2021-22 Ongoing Research

▸NEWS Lab

國立臺灣大學

NEWS Lab
嵌入式系統暨無線網路實驗室

Overview

▸ Autonomous Systems

  ▸ Distributed Vehicle Decision (ADLink)

  ▸ Vehicle Lane Change Decision

  ▸ Distributed Real-Time Messaging for V2V and V2X

  ▸ Autonomous Driving Middleware (Tier IV, JP)

▸ Smart Sensors

  ▸ CIM-Friendly Deep Neural Network Inference and Training

  ▸ Low-Power Always-On 3D Sensor Using CIM and Structure Light (MediaTek)

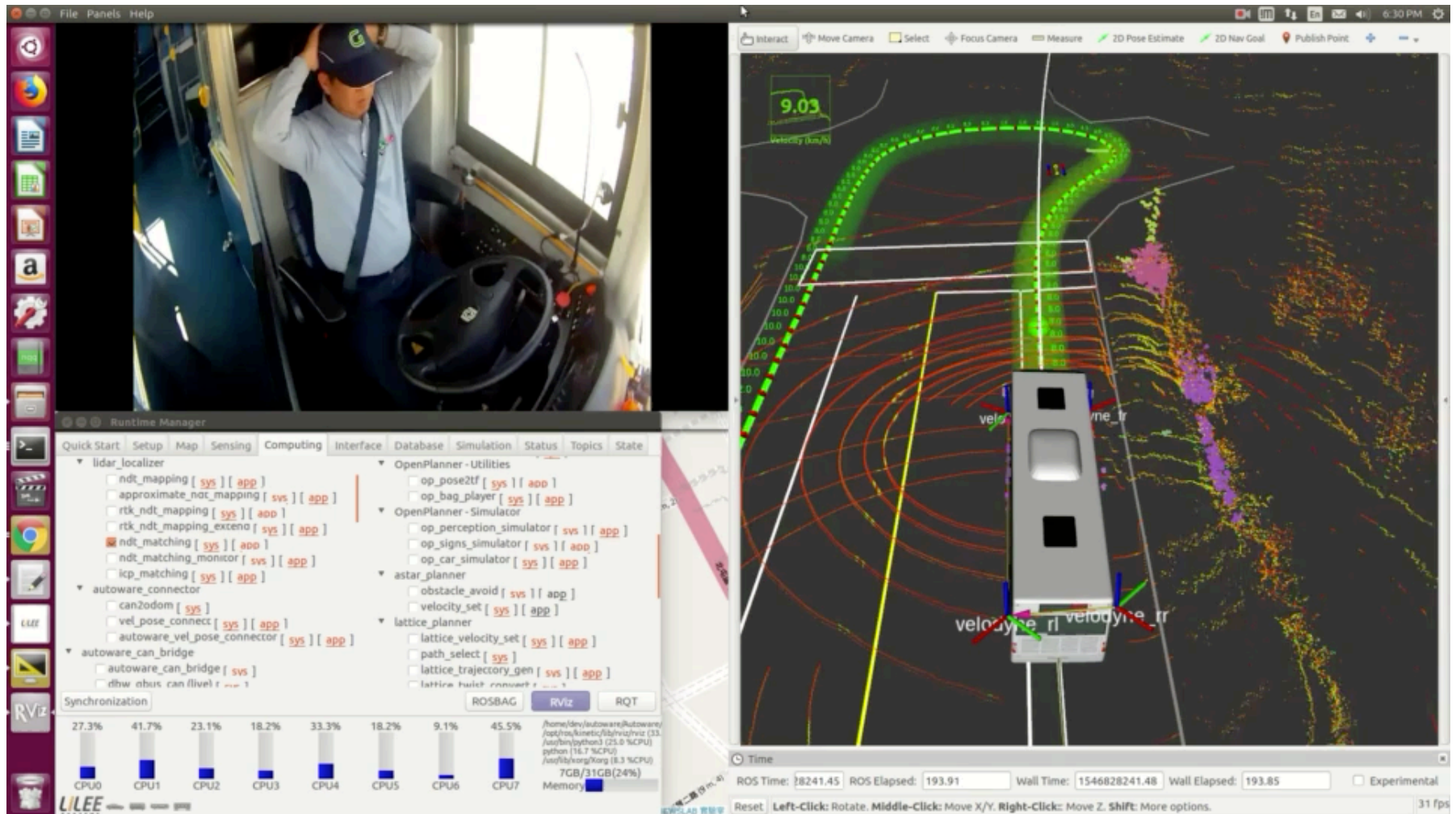 ▸ Structure Light 3D Reconstruction for Endoscope (QuanTa Computers)
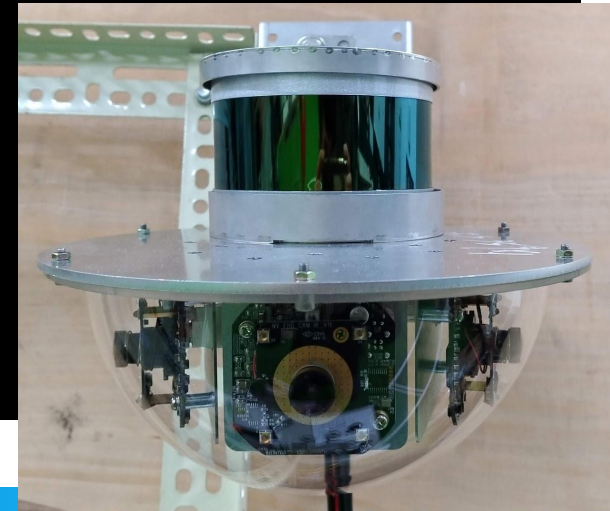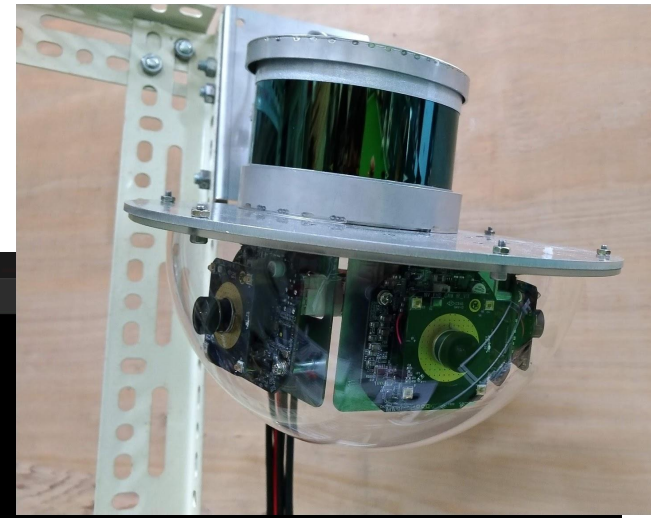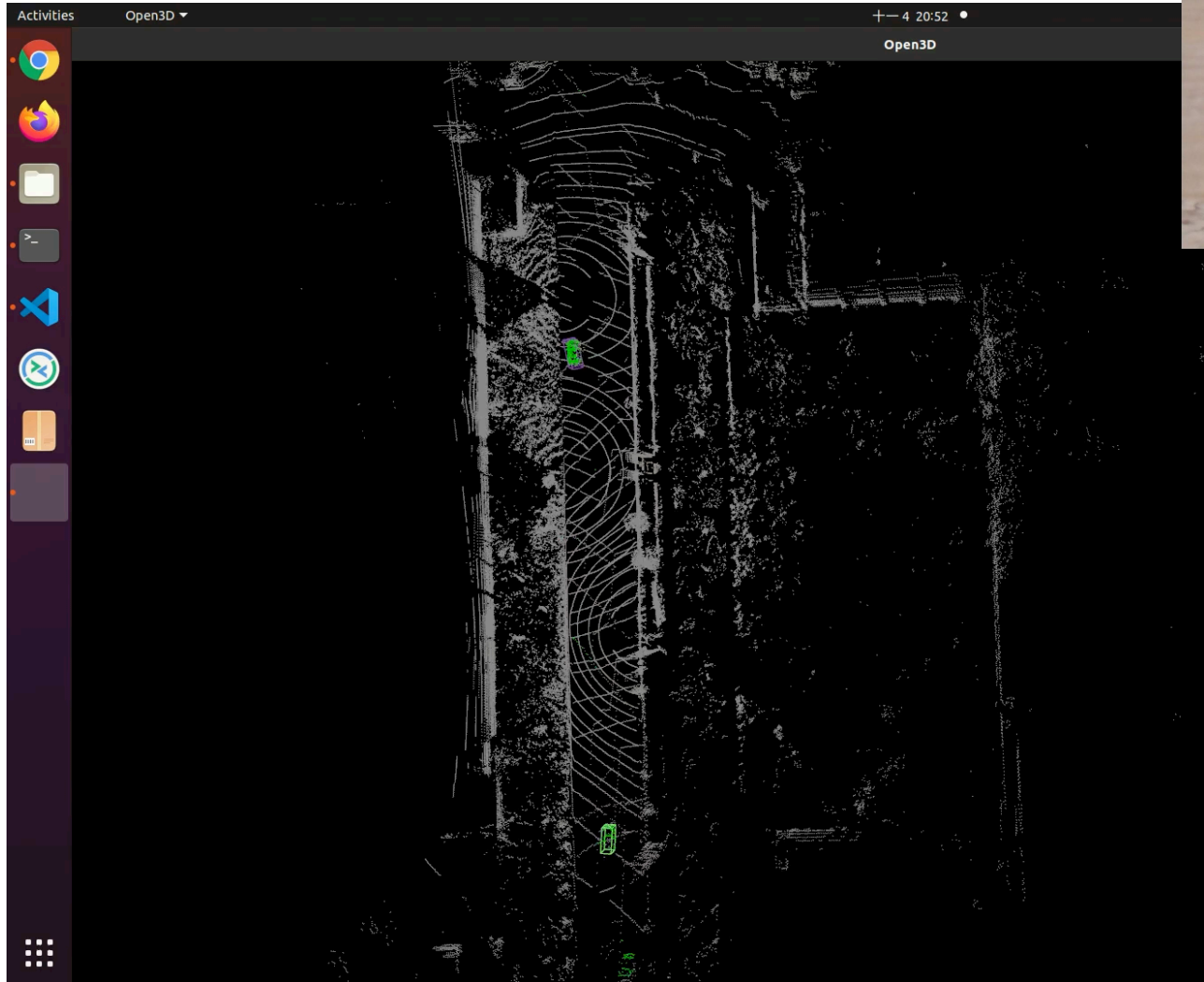
Autonomous Systems

