Towards the Measurement of a 3D Dynamic Urban Environment using an Intelligent Vehicle

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Our final goal

is to enhance driver safety, traffic data collection and generating a digital copy of a dynamic urban environment.

We want to detect the moving objects in the surroundings, and track their states, such as speed, direction, and size, so that dangerous situations can be predicted.

We also want to generate a 3D copy of the dynamic urban scenery that contains both stationary objects, e.g. buildings, trees, road etc., and mobile objects, e.g. people, bicycles and cars.

We also want to locate our-self into the virtual space.

ФОРУМ РЕКТОРОВ ВУЗОВ КИТАЯ
Jeep
京F 30903

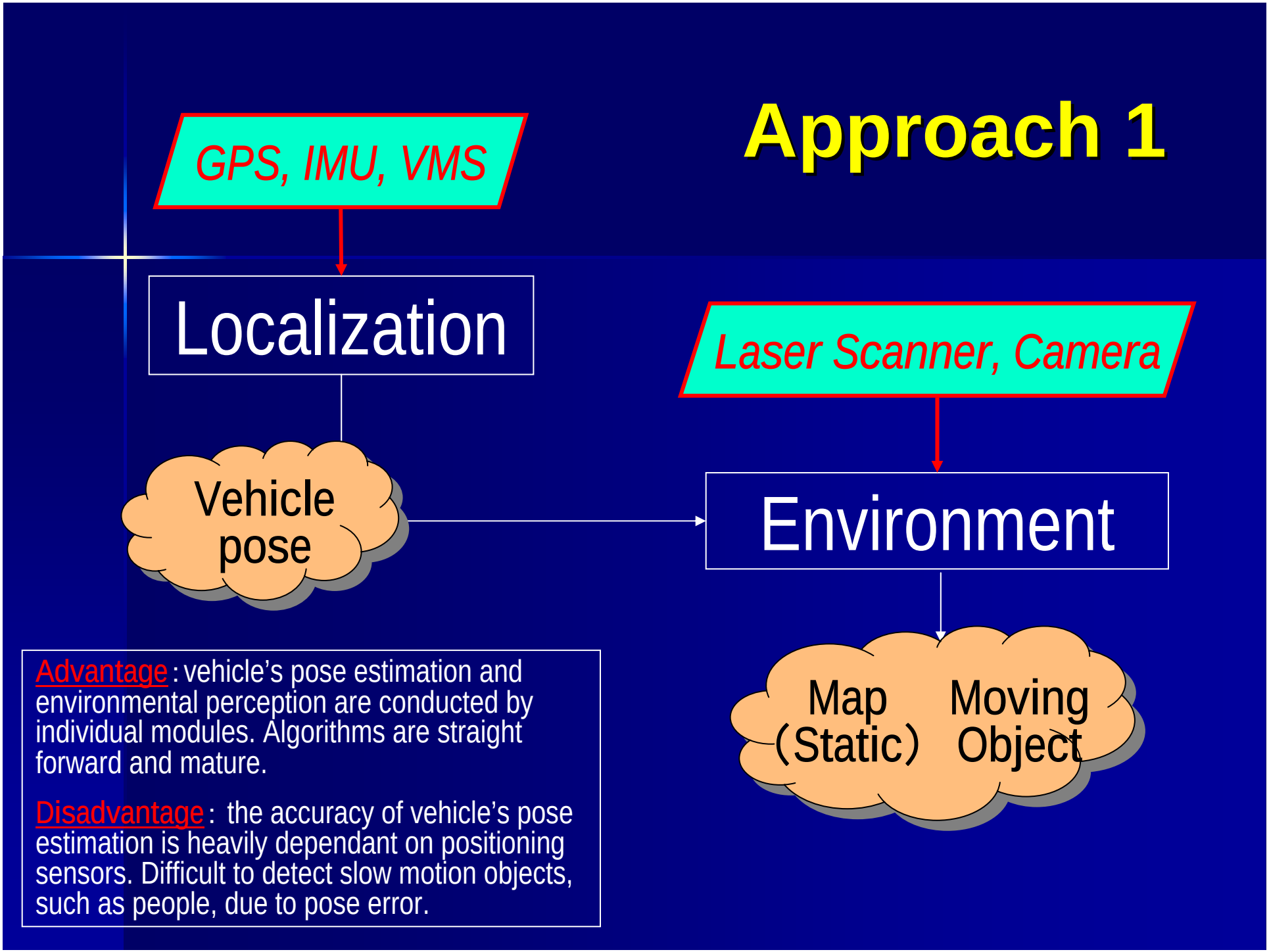
- **Objective**
  - Sensing a large dynamic environment in order for driving safety, 3D mapping and traffic data collection.

- **Three Problems**
  - Localization
  - Mapping
  - Mobile objects' detection, tracking and classification

- **Our Solution** : An Intelligent Vehicle
  - localization errors in urban area
  - a mixture of data from both mobile and static objects

GPS
IMU
L1
L5
Video Camera
Laser Scanner
L2,L3,L4

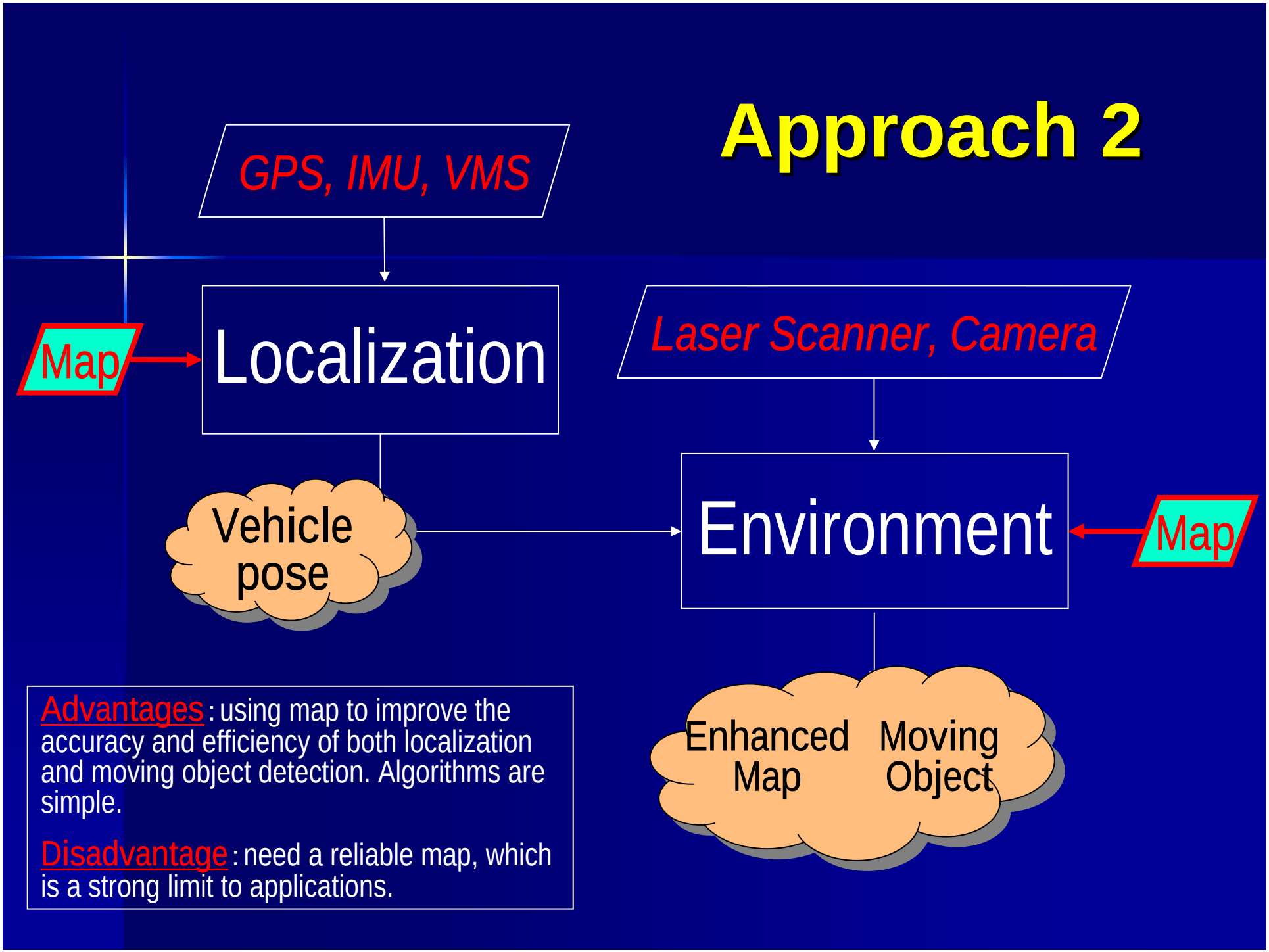
Approach 1



Advantage : vehicle's pose estimation and environmental perception are conducted by individual modules. Algorithms are straight forward and mature.

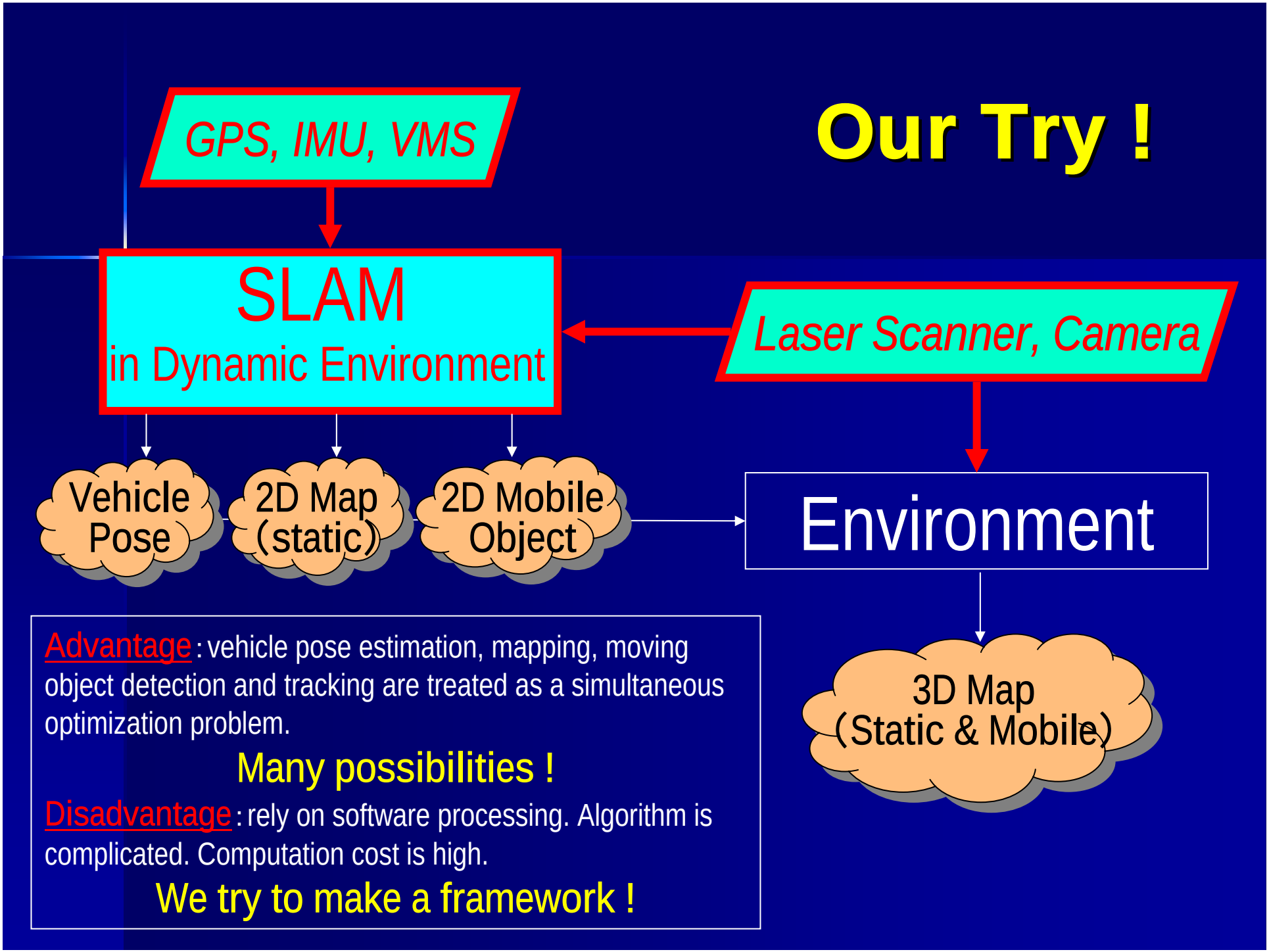
Disadvantage : the accuracy of vehicle's pose estimation is heavily dependant on positioning sensors. Difficult to detect slow motion objects, such as people, due to pose error.

