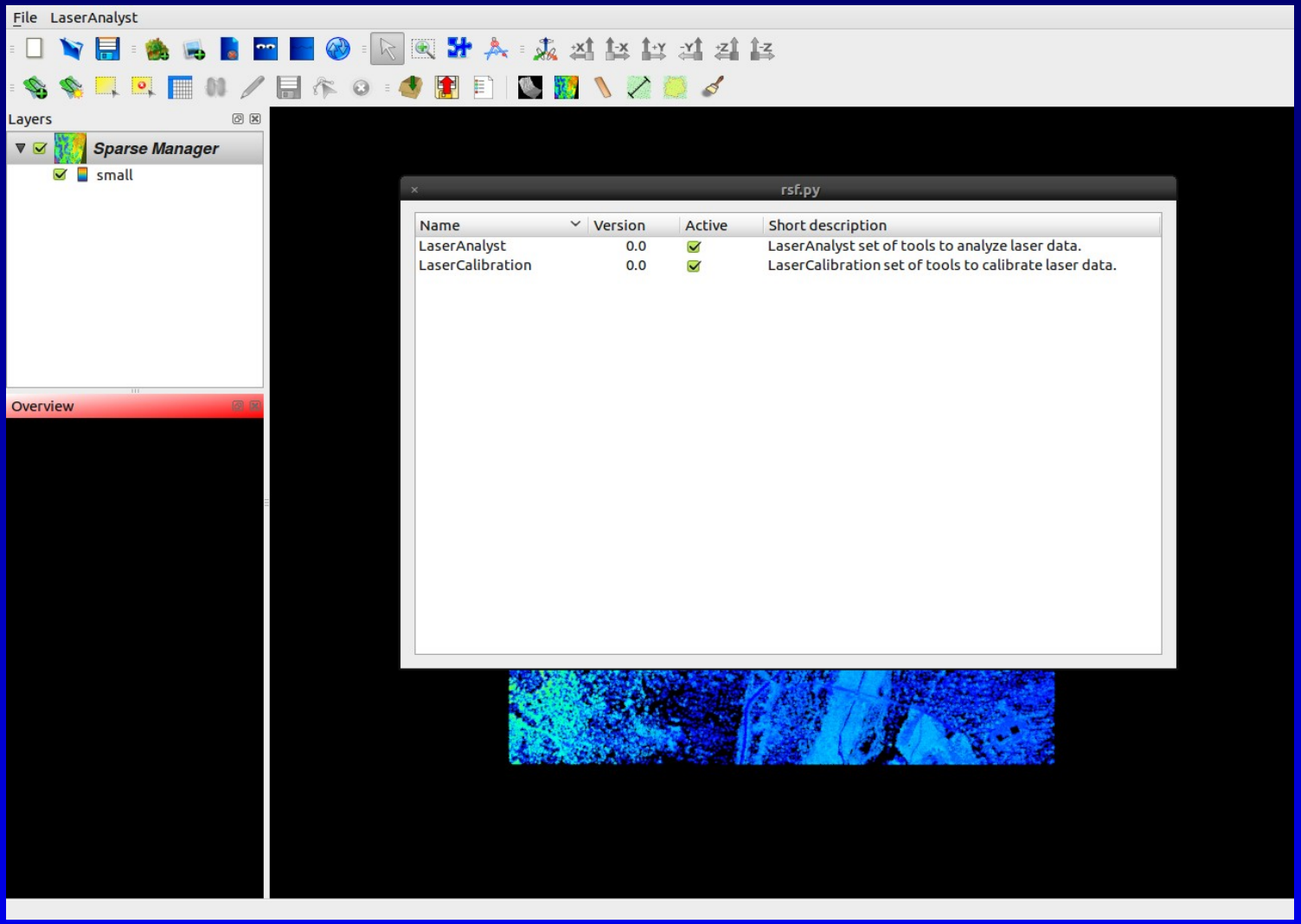
Mesh


File LaserAnalyst
Layers
Sparse Manager
small
mesh
Overview
TIN tool
Inside selection
Color by
elevation
Calculate
x = 2405146.174, y = 5148583.674, z = 1681.630