2D SLAM for RoboCup SPL

Autonomous Bus

LiDAR-Based Tracking Sponsored by THI and NTU

Top-view Map

Obstacle Map
$\left(M_{t_{obs}} \right)$

Observed Trajectory
(X)

$$\sum_{i=1}^{n} \min_{k \in [1, K]} \| (Y_i - \hat{Y}_i^{(k)}) \|^2$$

Trajectory Generator

Predicted Trajectory
$\left(\hat{Y}^{(k)} \right)$

Predicted Trajectory

Observed Trajectory

Trajectory Discriminator

Score of Real Data

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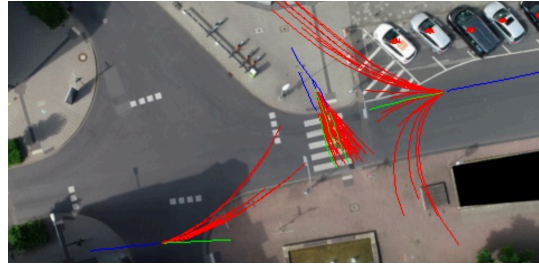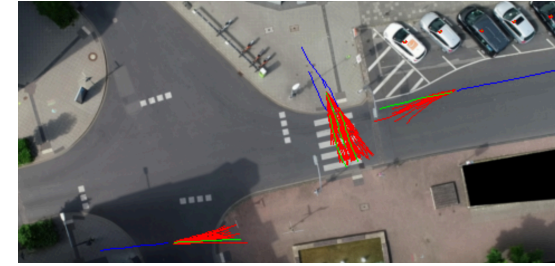
Intention Predication on Unsignalized Intersection
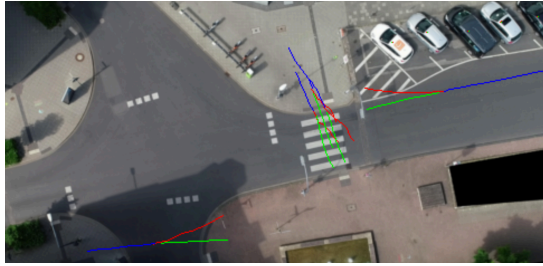
LSTM