Approach 2

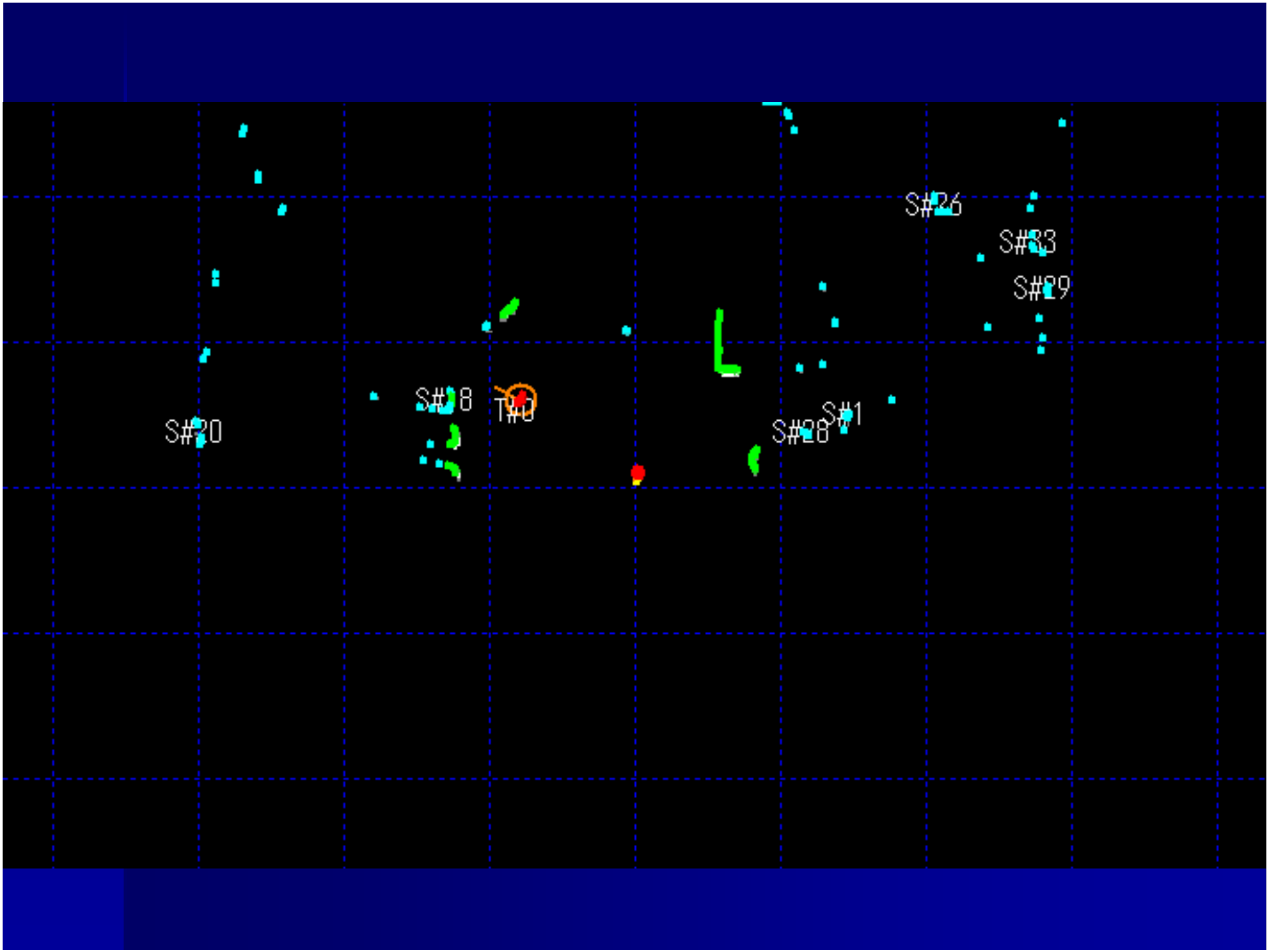


Advantages: using map to improve the accuracy and efficiency of both localization and moving object detection. Algorithms are simple.

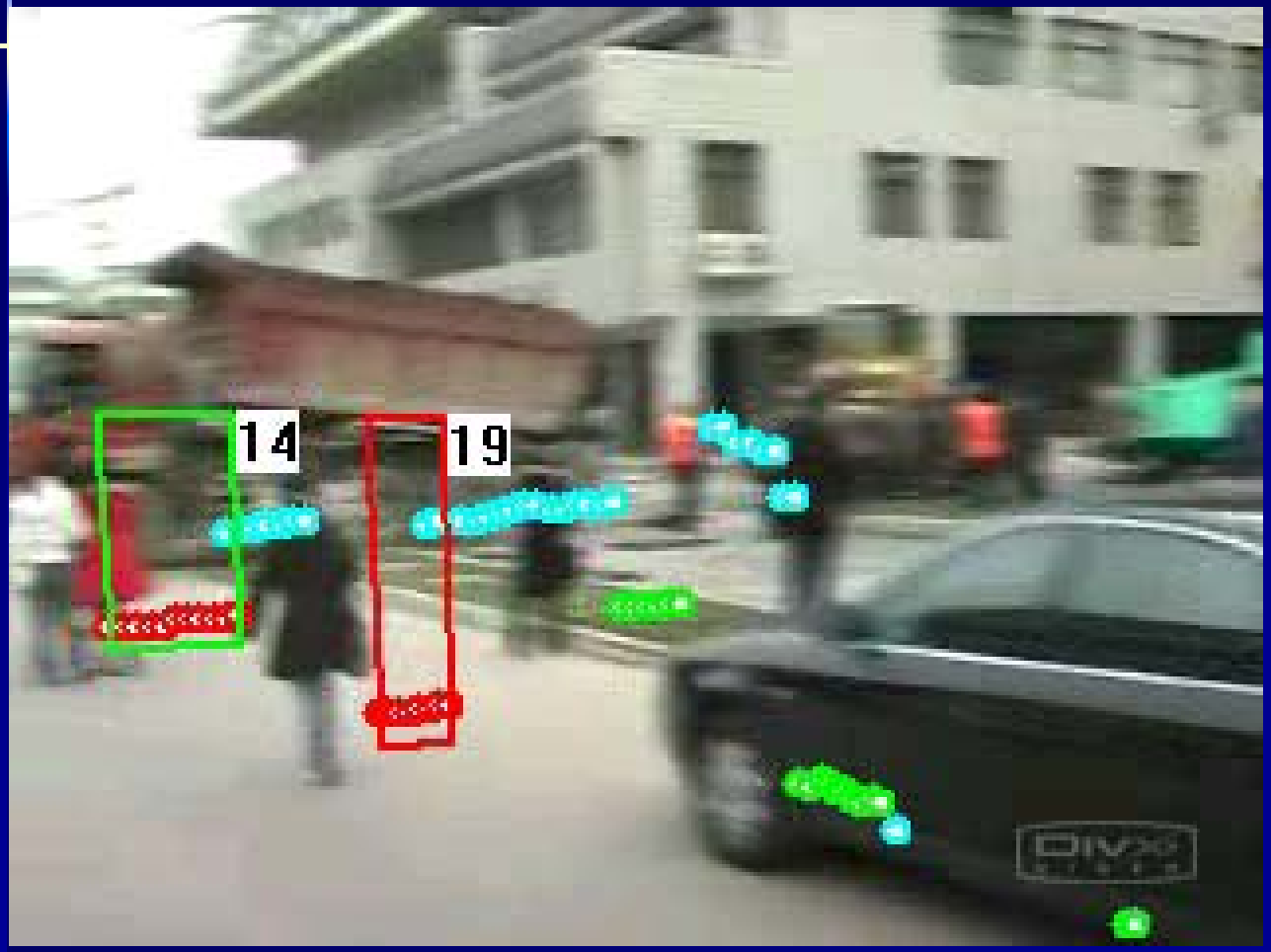
Disadvantage: need a reliable map, which is a strong limit to applications.


Our Try !
GPS, IMU, VMS
SLAM
in Dynamic Environment
Laser Scanner, Camera
Vehicle Pose
2D Map (static)
2D Mobile Object
Environment
3D Map (Static & Mobile)
Advantage : vehicle pose estimation, mapping, moving object detection and tracking are treated as a simultaneous optimization problem.
Many possibilities !
Disadvantage : rely on software processing. Algorithm is complicated. Computation cost is high.
We try to make a framework !