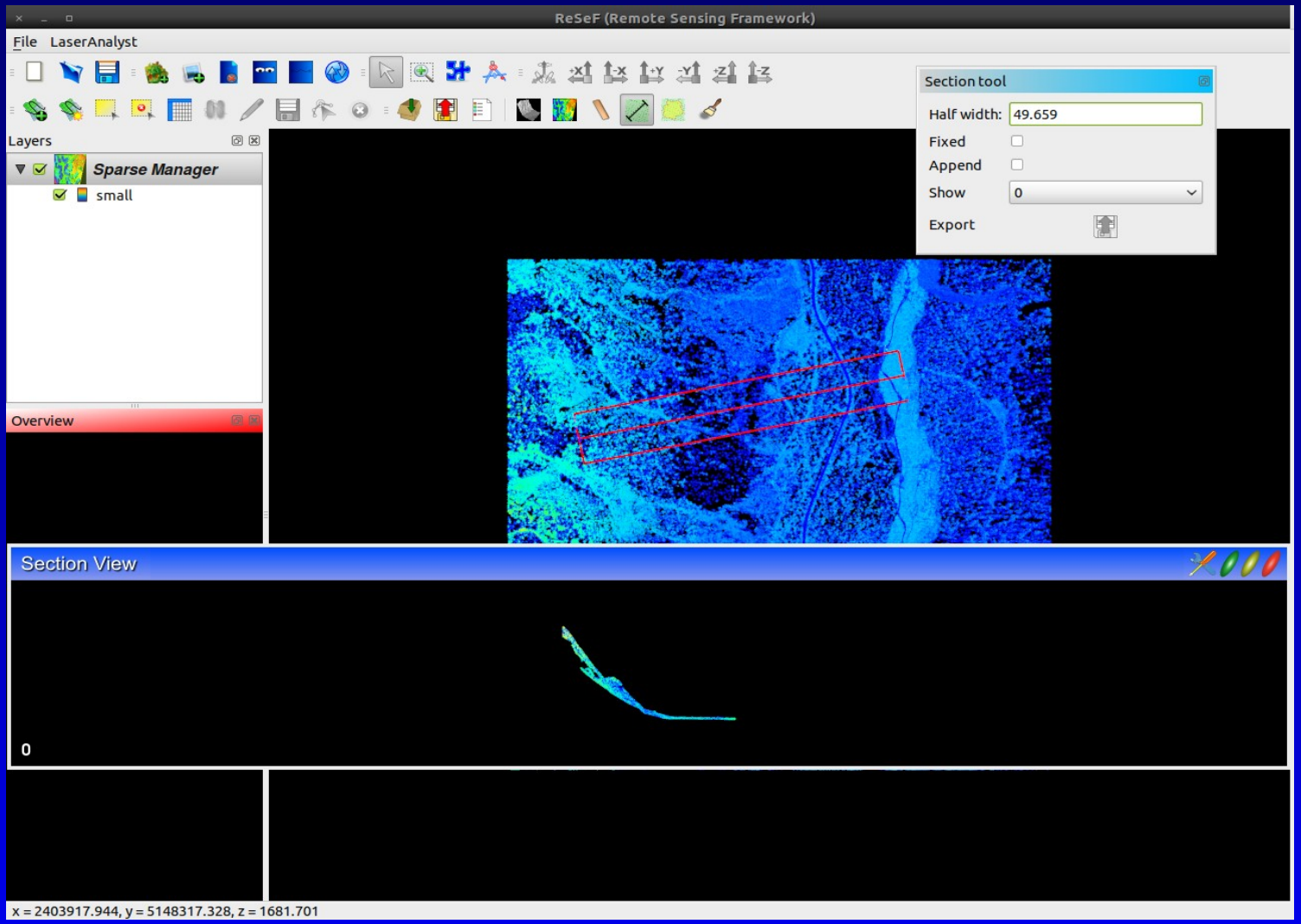
Mesh


File LaserAnalyst
Layers
Sparse Manager
small
mesh
Overview
TIN tool
Inside selection
Color by
elevation
Calculate
x = 2405244.023, y = 5147217.699, z = 2112.525