SGAN(K=20)

SCGAN(K=20)

- The LSTM model predicts deviated predictions
- With the social pooling module, SGAN predicts the vehicle to avoid the potential crashes.

However, it does not have location information, and therefore SGAN predicts it to slow down,
or speed up and turn around to avoid the pedestrians
- SCGAN learn to predicts the only feasible vehicle trajectories to slow down
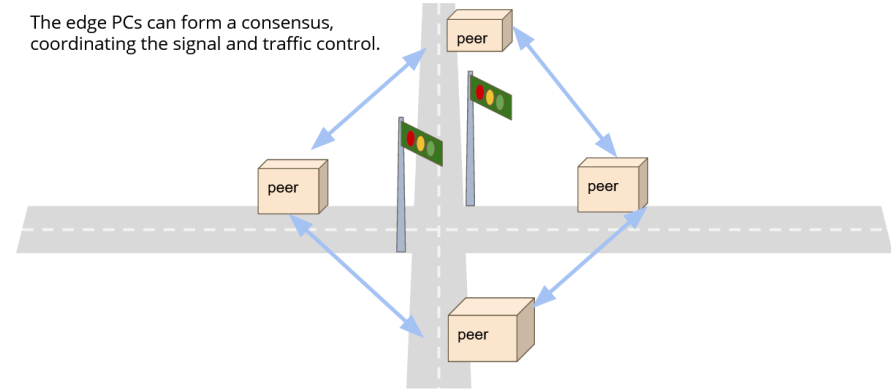
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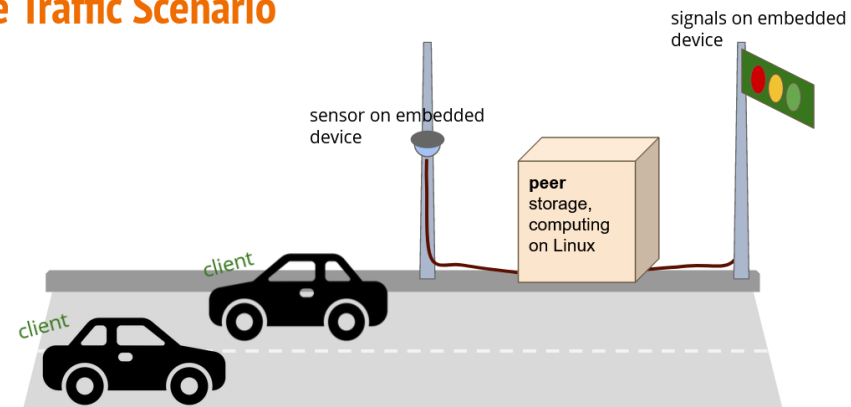# Distributed Consensus as Virtual Traffic Signals Sponsored by ADLink

- Goal: optimize the intersection use subject to safety requirements without traffic lights

- Methods:

  - Allow the vehicles to negotiate with each other and find the optimal decision to cross the intersection

  - Road Side Unit will serve as the observer, gateway and decision logger.

- Challenges:

  - The number of vehicles dynamically change.

  - The decision has hard deadline constraint.