SLAM with Object Tracking and Classification


S#26
S#33
S#29
S#18
T#0
S#20
S#28
S#1

Classification Results

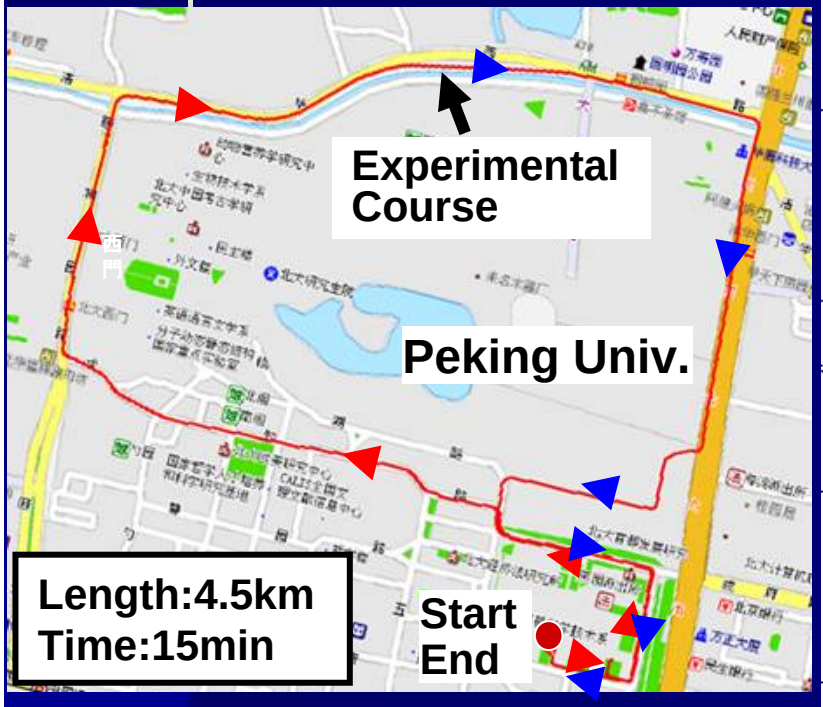


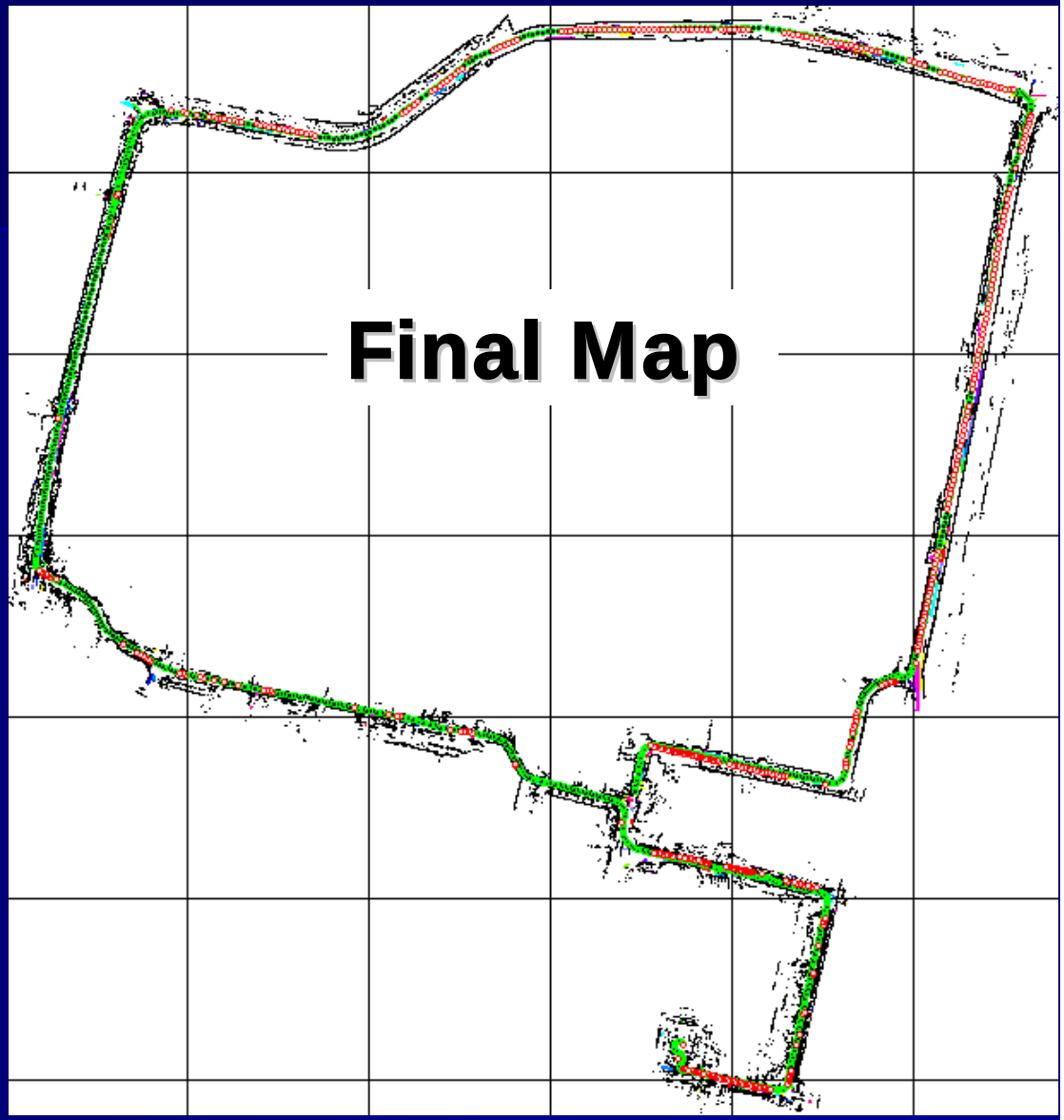
Objects

- people
- bicycle
- group
- car

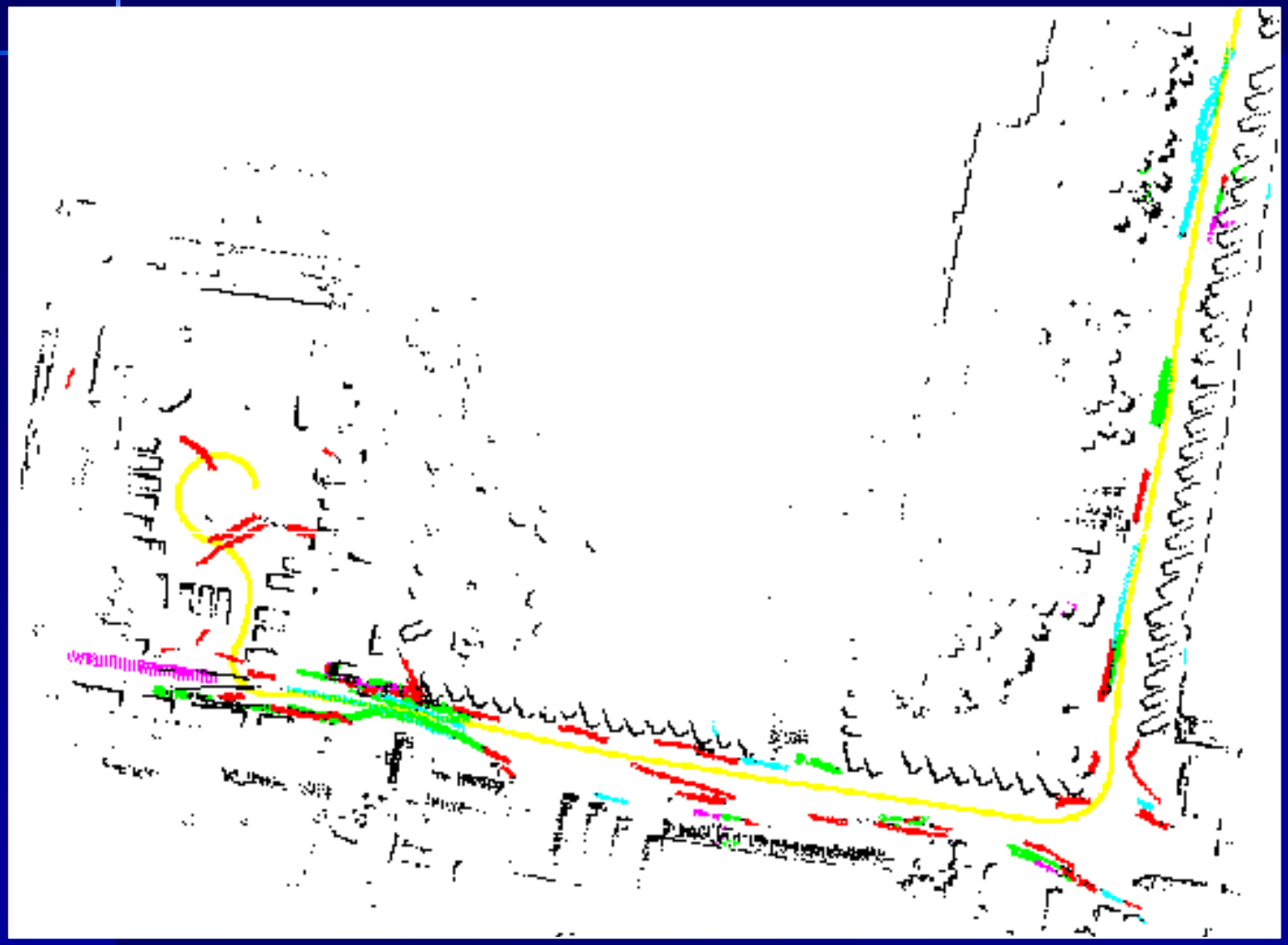
Laser Points

- moving
- seed
- group

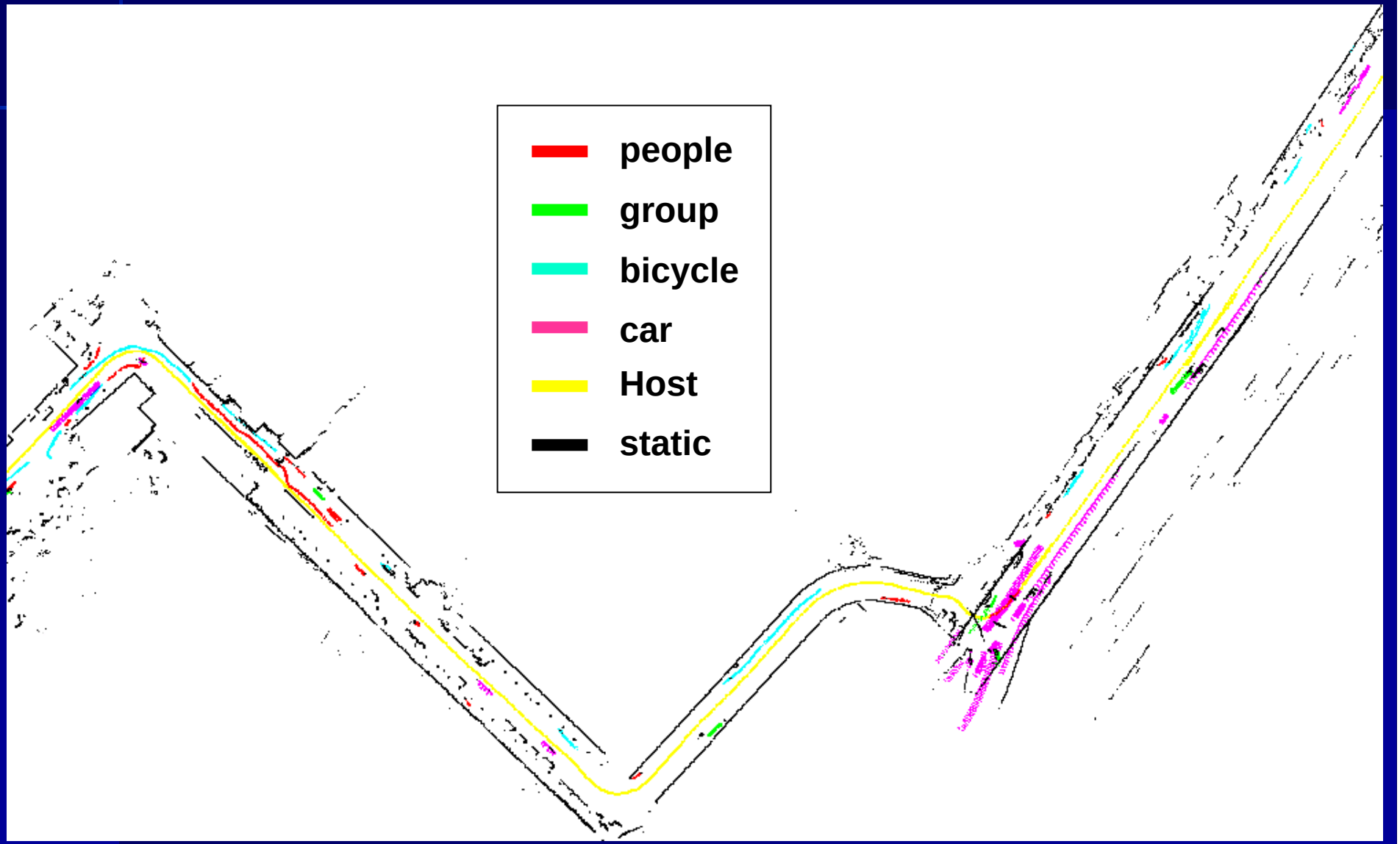

Experimental Course
Peking Univ.
Length:4.5km
Time:15min
Start
End


Final Map

A map of static & mobile objects



A map of static & mobile objects



Our Try !

GPS, IMU, VMS

SLAM
in Dynamic Environment

Laser Scanner, Camera

Vehicle Pose

2D Map (static)

2D Mobile Object

Environment

3D Map
(Static & Mobile)

Advantage : vehicle pose estimation, mapping, moving object detection and tracking are treated as a simultaneous optimization problem.