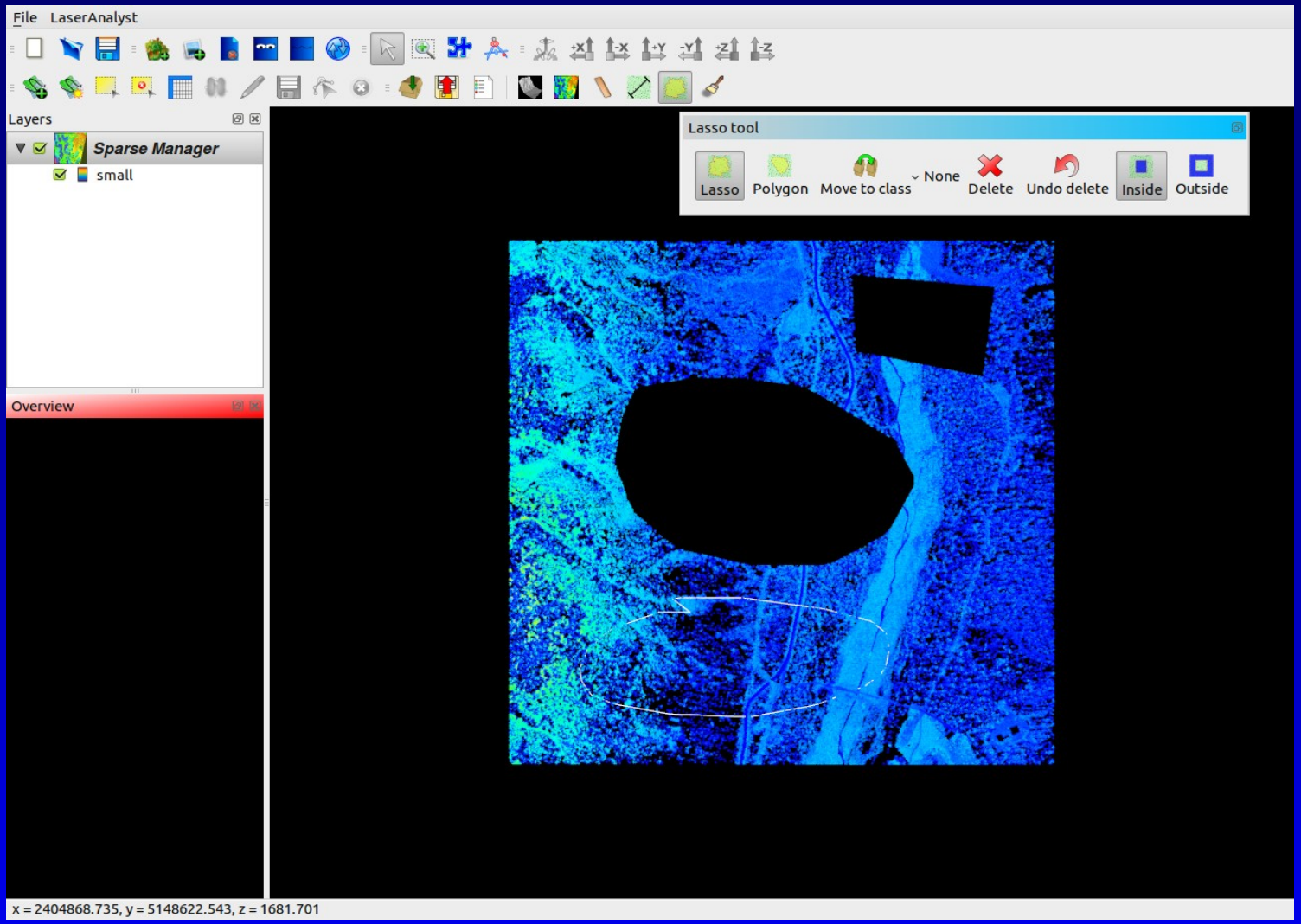
Plugin


File LaserAnalyst
Layers
Sparse Manager
small
Overview
rsf.py
Name
Version
Active
Short description
LaserAnalyst
0.0
LaserAnalyst set of tools to analyze laser data.
LaserCalibration
0.0
LaserCalibration set of tools to calibrate laser data.