Coordinating Roadside Devices

The edge PCs can form a consensus, coordinating the signal and traffic control.

peer

peer

peer

peer

The Traffic Scenario

signals on embedded device

sensor on embedded device

peer storage, computing on Linux

client

client

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V2X Communication
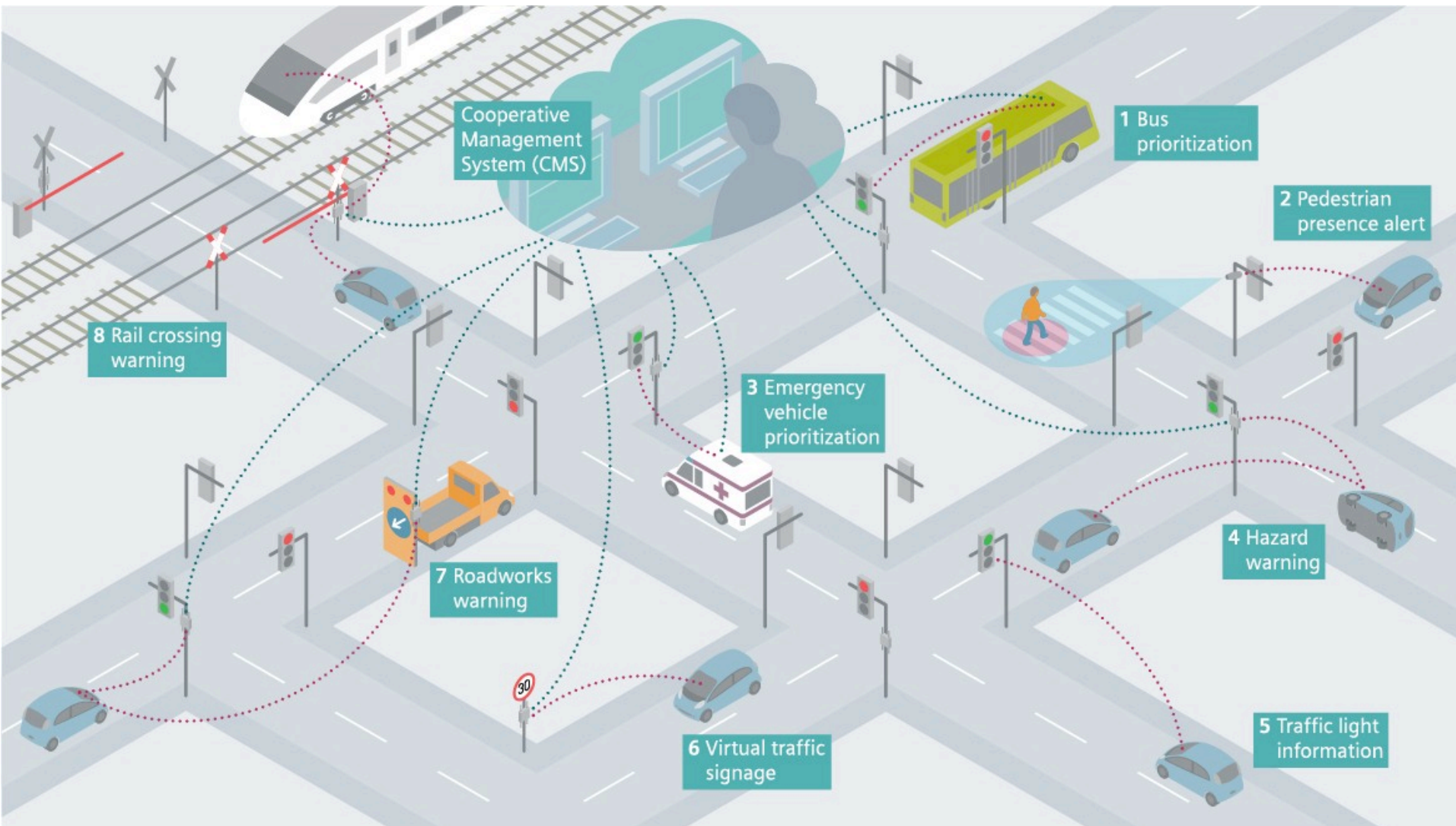
Smart Sensors:
Low-Power r Always-On Real-Time 3D Sensing