Many possibilities !

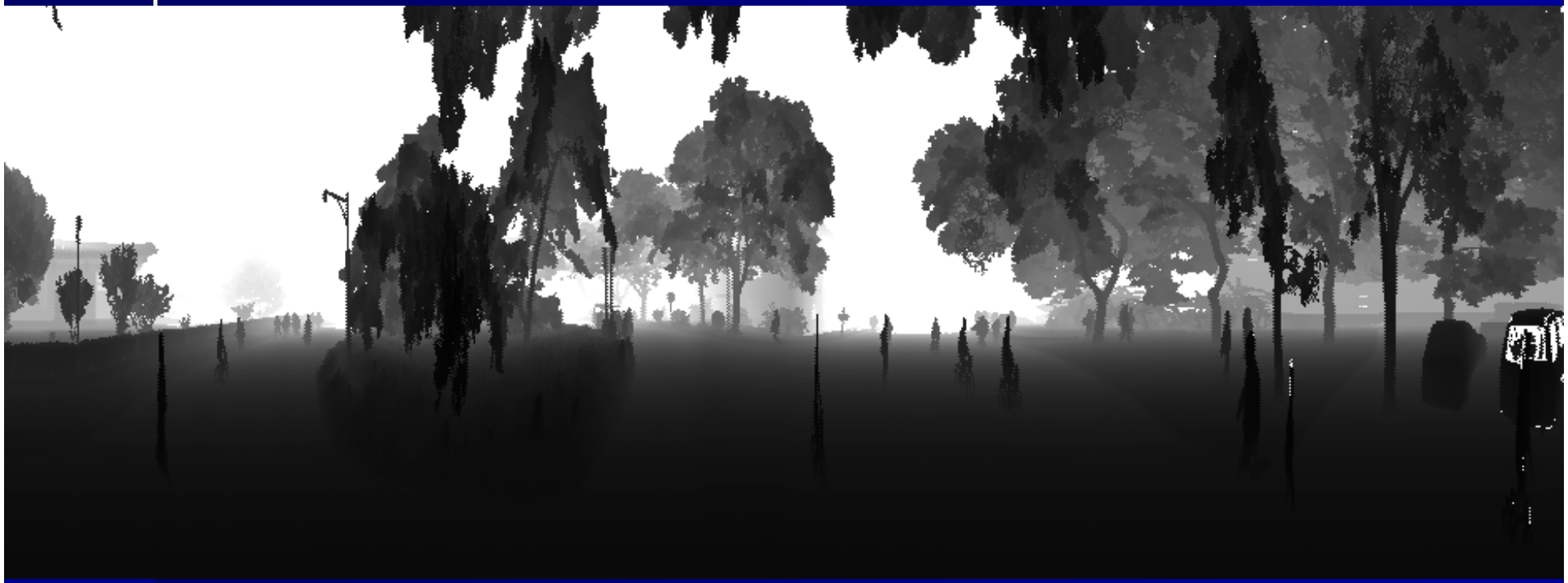
Disadvantage : rely on software processing. Algorithm is complicated. Computation cost is high.

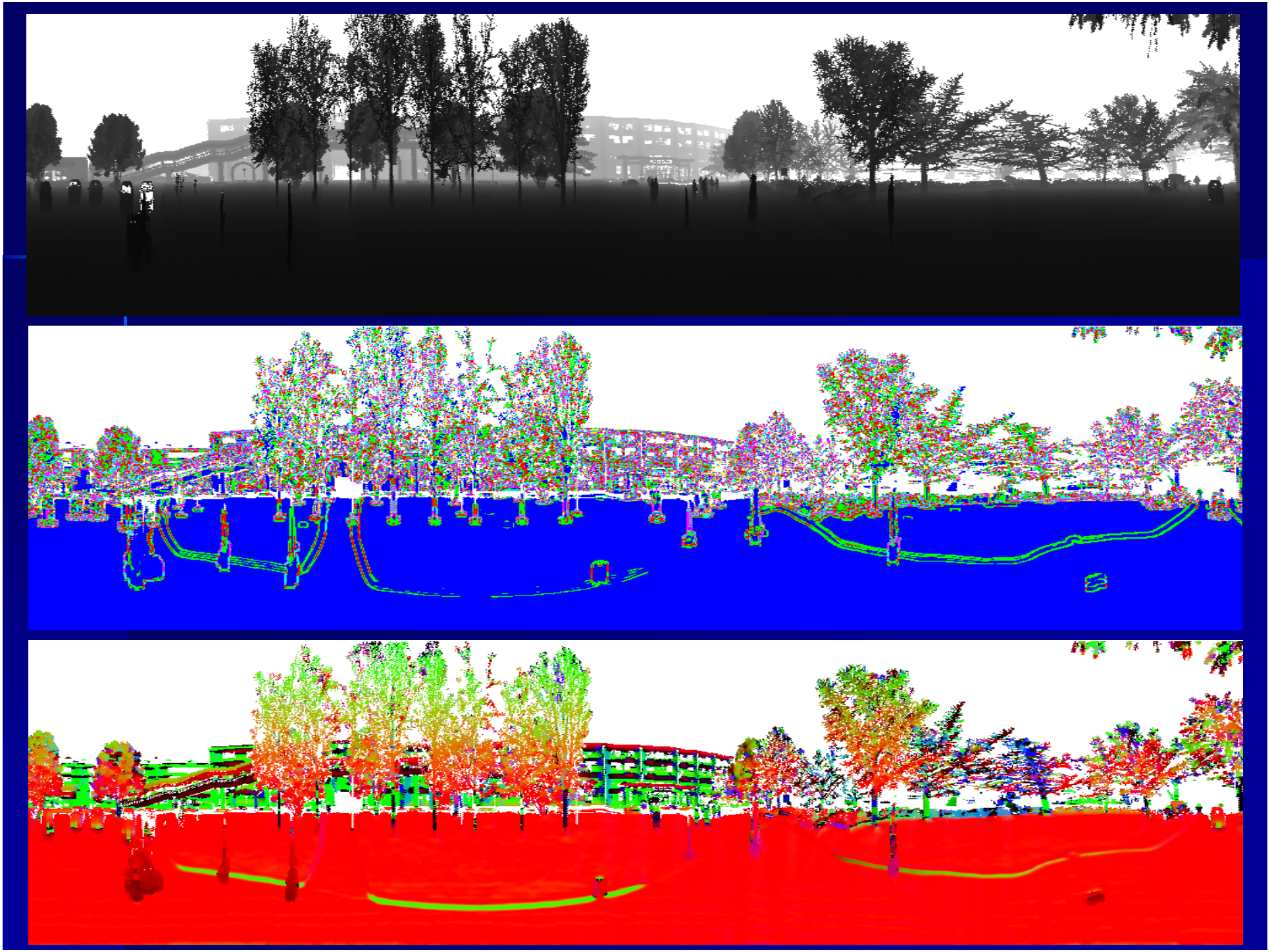
We try to make a framework !

