Destination ACM – Demonstrating Sensors Making the Unseen Visible

By the VSI Labs Team

VSI Labs visits the American Center for Mobility (ACM) once a quarter to showcase the ADAS/AD innovations from our sponsors. This is a unique opportunity for sponsors to demonstrate their innovation to industry and media and do so in an environment that is designed to do just that.

VSI Labs has been testing and demonstrating ADAS/AD technologies for many years. Clients often hire VSI to do the integration and programming on VSI vehicles while the actual testing is done at ACM. Often, the technologies are put to test in active systems first at a proving ground before they are ready for real world trials.

On June 25 of this year VSI hosted its second open house at ACM. What made this event special was some of the newer sensor technologies being shown to the industry for the first time. This included near infrared imaging and long range lidar. Both new sensor technologies bring capabilities to ADAS, and AD applications not seen before. Essentially, NIR can illuminate a scene better than anything else when faced with challenging environmental conditions.

This demonstration was done in a way that exhibits the behavior of a near infrared camera (Bright Way Vision) and a visible camera (Leopard) near an entrance of a tunnel. Following is an image of the tunnel located at ACM which was utilized during the demonstration.

The demonstration was done in a static manner whereby the car was not moving and parked in front of the tunnel entrance while the actors and objects were placed inside the tunnel. This scenario represents a real-world challenging condition for cameras used in ADAS and AD applications.

In addition to the NIR cameras, VSI demonstrated how a front facing long range LiDAR (AEye) behaves in the same scenario.

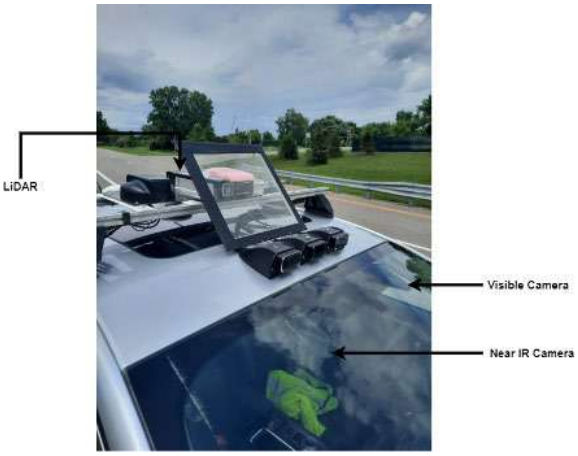
The demonstration was set up outside but the sensor feeds were streamed live to TV monitors in the indoor exhibit area where VSI staged various vehicle exhibits and sensor technologies.

Tunnel Setup at ACM

Moreover, a rain generator was placed in front of the sensors to make the scenery more challengeable. That primary purpose of this demonstration was to exhibit the behavior of the two cameras and the LiDAR in challenging rain conditions. As it turned out, we did not need the rain generator because on the day of the demonstration it was raining anyway.

Sensor Placement

The visible camera and near infrared camera were placed under the VSI research vehicle's windshield as shown in the picture below. Parallel to them, the LiDAR was placed right centered on vehicle's roof rack. One of the primary capabilities of this LiDAR is to penetrate through regular vehicle windshields. Even though, LiDAR was not installed under the windshield, all the demonstrations were carried out placing a piece of regular windshield glass in front of it.



Sensor Placement on VSI Vehicle

Target Placement

There were nine static targets all together including two soft pedestrian targets (SPT), a soft black dog, and six 8x8x8 inch cinder blocks to carry out this demonstration. The adult SPT and the child SPT were placed right next to each other. They were heated and placed inside the tunnel 110 meters from the vehicle. Then, five cinder blocks and the soft black dog were placed further inwards to the tunnel away from the SPTs at 120 meters. The remaining cinder block was positioned closer to the vehicle and out of the tunnel to exhibit it as a regular observable object on the road.

Cinder Block Placement

SPT, Dog, and Brick Placement

Apart from the mentioned targets, a rain generator was placed between the tunnel entrance and vehicle's location. The main purpose of this rain generator was to create rain showers to see how the sensors behave during such kind of a weather condition. But there were some natural rain showers since the morning of the demonstration day. So, the rain generator was not utilized during some occasions however, there were several occasions where the rain generator was been used with the natural rain to make the scenery challengeable for the sensors.

Rain Generator Setup

The two SPT's and the five cinder blocks bricks were hardly visible to the human eye, relative to the sensor placement. But the soft black dog was non-observable to human vision. For more clarification, a rough sketch of the entire setup is illustrated as follows.

Sensor Perception

Visible camera: This is an automotive Leopard HDR visible camera which has a field of view of 40 degrees. It was completely blind near the tunnel entrance and no targets were observable as shown in the image below.