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現有成果 – 以 VCSEL (15 x 25)為光源

Resolution is 17um at 20cm
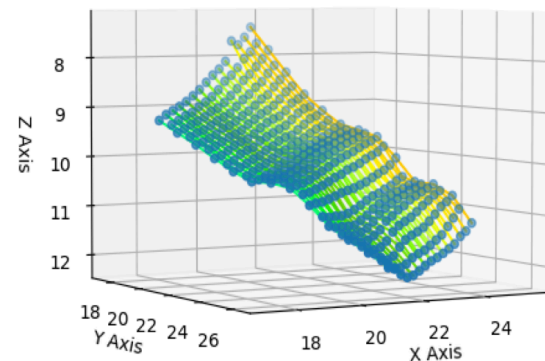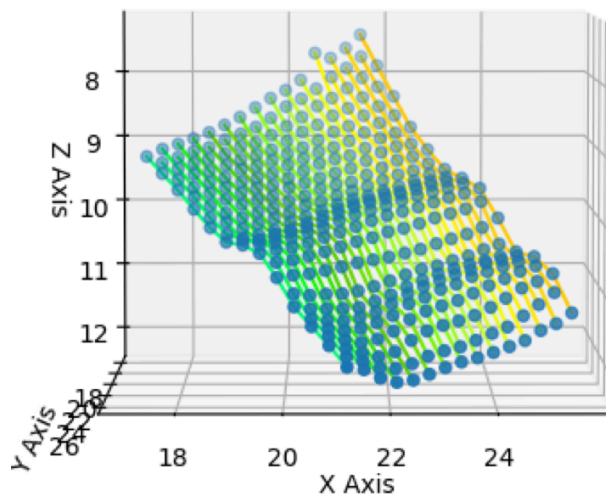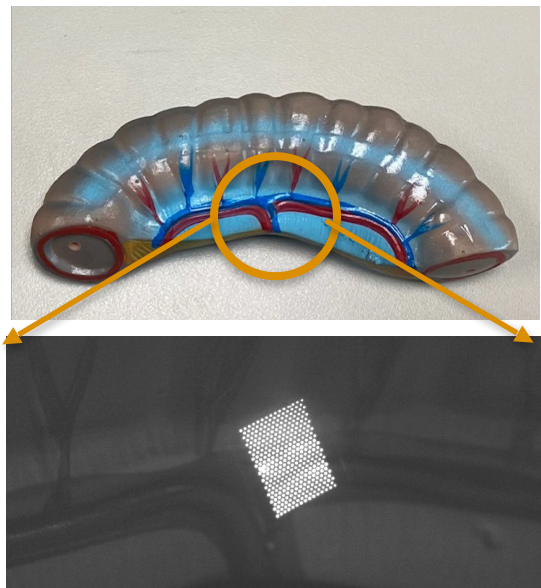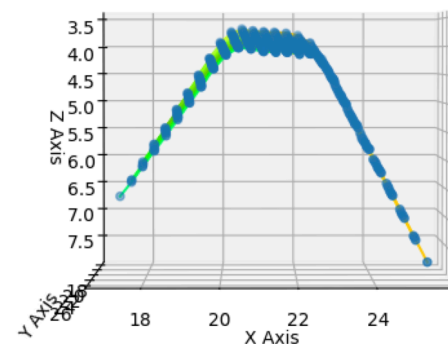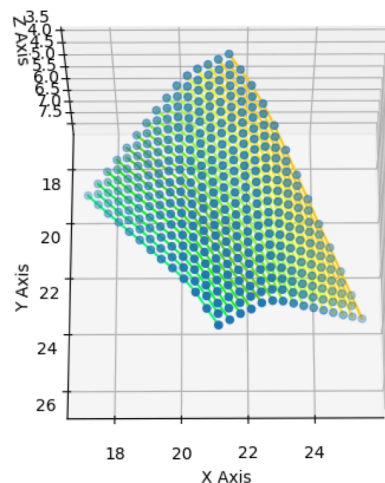
From 2D to 3D Endoscope

▸ The visualization of a 3-dimensional surgical field has the theoretical advantage to provide the surgeon with more realistic information about the anatomy of the surgical field which may be beneficial for surgical control and may even reduce complications.