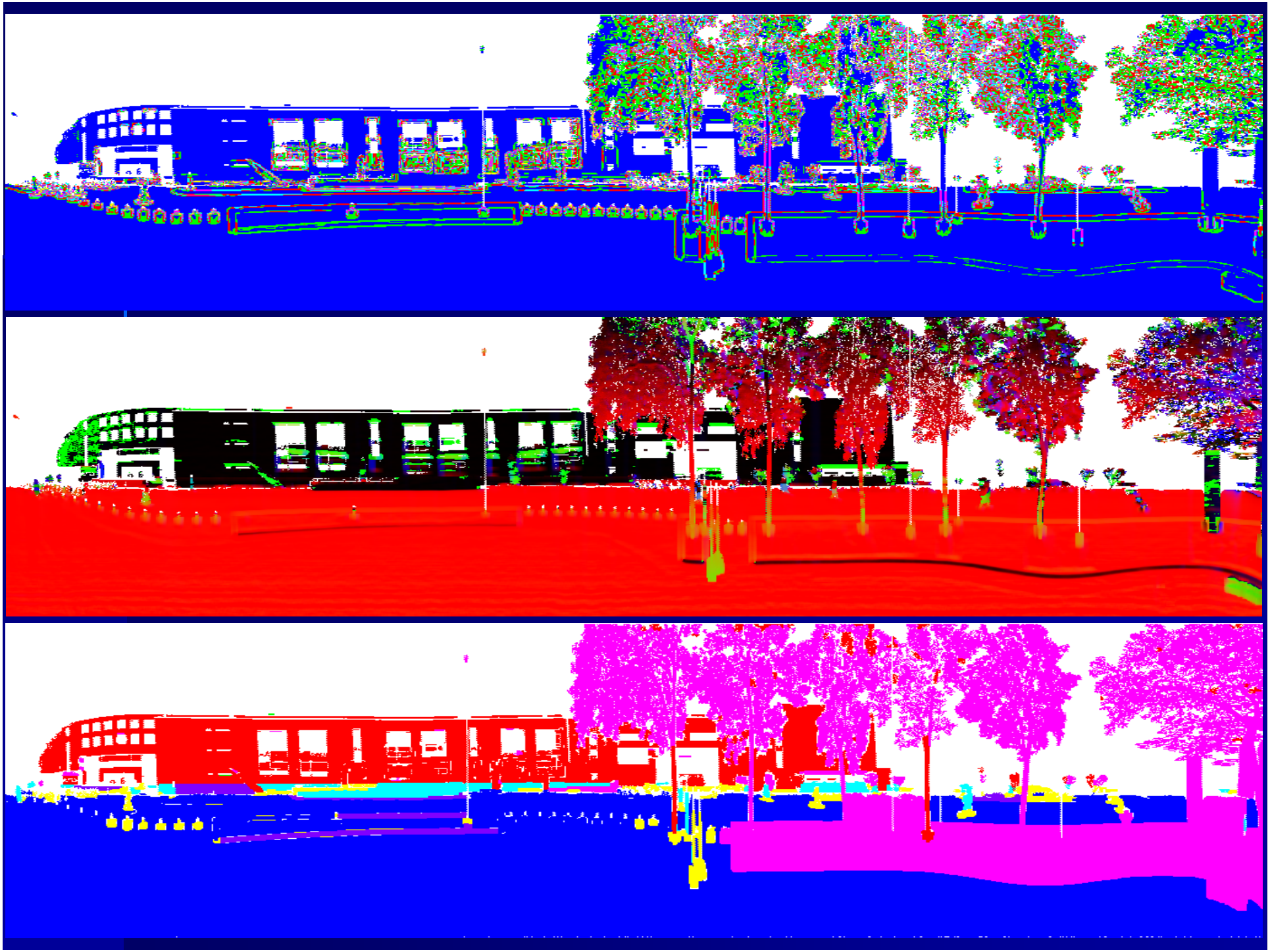
3D Mapping

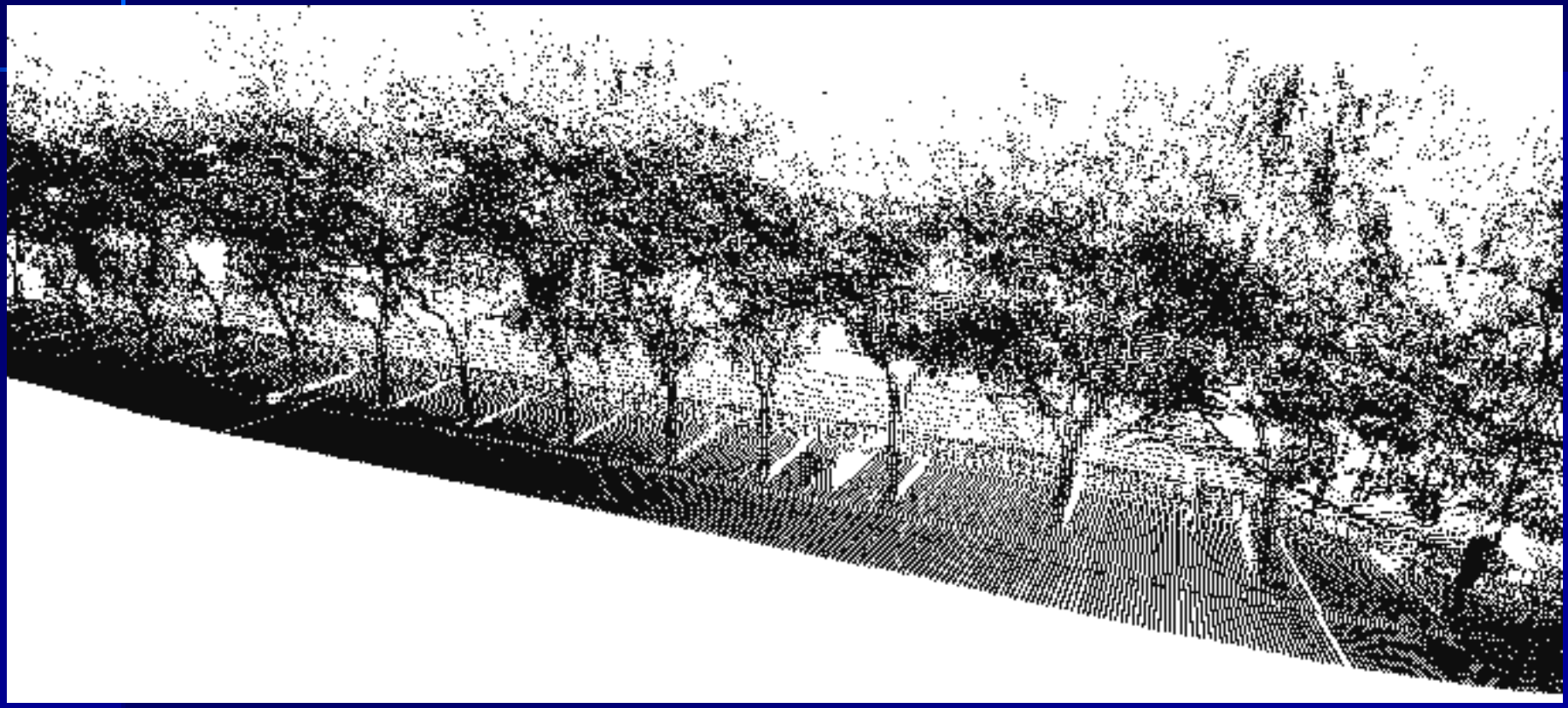
ФОРУМ РЕКТОРОВ ВУЗОВ КИТАЯ
Vertical Laser Scanning
Jeep
京F 30903