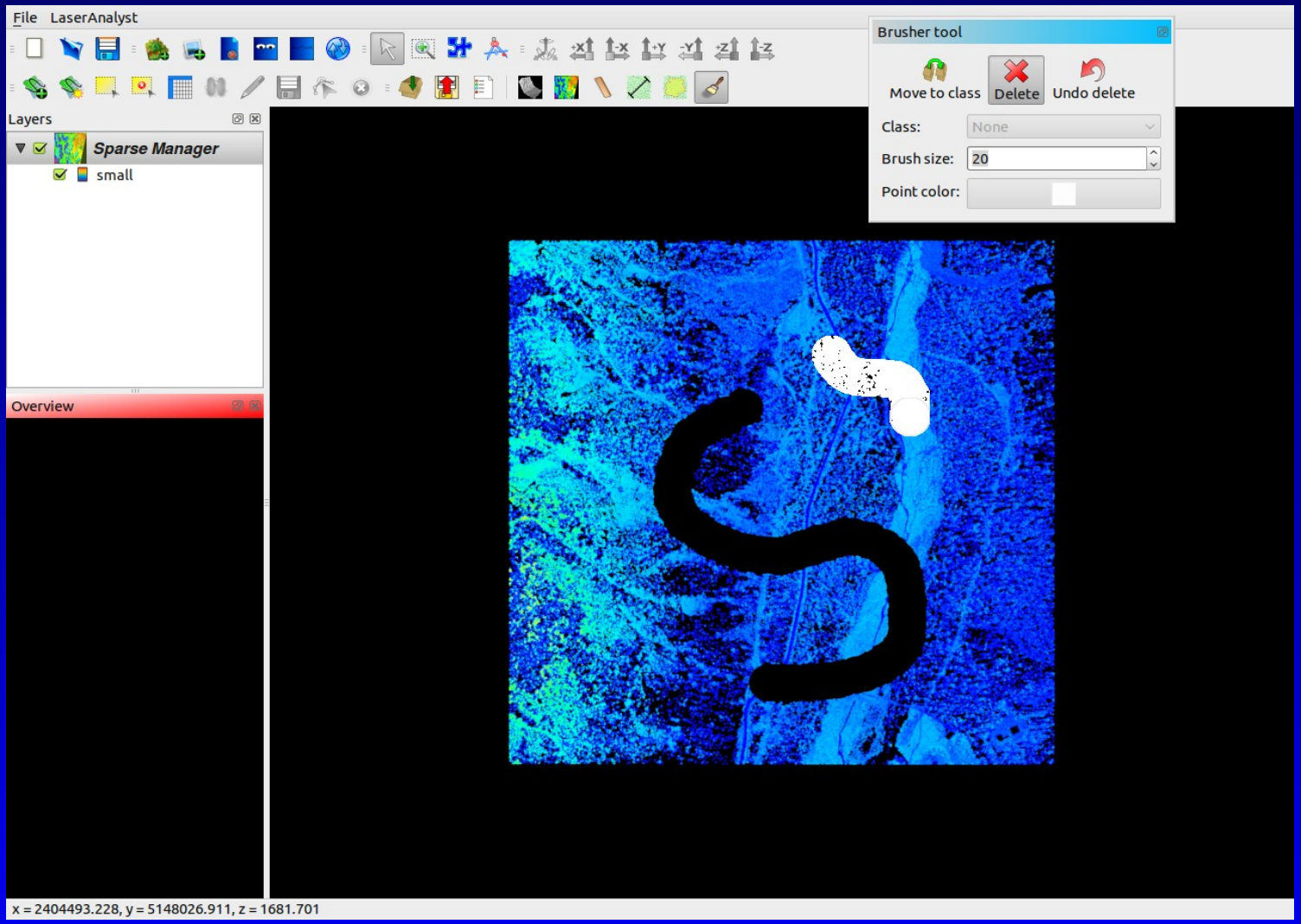
Plugin


ReSeF (Remote Sensing Framework)
File LaserAnalyst
Section tool
Half width: 49.659
Fixed
Append
Show 0
Export
Layers
Sparse Manager
small
Overview
Section View
0
x = 2403917.944, y = 5148317.328, z = 1681.701