▸ Current Products:

- Da Vinci XI

- Image1 S by KARL STORZ

- Olympus 3D Imaging Solutions

Traditional endoscope

Da Vinci S

Imaging All Sinus

◆ Mean × Median

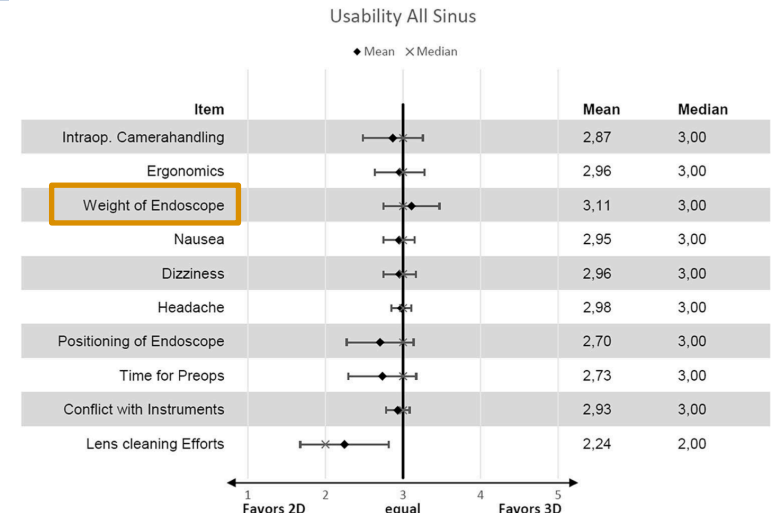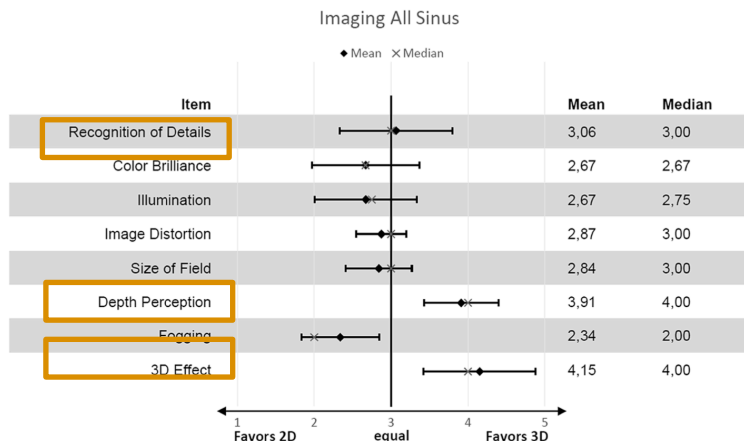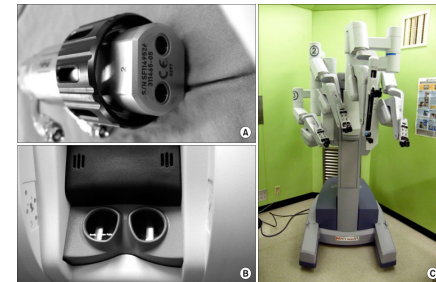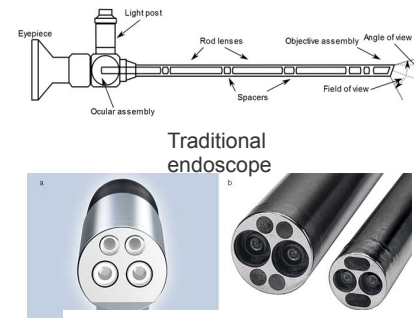| Item		Mean	Median
Recognition of Details		3,06	3,00
Color Brilliance		2,67	2,67
Illumination		2,67	2,75
Image Distortion		2,87	3,00
Size of Field		2,84	3,00
Depth Perception		3,91	4,00
Fogging		2,34	2,00
3D Effect		4,15	4,00

1 Favors 2D — 3 equal — 5 Favors 3D

Usability All Sinus

◆ Mean × Median

Item		Mean	Median
Intraop. Camerahandling		2,87	3,00
Ergonomics		2,96	3,00
Weight of Endoscope		3,11	3,00
Nausea		2,95	3,00
Dizziness		2,96	3,00
Headache		2,98	3,00
Positioning of Endoscope		2,70	3,00
Time for Preops		2,73	3,00
Conflict with Instruments		2,93	3,00
Lens cleaning Efforts		2,24	2,00