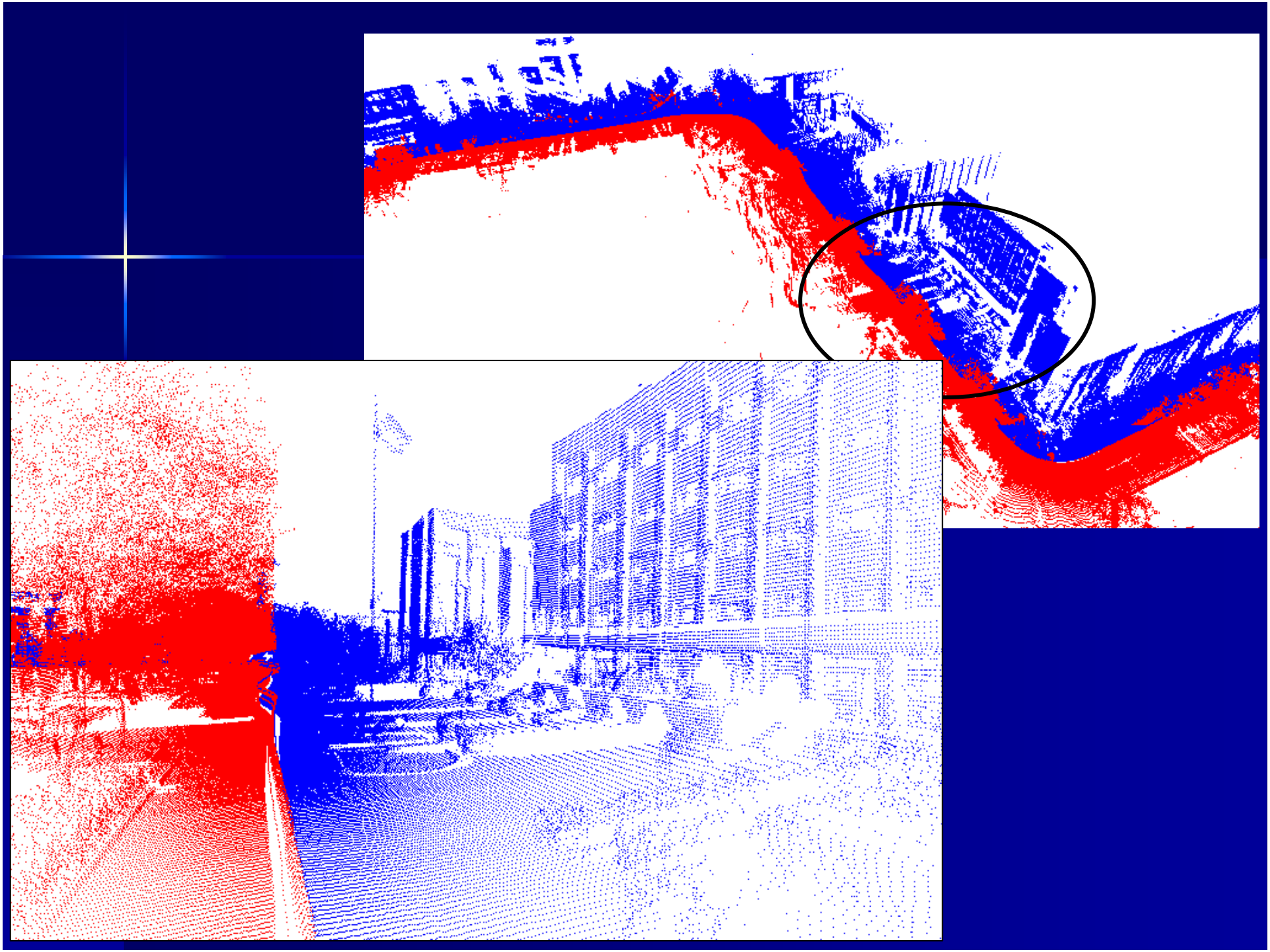
A Piece of Range Image

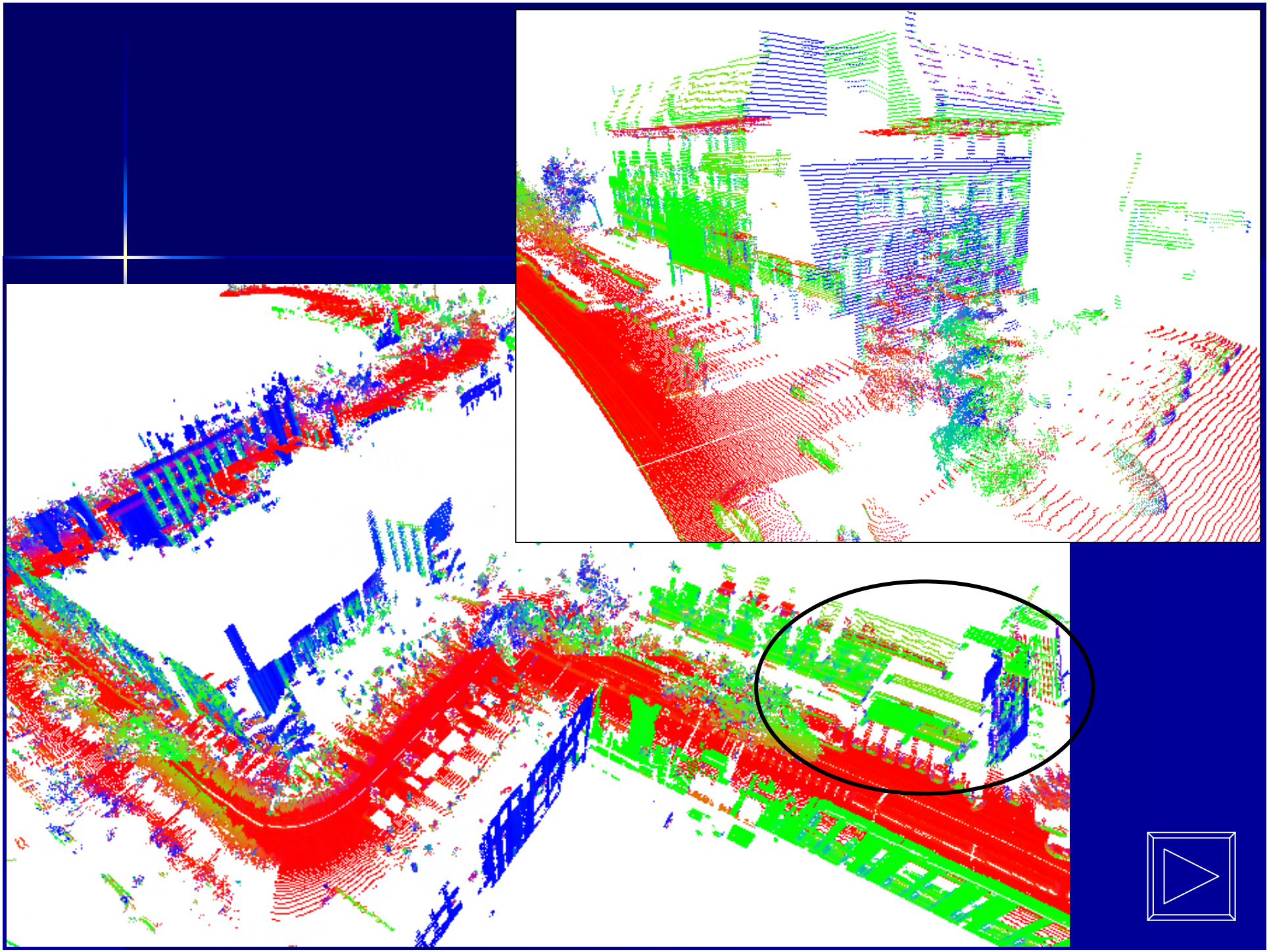


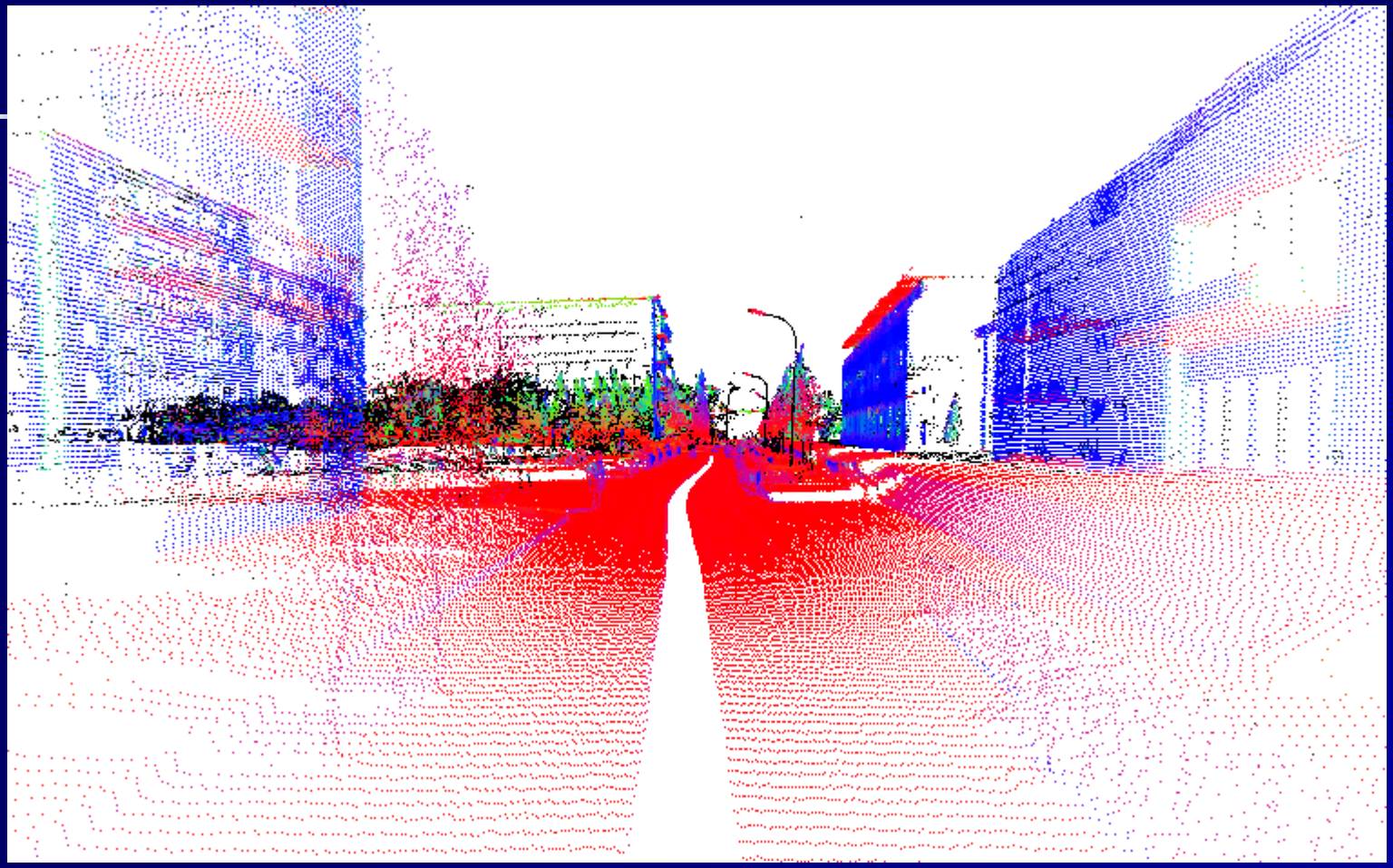


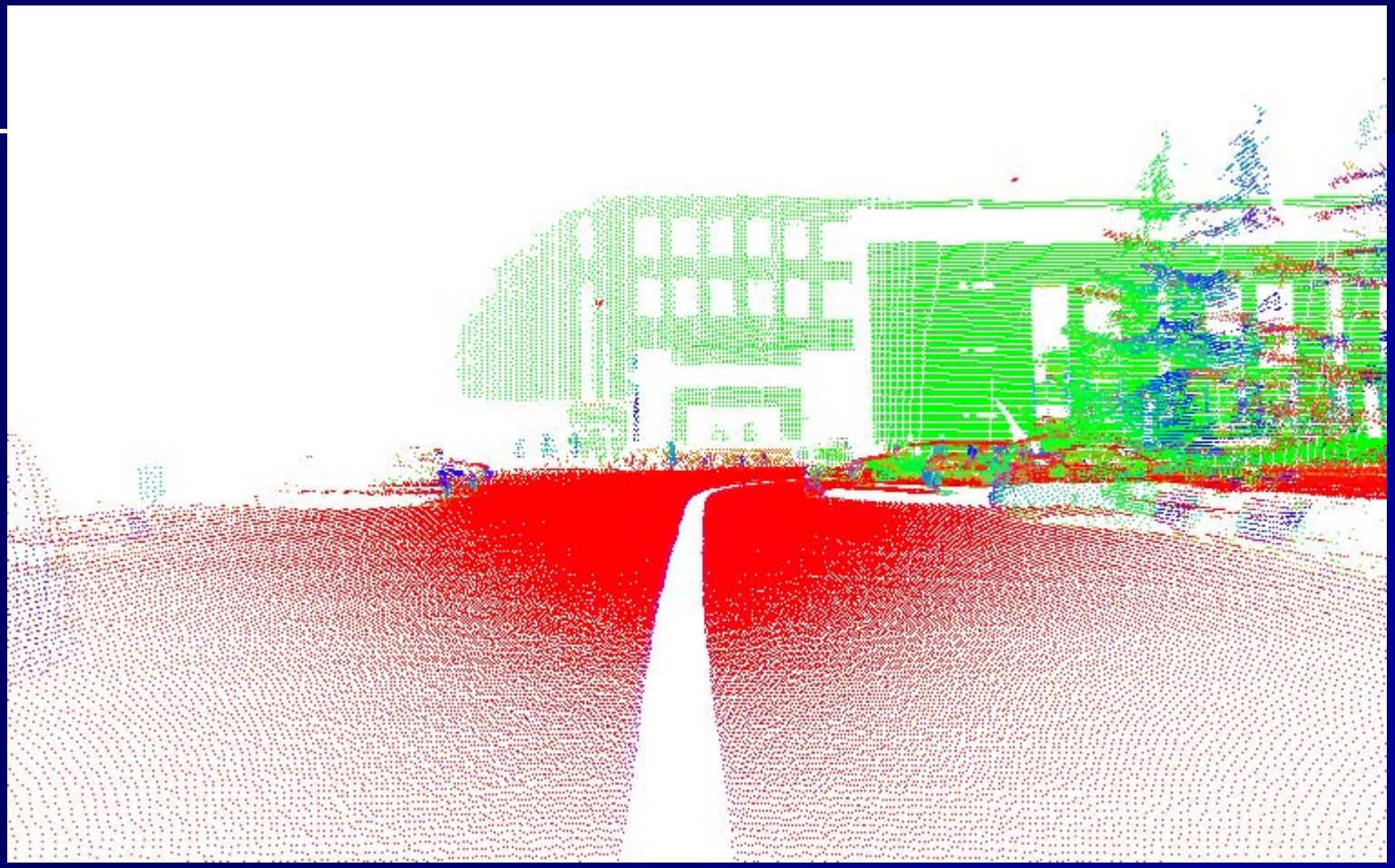


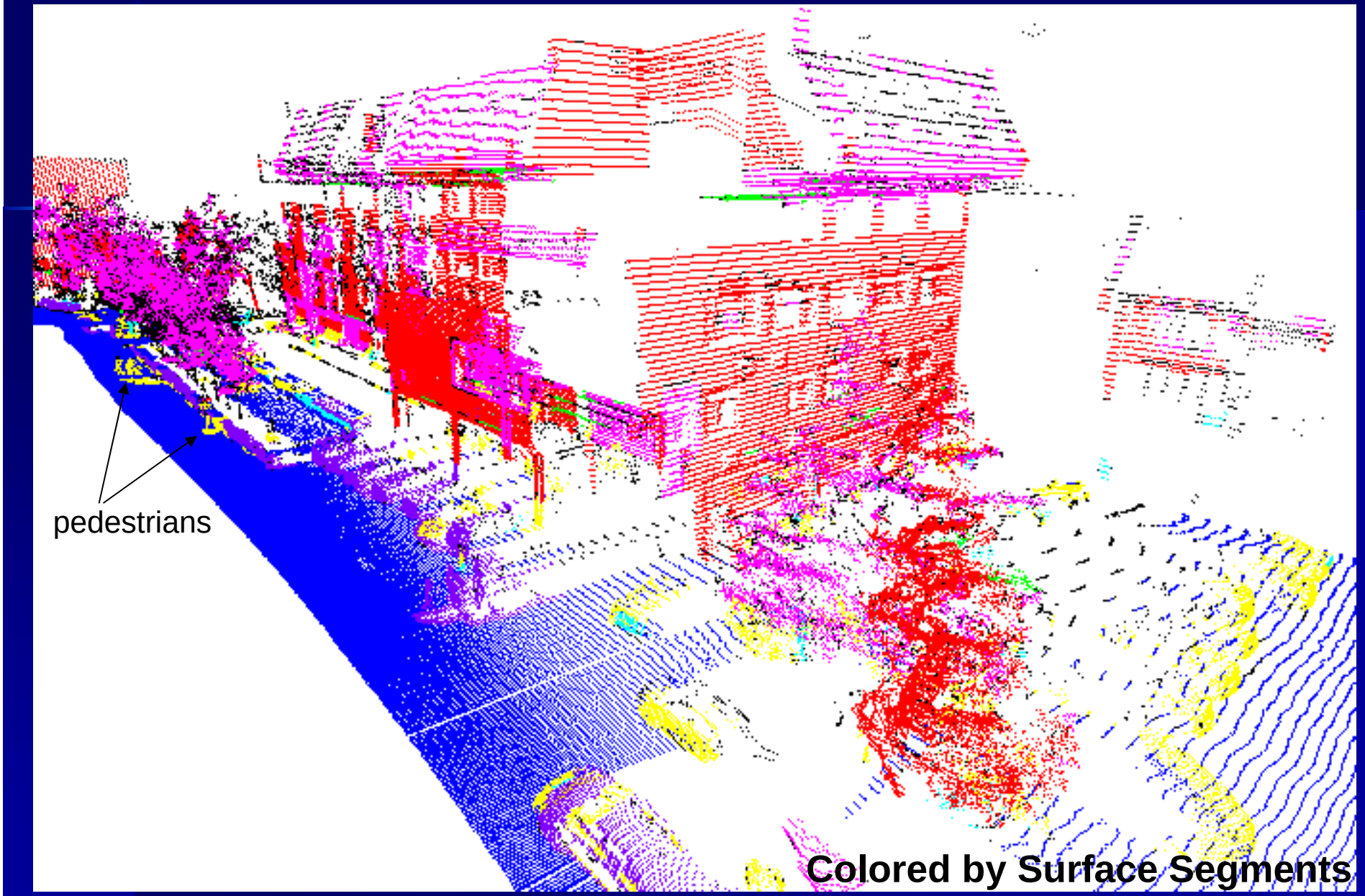


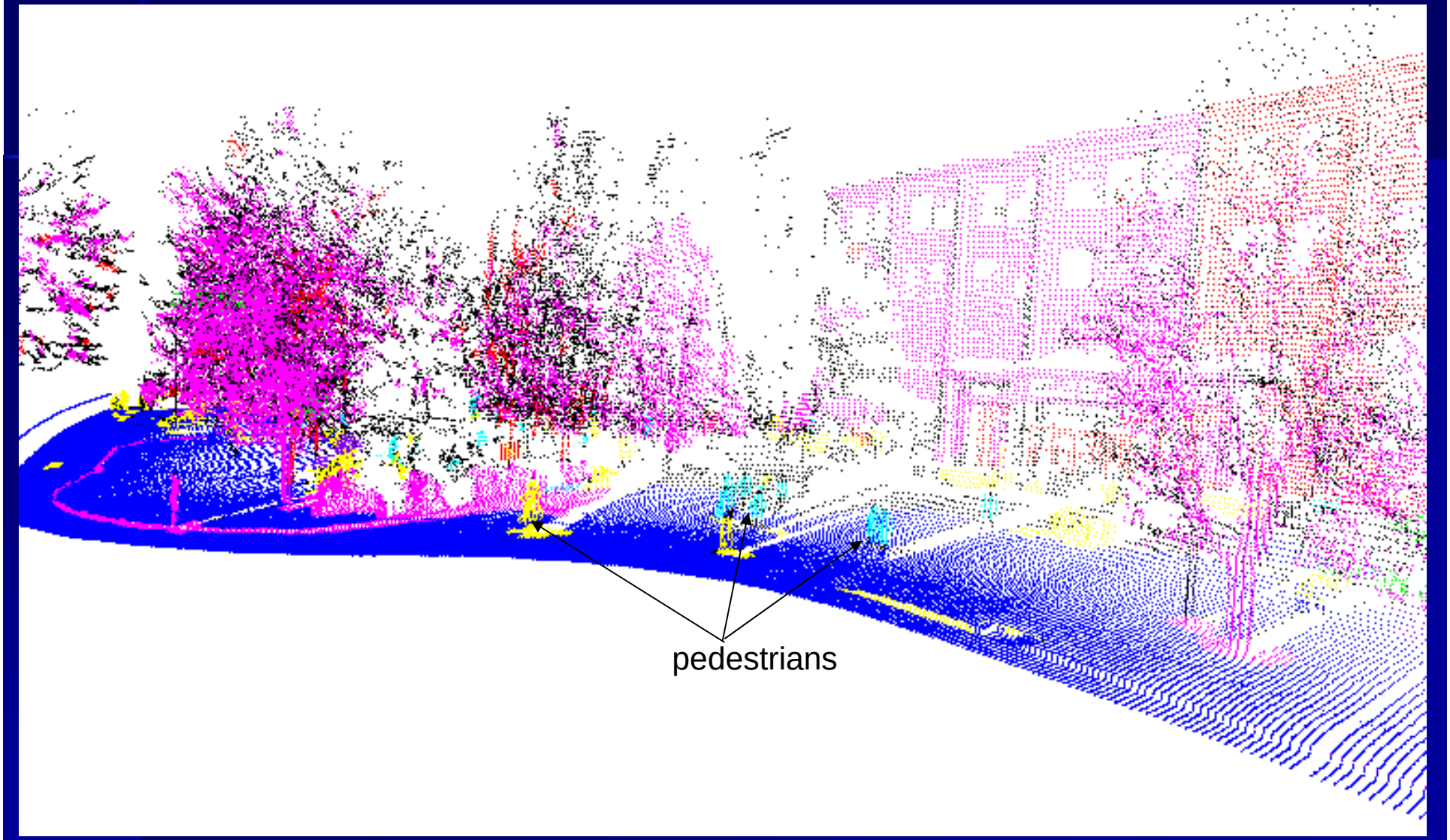









pedestrians
Colored by Surface Segments