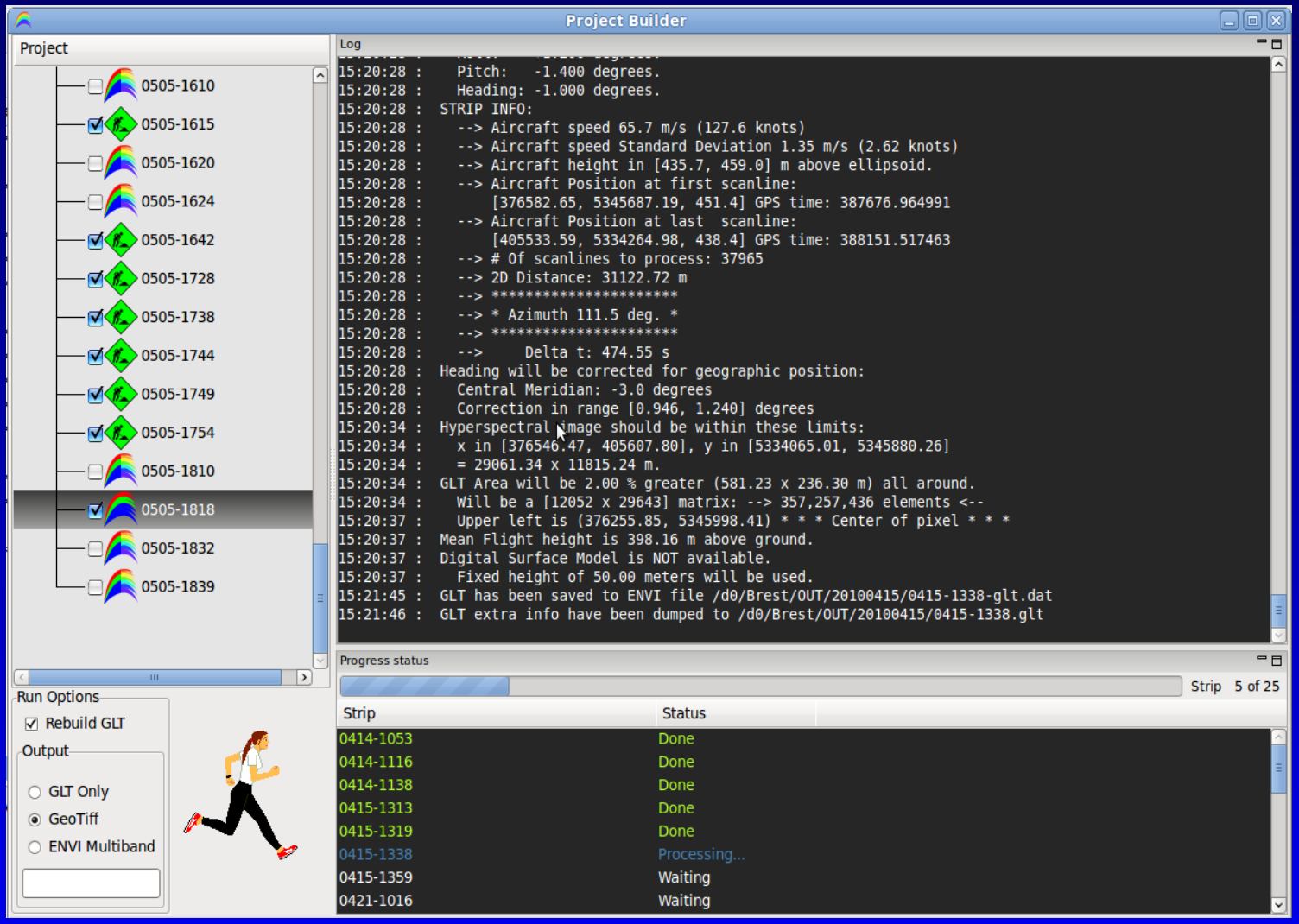
Plugin


File LaserAnalyst
Layers
Sparse Manager
small
Overview
Lasso tool
Lasso
Polygon
Move to class
None
Delete
Undo delete
Inside
Outside
x = 2404868.735, y = 5148622.543, z = 1681.701

