2021-22 Ongoing Research

NEWS Lab
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
Intention Predication on Unsignalized Intersection
Sponsored by MediaTek and MOST

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

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 learns to predict the only feasible vehicle trajectories to slow down.
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.
V2X Communication

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

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 ($P = 0.334$).

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

Camera (CMOS)

Laser Speckle/VCSEL

CLK Syn

Always-On 3D Sensor (CIM 2022 Platform)

3D Point Cloud

CIM for 3D Point Cloud Reconstruction

RGB Image + Structure Light Pattern

RGB Image

Memory for RGB

3D Image Reconstruction (on CPU/GPU)

2D Image Output

Always-On 3D Sensor (CIM 2023 Platform)

3D Image Output