pedestrians

3D Mapping

Slant Laser Scanning

Laser + Video

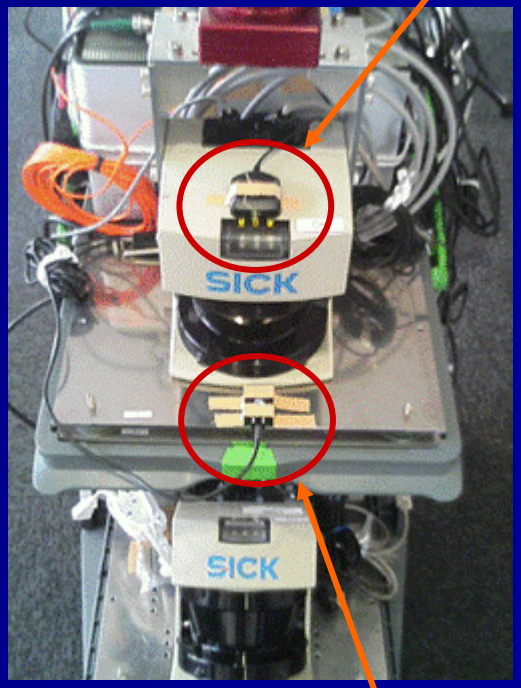
Previous IVs

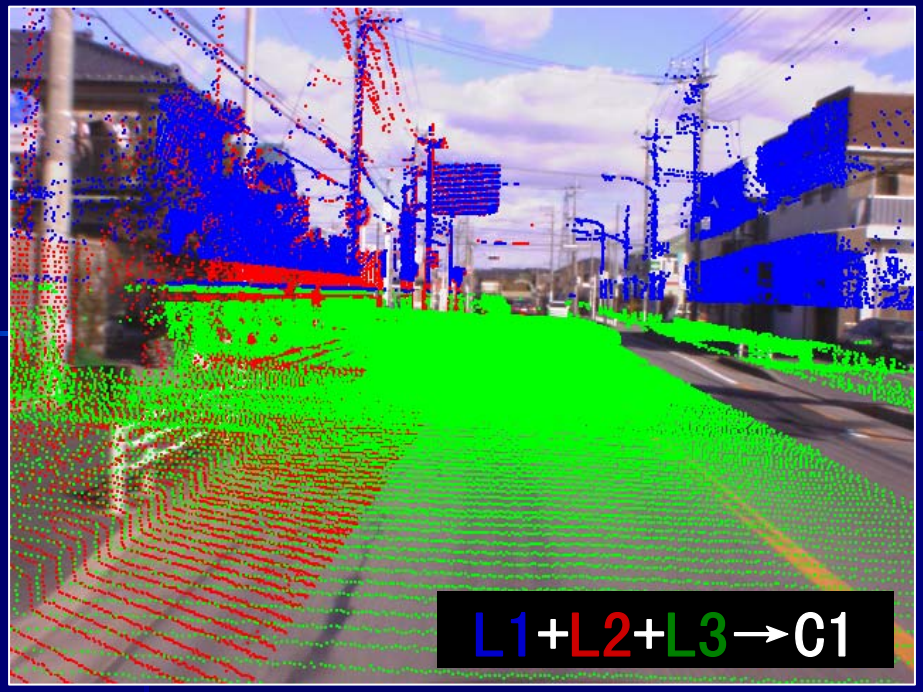
- Univ. of Tokyo

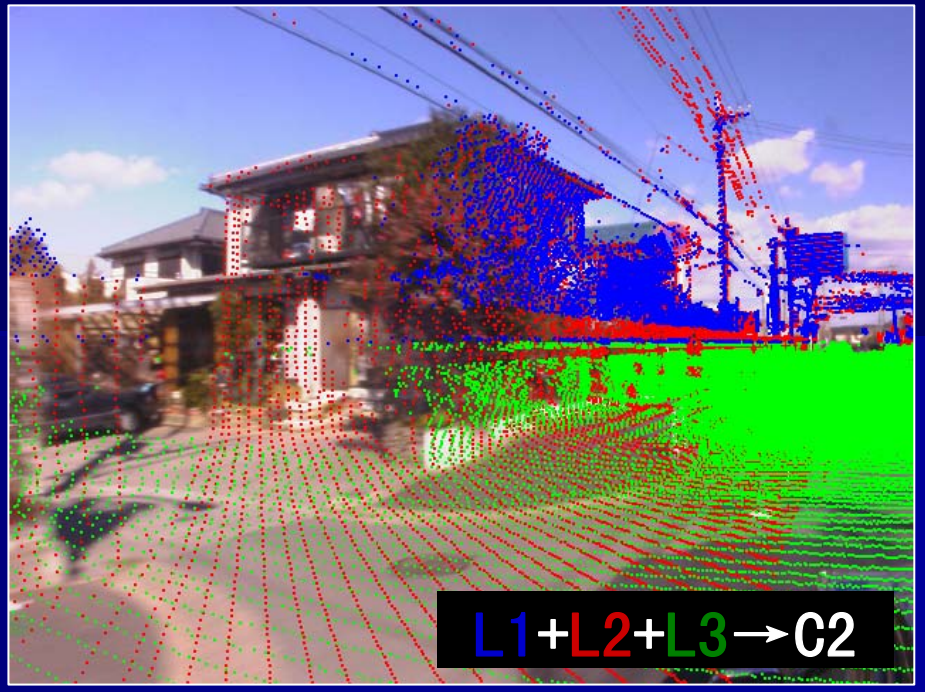
- Mazda Motor Co.

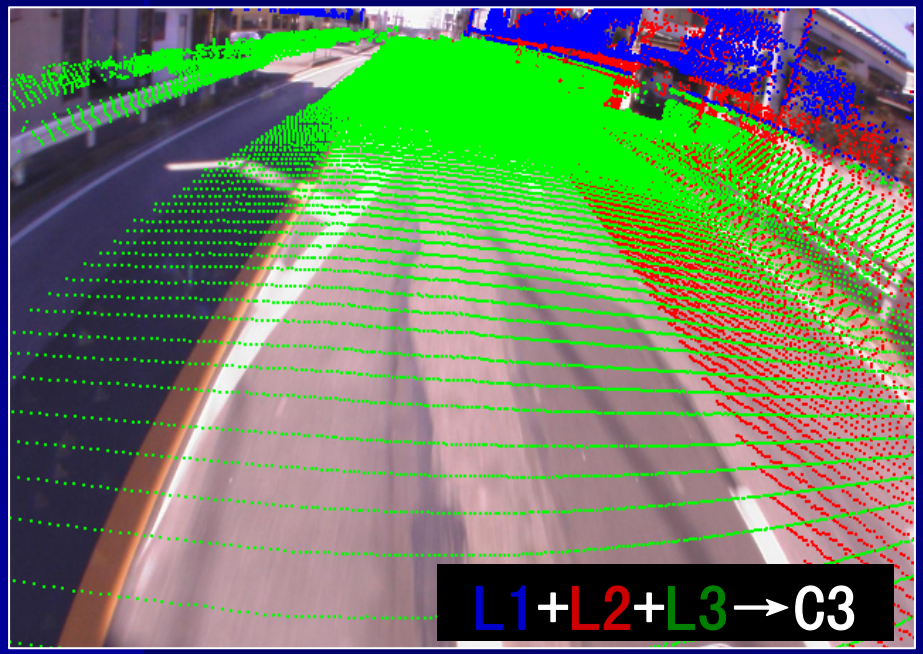
- Asia Aerial Survey Co.