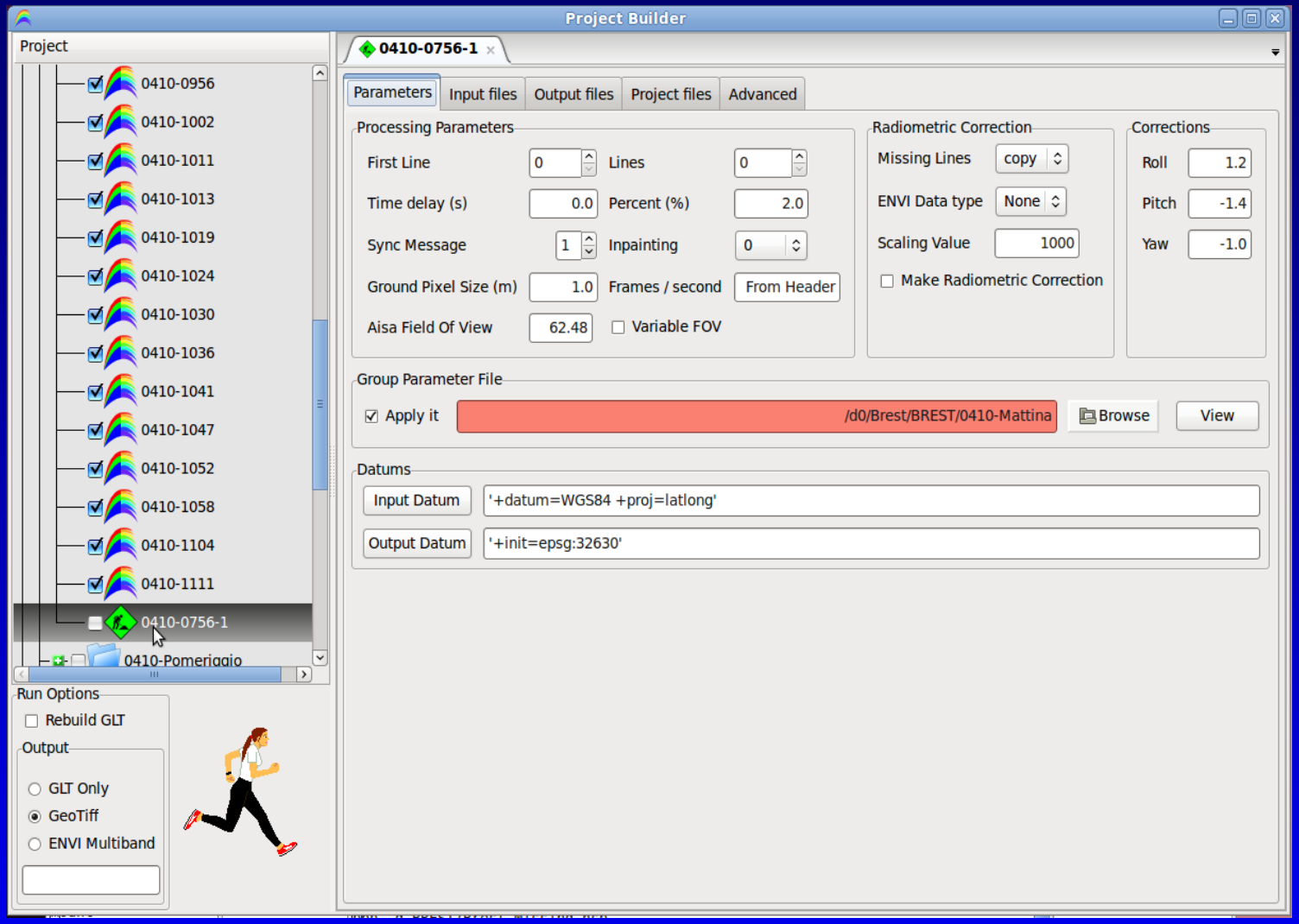
Plugin


File LaserAnalyst
Layers
Sparse Manager
small
Overview
Brusher tool
Move to class
Delete
Undo delete
Class:
None
Brush size:
20
Point color:
x = 2404493.228, y = 5148026.911, z = 1681.701