Automotive HDR Camera Feedback

Near IR camera: This is a near IR camera from Bright Way Vision with a 30-degree field of view. The soft pedestrian targets and the cinder blocks which were barely visible to the

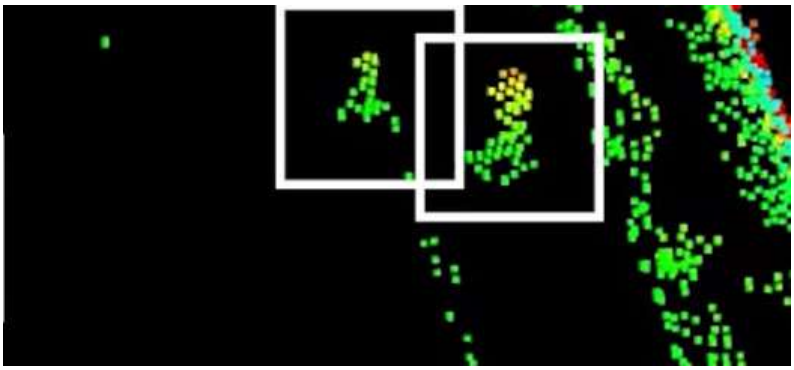
human eye and the soft black dog which was not visible can be observed clearly from this camera's feedback as shown below.

Near IR Camera Feedback

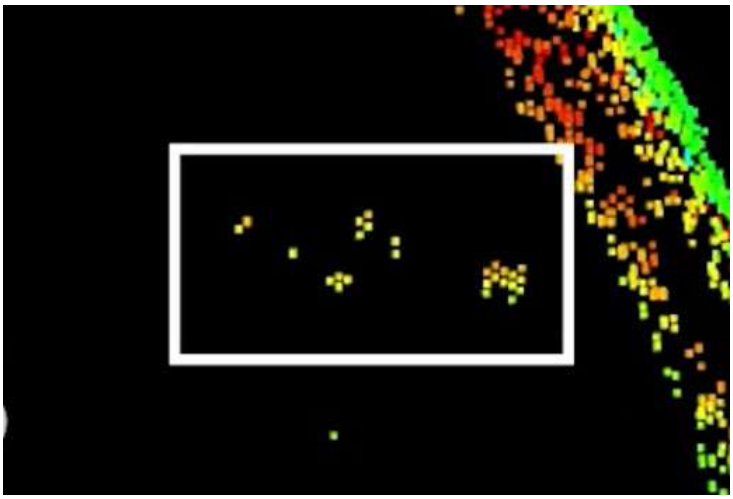
LiDAR: AEye demonstrated their 4SightM Lidar sensor, which maintains high performance even in rainy conditions. The higher power of emission available at the 1550nm wavelength allows better penetration through raindrops and other particles in the air. Furthermore, the sensor can measure up to 4 echos per laser emission and different distance and strength for each echo to aid in seeing through rain. The AEye Lidar can be configured to several different scan patterns that can be changed dynamically in real-time. The scan patterns vary in range, resolution, and framerate.

The scan pattern we used for this demo had a horizontal resolution of 0.2 degrees and vertical resolution of 0.4 degrees. Additionally, there was a 22.5 x 8-degree region of interest that covered the area where the bricks were located and more. The ROI had an increased resolution of 0.075 vertical and 0.05 horizontal. This scan pattern runs at 10hz and is included in the ADAS product Aeye is producing with Continental.

The Aeye Lidar was able to maintain several points on all targets including the cinderblocks with and without the real rain and/or artificial rain from the generator.



Adult SPT and child SPT in the tunnel with several Lidar points



Bricks and Dogs in Lidar View

Conclusion

As ADAS/AD applications continue to proliferate it is important to address the challenges faced by current sensor technologies. There is no question traditional visible cameras will continue to proliferate as these technologies can handle most of the use case presented in normal driving conditions. However, weather, and challenging lighting conditions continue to plague traditional visible sensors and over-reliance upon them inevitably leads to scenarios where their performance falls short. To address these challenging conditions automakers must continue to explore the new sensor technologies being brought to market. VSI does not condone these technologies for all applications but depending on the ODD of the application the use case may be justifiable.

About VSI Labs

Established in 2014 by Phil Magney, VSI Labs is one of the industry's top advisors on AV technologies, supporting major automotive companies and suppliers worldwide. VSI's research and lab activities have fostered a comprehensive breakdown of the AV ecosystem through hands-on development of its own automated vehicle platform. VSI also conducts functional validation of critical enablers including sensors, domain controllers, and AV software development kits. Learn more about VSI Labs at https://vsi-labs.com/.

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