October 2019

Autonomous Vehicle INTERNATIONAL

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OEM interview

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Autonomous Vehicle Technology Expo 2019 in Novi, Michigan

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Test tracks

AVI looks at some of the newest bespoke CAV testing facilities to be put into operation around the world

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Point of view

Louis Nastro, director of land and autonomous vehicle strategy at Applanix Corporation, reveals how the company tailors its AV positioning solutions to meet the exact requirements of its clients

Interview by **Helen Norman**

What does Applanix offer the AV industry?

We supply GNSS-inertial solutions for both end users and OEMs. These systems have a variety of uses, from providing accurate and repeatable reference position and orientation data, to aiding real-time localization data on board AVs. We work with OEMs and system integrators in a number of application areas to custom-tailor solutions to the use case.

Building on our core technical base, Applanix is working with several clients in various industries to provide high-precision localization as an aiding source, as well as a complete workflow, offering customers the ability to build their own georeferenced maps and localize against that reference in real time.

We have shown clients how georeferenced localization data used during AV operations can also provide critical data with a precision and frequency that was previously unattainable. For example, we have recently worked in the notoriously difficult environment of deep open pit mining. Data is constantly collected and mapped as the AV moves past obstacles like mine walls and ore piles, and this pass-to-pass data can be utilized to detect changes in the environment without having to send dedicated personnel to scan that same space. In order to make acquiring and processing this data seamless, we have developed a simple and intuitive workflow based on our POSPac software, in addition to providing the real-time data in the AV itself.

What developments is the company working on currently?

We are working on providing our AV clients bespoke solutions, which go beyond the GNSS-inertial offering. We perform a number of detailed steps before we even deploy our localization solutions. These include characterizing sensor performance, ensuring that the sensor will work with our localization software, validating items such as precise timing and calibration, etc.

Building a complete workflow that simply and reliably provides base maps for our real-time localization technology has taken time, but what is more involved is the on-site testing, validation and modification of the hardware and software to ensure it meets clients' expectations. Many of the applications we now deal with involve both indoor and outdoor use. An expensive GNSS-inertial system was previously required in order to operate indoors for long periods of time. By offering a localization solution alongside the existing system, we can open up a host of options to our clients, which meet a variety of performance needs.

What are the main challenges with AV positioning?

The biggest challenge is that each client has unique specifications compounded with different operating environments that are constantly changing. We always begin with a very rigorous process of defining technical and business requirements. We have taken a sensor agnostic approach to offering dependable localization in all environments, so our next step is thorough testing and validation of the sensor to ensure it will function as expected. In addition to sensor performance is the challenge of having to precisely position in a variety of different scenarios, often requiring very long periods of time operating without assistance from GNSS. Offering localization data as a means of position augmentation is not always enough as environments change and there may be obstructions to what sensors can view at any given moment. This is why we conduct rigorous on-site testing in order to fine-tune the hardware

"GNSS AND INERTIAL TECHNOLOGY IS ONE PART OF A LAYERED APPROACH TO NAVIGATING AN AV SUCCESSFULLY"

The Applanix sensor suite for land vehicles, including four lidars, a POS LV inertial navigation system with dual antennas and an internal computer, enables lidar-based navigation in GNSS-denied environments

POS LVX dual GNSS-inertial solution for high-accuracy positioning and orientation on autonomous ground vehicles

and software we sell to ensure it operates as expected at the client site.

How are you working to overcome these challenges?

GNSS and inertial technology is one part of a layered approach to navigating an AV successfully. The more sensors on a vehicle that provide true 360° coverage in all weather conditions, the better that sensor-fused approach can contribute to the navigation task. Providing localization data to a GNSS-inertial system, and using it correctly, can be a valuable source of aiding data, which is a critical part of our product strategy moving forward. In real time, the sensor data can be used for aiding; in near real-time and post-processing, localization data from the vehicles can be used to crowdsource maps critical for the navigation task.

In the second scenario, you would run the georeferenced point cloud or camera data through our POSPac software to align the scans from multiple vehicles. This would allow you to create and update existing maps. This entire workflow is available today. It becomes salient when autonomous vehicles move beyond testing and operating in very favorable conditions, as they are today, to operating 24/7 in adverse and constantly changing weather conditions. For example, you can start the day with a clear sky and no snow on the ground, but then a storm could cause certain lanes on the highway to be obstructed by snow banks or other obstacles. Therefore, updating the map, which is critical to navigating the vehicle, becomes a necessity.

What technologies need to advance further to improve AV positioning?

There are many companies working on providing reliable means of positioning for AVs and we currently hear the term 'sensor fusion' used to provide an over-arching means of taking individual data streams and combining them to perform localization and perception. The only way this can truly be achieved and deployed comprehensively is to have sensors such as lidar and cameras working in all environments and available at an acceptable price-point. There are many technological hurdles to overcome before this becomes a reality. This is why we see many AV companies deploying test programs in geographic areas with consistently mild weather. Heavy rain, snow and fog present obvious challenges to many sensor applications, but there has been some interesting research done on using radar, UWB and infrared mapping of streets in concert with GNSS-inertial technology to overcome the issues posed by adverse weather.

Can you tell us about any projects you have worked on with regards to AV positioning?

We recently returned from a deployment where the client wished to automate vehicles for use in ports and harbors. This is a challenging environment where the surroundings are constantly changing and the availability of RTK GNSS can be unreliable at times. Using our solution, we demonstrated highly accurate and repeatable positioning. This was similar to a challenge another client faced in a stone quarry where large pieces of equipment were being automated to bring raw materials from outside indoors for processing, while maintaining very high levels of positioning without GNSS. Having GNSS-inertial along with lidar-based localization presented redundant sources of positioning, which allowed the client to have confidence in the integrity of the measurements and a seamless transition between environments. ❮

"THERE HAS BEEN SOME INTERESTING RESEARCH DONE ON USING RADAR, UWB AND INFRARED MAPPING OF STREETS IN CONCERT WITH GNSS-INERTIAL TECHNOLOGY TO OVERCOME THE ISSUES POSED BY ADVERSE WEATHER"

For its mining application Applanix used two lidars for navigation, with the foremost lidar being used for detailed mapping of tunnels