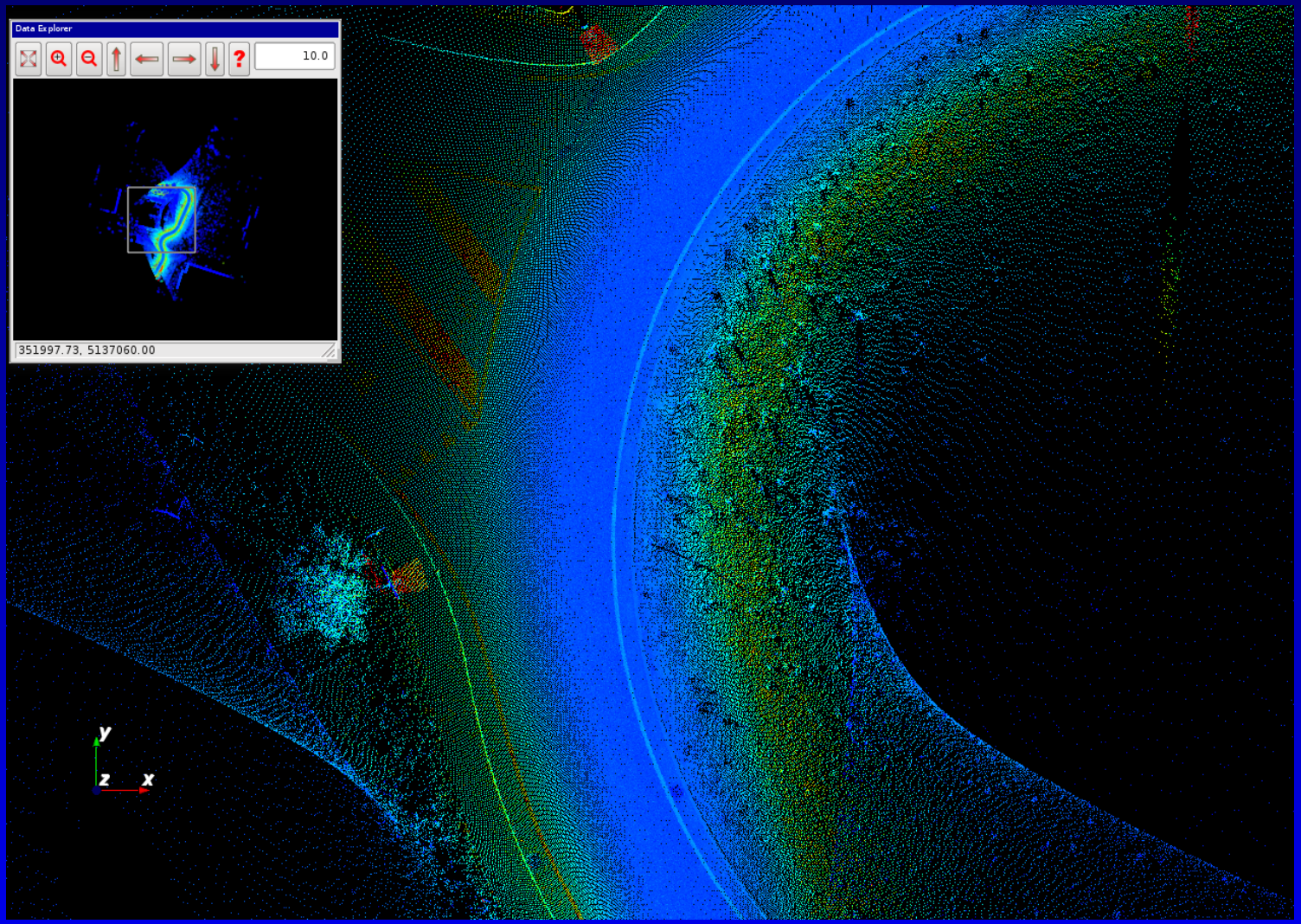
Plugin


Project Builder
Project
0505-1610
0505-1615
0505-1620
0505-1624
0505-1642
0505-1728
0505-1738
0505-1744
0505-1749
0505-1754
0505-1810
0505-1818
0505-1832
0505-1839
Run Options
Rebuild GLT
Output
GLT Only
GeoTiff
ENVI Multiband
Log
15:20:28 : Pitch: -1.400 degrees.
15:20:28 : Heading: -1.000 degrees.
15:20:28 : STRIP INFO:
15:20:28 : --> Aircraft speed 65.7 m/s (127.6 knots)
15:20:28 : --> Aircraft speed Standard Deviation 1.35 m/s (2.62 knots)
15:20:28 : --> Aircraft height in [435.7, 459.0] m above ellipsoid.
15:20:28 : --> Aircraft Position at first scanline:
15:20:28 : [376582.65, 5345687.19, 451.4] GPS time: 387676.964991
15:20:28 : --> Aircraft Position at last scanline:
15:20:28 : [405533.59, 5334264.98, 438.4] GPS time: 388151.517463
15:20:28 : --> # Of scanlines to process: 37965
15:20:28 : --> 2D Distance: 31122.72 m
15:20:28 : --> **********
15:20:28 : --> * Azimuth 111.5 deg. *
15:20:28 : --> **********
15:20:28 : --> Delta t: 474.55 s
15:20:28 : Heading will be corrected for geographic position:
15:20:28 : Central Meridian: -3.0 degrees
15:20:28 : Correction in range [0.946, 1.240] degrees
15:20:34 : Hyperspectral image should be within these limits:
15:20:34 : x in [376546.47, 405607.80], y in [5334065.01, 5345880.26]
15:20:34 : = 29061.34 x 11815.24 m.
15:20:34 : GLT Area will be 2.00 % greater (581.23 x 236.30 m) all around.
15:20:34 : Will be a [12052 x 29643] matrix: --> 357,257,436 elements <--
15:20:37 : Upper left is (376255.85, 5345998.41) * * * Center of pixel * * *
15:20:37 : Mean Flight height is 398.16 m above ground.
15:20:37 : Digital Surface Model is NOT available.
15:20:37 : Fixed height of 50.00 meters will be used.
15:21:45 : GLT has been saved to ENVI file /d0/Brest/OUT/20100415/0415-1338-glt.dat
15:21:46 : GLT extra info have been dumped to /d0/Brest/OUT/20100415/0415-1338.glt
Progress status
Strip 5 of 25
Strip
Status
0414-1053 Done
0414-1116 Done
0414-1138 Done
0415-1313 Done
0415-1319 Done
0415-1338 Processing...
0415-1359 Waiting
0421-1016 Waiting