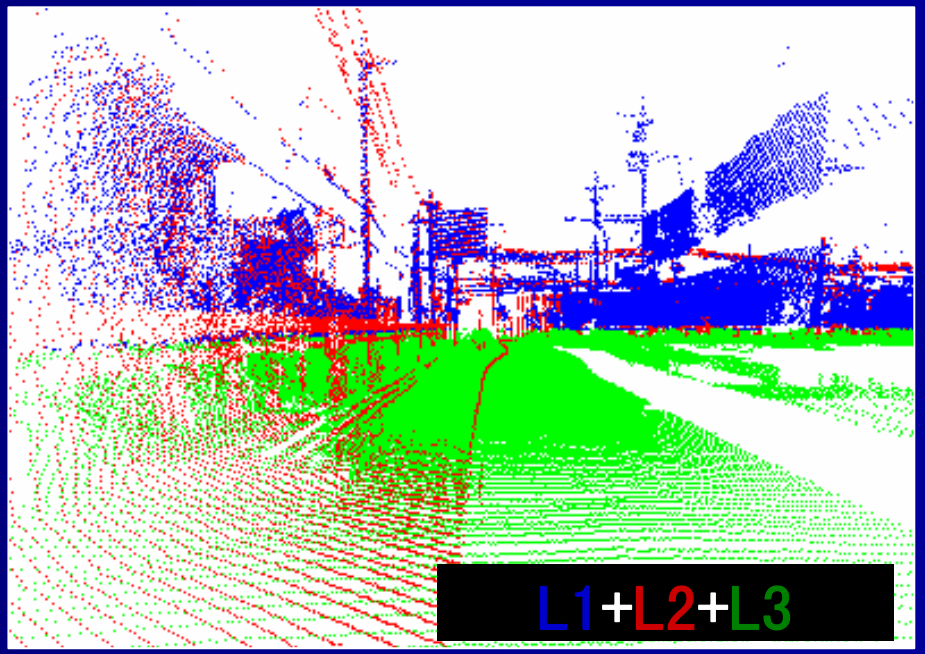
Intelligent Cart for 3D Acquisition

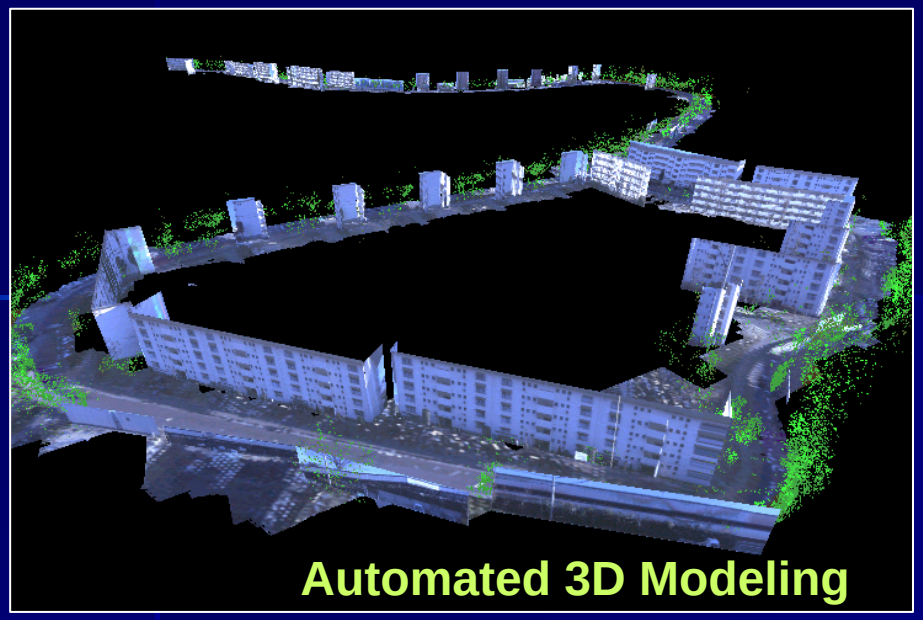



L1+L2+L3→C1

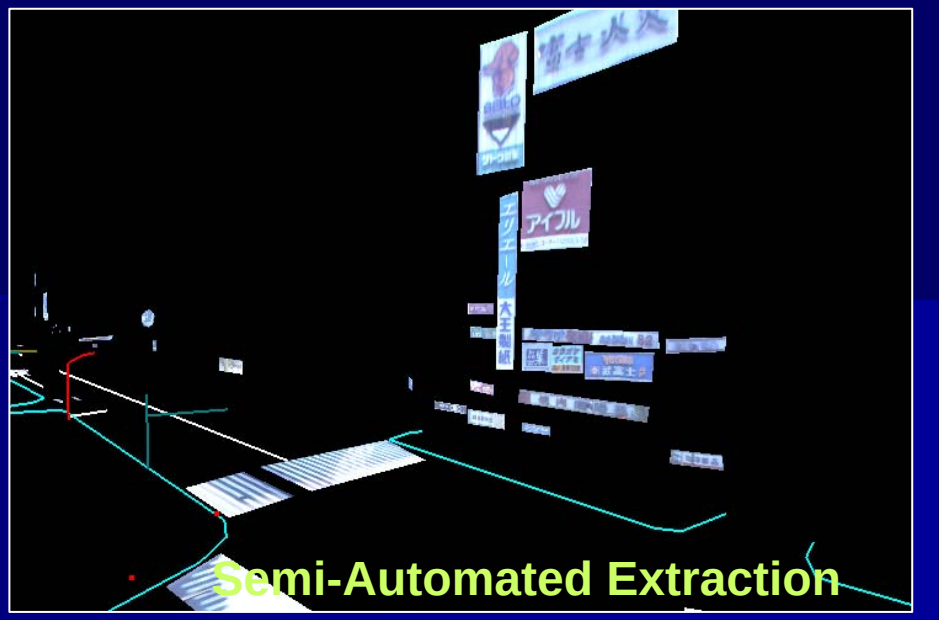

L1+L2+L3→C2


L1+L2+L3→C3

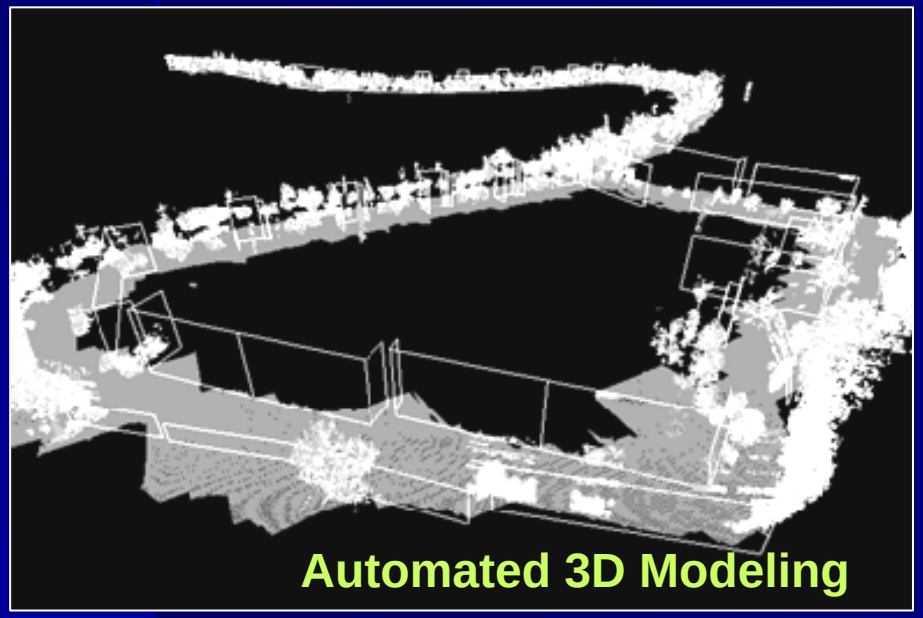

L1+L2+L3



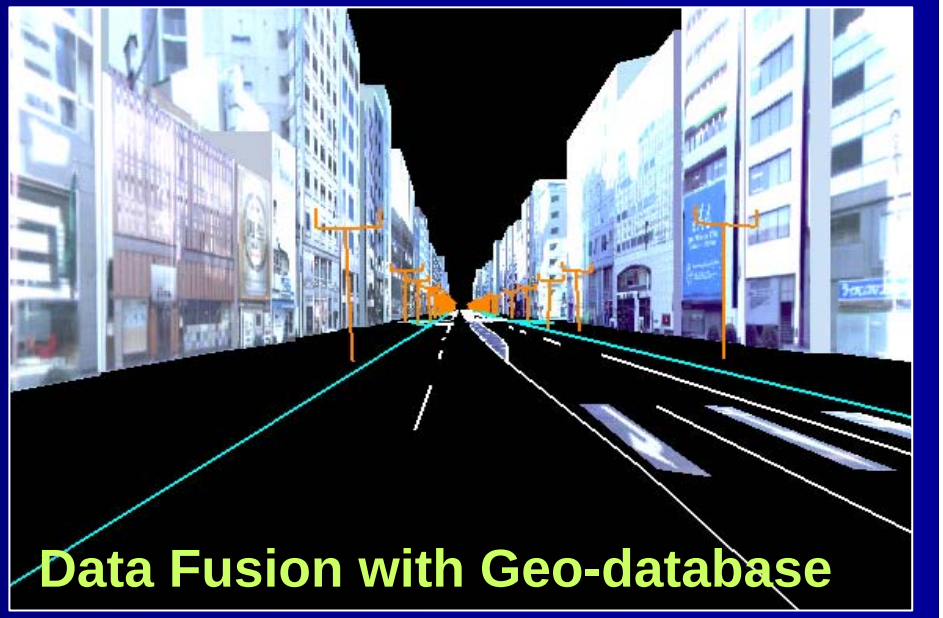
Automated 3D Modeling



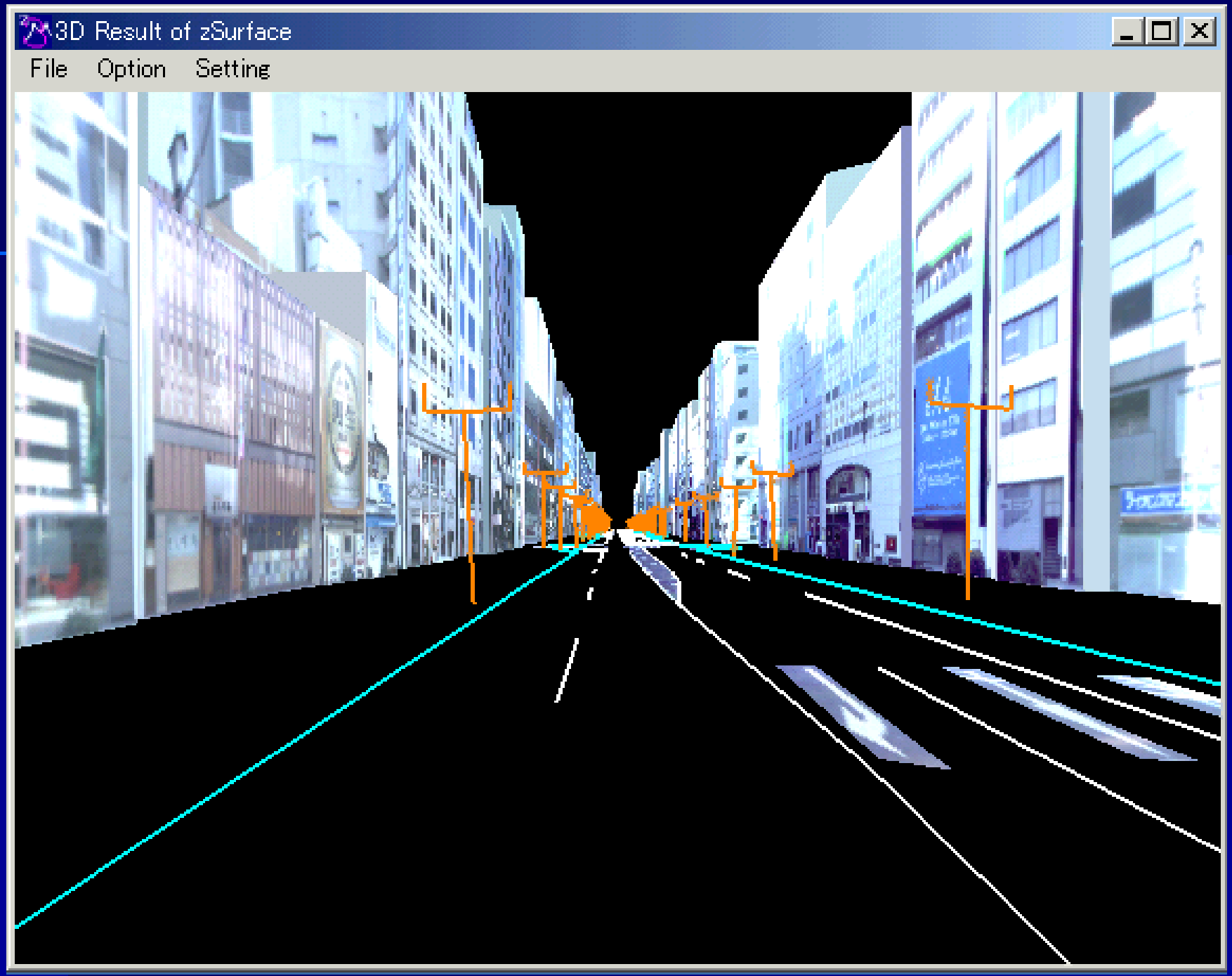
Semi-Automated Extraction



Automated 3D Modeling



Data Fusion with Geo-database


3D Result of zSurface
File
Option
Setting

Thank you !

Contact Info:

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Peking University