1 Favors 2D — 3 equal — 5 Favors 3D

The mean duration for surgery (per sinus) was 7.75 min (SD 4.38) for 2D and 8.06 min. (SD 5.76) for 3D without statistical significance (P = 0.334).
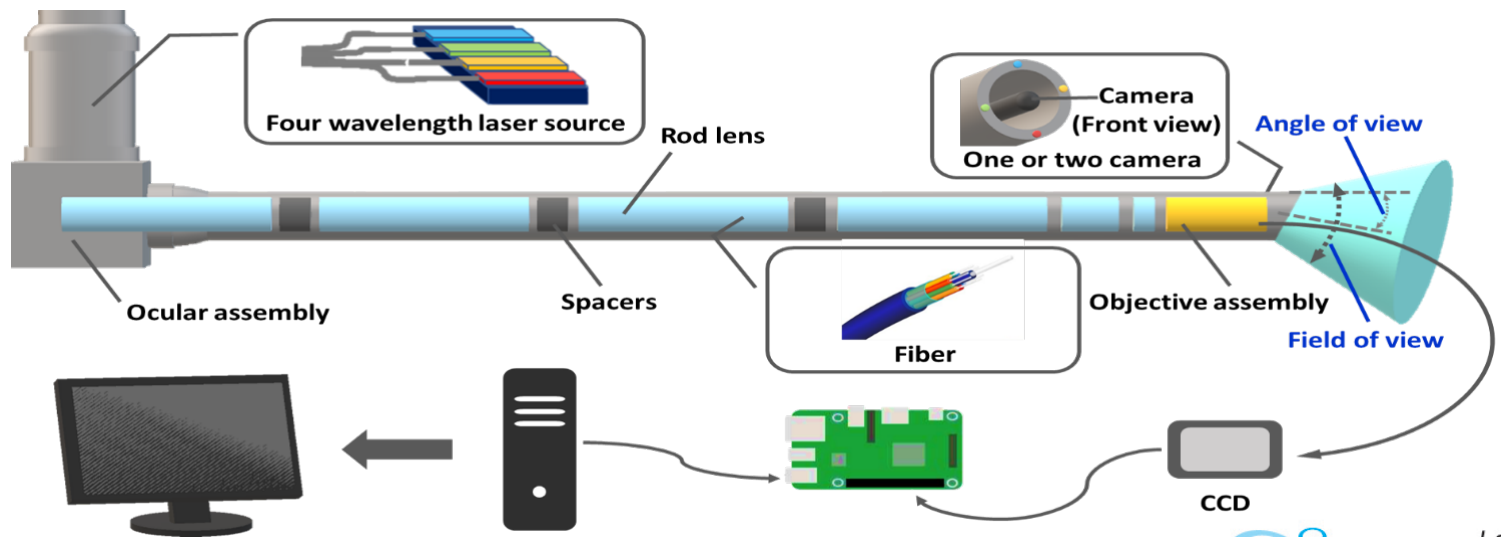
https://onlinelibrary.wiley.com/doi/10.1111/coa.13494

Proposed Design

To better fit the light sources and camera into tube of endoscopes, we propose to

    (1) use fiber to carry the light of different wavelengths and

    (2) add space mask to create structure patterns

to create structure patterns on surface. Given our current approaches, we can analyze the images to estimate the depth of the surface or create three-dimension mash of the image.

Architecture of Smart Sensors

Always-On 3D Sensor (CIM 2023 Platform)

Always-On 3D Sensor (CIM 2022 Platform)

Laser Speckle/ VCSEL

CLK Syn

Camera (CMOS)

CIM for 3D Point Cloud Reconstruction

3D Point Cloud

RGB Image + Structure Light Pattern

RGB Image

3D Image Reconstruction (on CPU/GPU)

3D Image Output

Memory for RGB

2D Image Output

2D Image Output