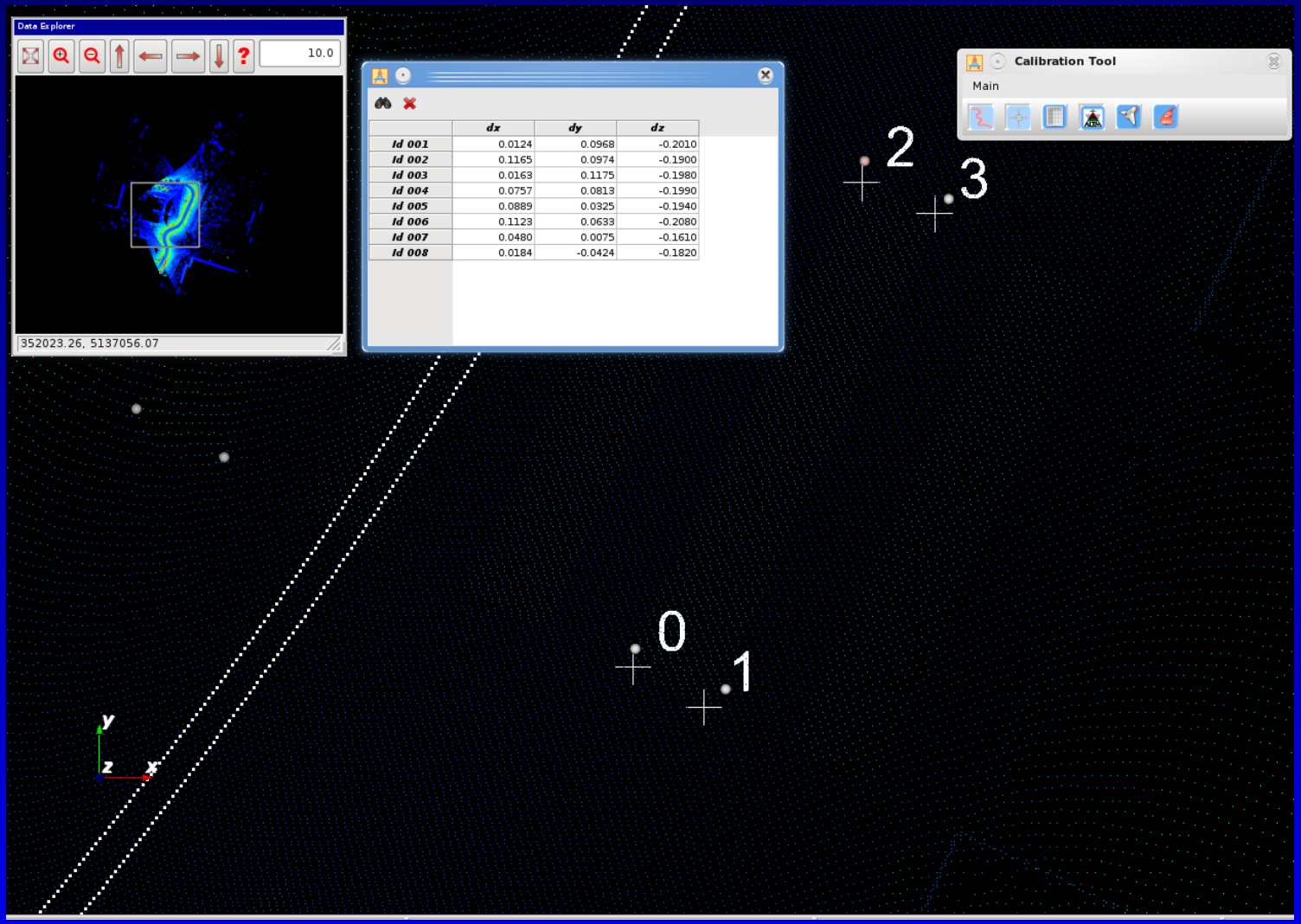
Plugin


Project Builder
Project
0410-0956
0410-1002
0410-1011
0410-1013
0410-1019
0410-1024
0410-1030
0410-1036
0410-1041
0410-1047
0410-1052
0410-1058
0410-1104
0410-1111
0410-0756-1
0410-Pomeriggio
Run Options
Rebuild GLT
Output
GLT Only
GeoTiff
ENVI Multiband
0410-0756-1
Parameters
Input files
Output files
Project files
Advanced
Processing Parameters
First Line
0
Lines
0
Time delay (s)
0.0
Percent (%)
2.0
Sync Message
1
Inpainting
0
Ground Pixel Size (m)
1.0
Frames / second
From Header
Aisa Field Of View
62.48
Variable FOV
Radiometric Correction
Missing Lines
copy
ENVI Data type
None
Scaling Value
1000
Make Radiometric Correction
Corrections
Roll
1.2
Pitch
-1.4
Yaw
-1.0
Group Parameter File
Apply it
/d0/Brest/BREST/0410-Mattina
Browse
View
Datums
Input Datum
'+datum=WGS84 +proj=latlong'
Output Datum
'+init=epsg:32630'

Plugin



Plugin


Data Explorer
10.0
352023.26, 5137056.07
dx dy dz
Id 001 0.0124 0.0968 -0.2010
Id 002 0.1165 0.0974 -0.1900
Id 003 0.0163 0.1175 -0.1980
Id 004 0.0757 0.0813 -0.1990
Id 005 0.0889 0.0325 -0.1940
Id 006 0.1123 0.0633 -0.2080
Id 007 0.0480 0.0075 -0.1610
Id 008 0.0184 -0.0424 -0.1820
Calibration Tool
Main
2
3
0
1
y
z
x

Alcuni dati

- Circa 60000 righe di codice

- Visualizzazione rapida mediate un algoritmo di LOD (Level of Detailed) creato appositamente per gestire grandi volumi di dati

Alcuni dati

- Gestione di grandi nuvole di punti (> 100 Milioni di punti) mediante l'uso di 'Mapped arrays' per limitare l'impronta in memoria tipico dei dati laser
- Gestione di raster di notevoli dimensioni. I dati iperspettrali possono essere molto grandi (decine di Gb)
- Geocodfica iperspettrale di immagini enormi (> di 90 km in lunghezza, circa 100 Gb come dimensione del dato)

Conclusioni

- E' possibile creare un ambiente di sviluppo per applicazioni nel campo del telerilevamento solo usando strumenti open source

- Python offre tutto il necessario per la creazione di applicativi veloci ed efficienti nella gestione ed analisi di grandi volumi di dati telerilevati