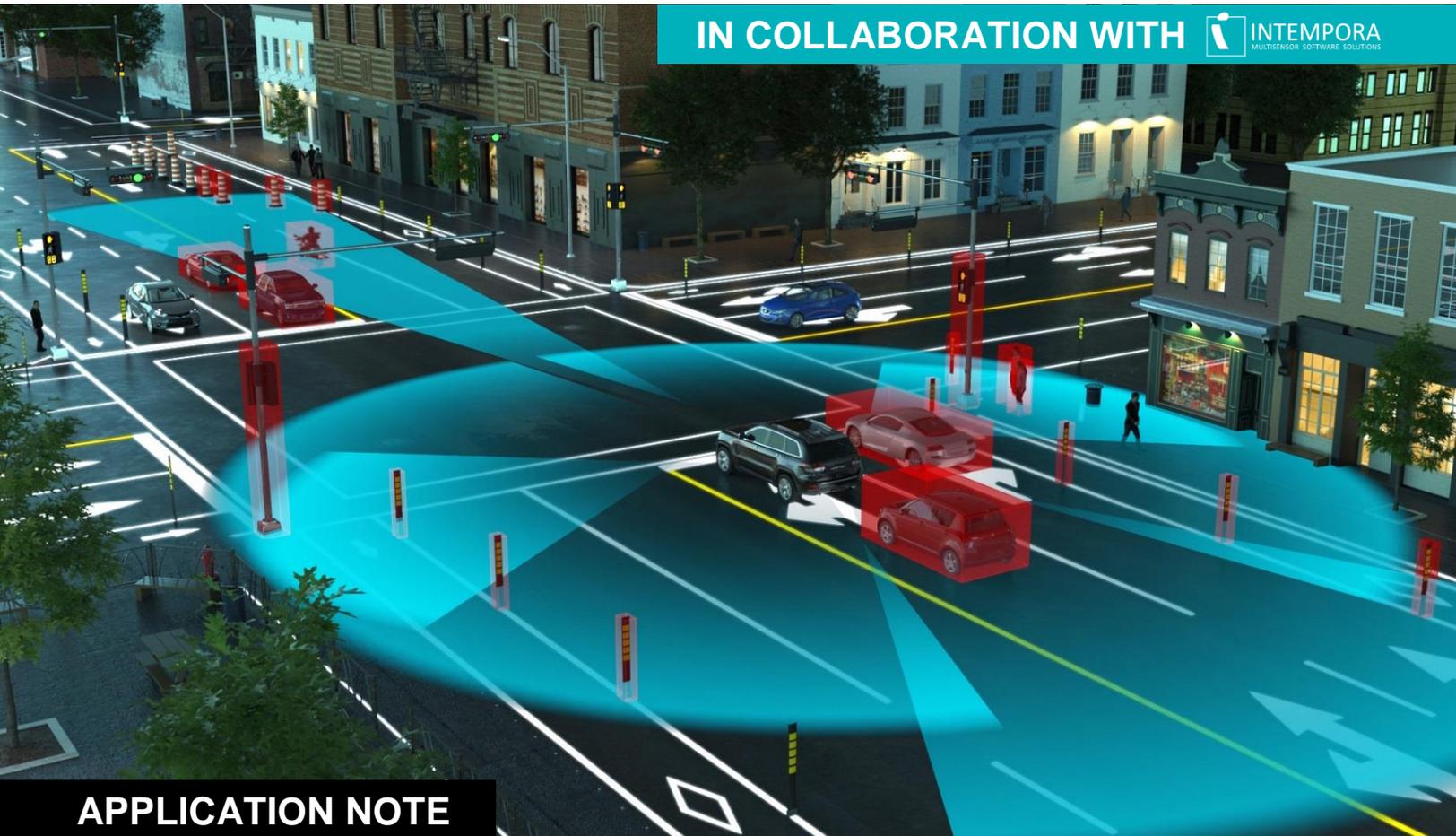


UNLEASH THE POWER OF LEDDARTECH'S SOLID-STATE SCANNING LIDARS WITH INTEMPORA RTMAPS

IN COLLABORATION WITH



APPLICATION NOTE

ABSTRACT

Over the past decade, the LiDAR technology has become a highly accessible solution to enable obstacle detection, avoidance, and safe navigation through various environments in an assortment of vehicles. These vehicles, equipped not only with LiDAR sensors but also with several other technologies such as vision, radar and ultrasound sensors, will have a substantial impact on ADAS and AD systems and how such complex systems interact with our environment in cities and on roadways.

To accelerate the development of multi-sensor platforms, France-based company Intempora has developed RTMaps since 2001, a robust and easy-to-use framework used by the industry to solve inherent challenges to data acquisition, such as recording, synchronizing, and playing

back data from several sensors and communication buses, and also the prototyping, testing, and benchmarking of perception and data fusion algorithms.

This Application Note provides an overview of which functionalities are currently available in LeeddarTech's package for RTMaps. Also, it shows how Intempora's framework enables the power of the LeeddarTech solid-state scanning LiDARs through three simple diagrams to make what was previously considered as complex applications.

RTMAPS IN A NUTSHELL

RTMaps is a complete data acquisition platform that supports the most popular hardware used by the industry. Component inputs and outputs are linked and chained together to perform complex tasks into a diagram where sub-systems can be abstracted as macro-component.

LEDDARTECH'S® PACKAGE FOR RTMAPS

LeddarTech is providing a complete and easy-to-use package for RTMaps that is compatible with all its sensors, in various configurations:

- **LeddarOne** (*MODBUS*);
- **LeddarVu8** (*USB, SPI and MODBUS*);
- **M16/IS16/EvalKit** (*USB and MODBUS*);
- **LCA2 or LCA3-based Evaluation Kit** (*TPC/IP*).

This package contains six components that provide different functionality, as described below. It is available through Intempora's integrated distribution platform.

LEDDARTECH SENSOR

The main component is the *LeddarTech Sensor*, as it allows the user to connect to LeddarTech's sensor. The user can also list devices connected to the computer by toggling the eponym checkbox. When using the MODBUS protocol, up to three Vu8 modules can be connected on the same COM port.

LEDDARTECH FILTER

The *LeddarTech Filter* component allows to filter the detections based on distances, amplitudes, segments in a given range, or using a flag. When a detection meets the filter condition(s), its distance, amplitude, segment and flag information is outputted. For instance, the user could set a region of interest (ROI) using the "Segment" filter, or to apply specific processing algorithms on detections issued from the demerging option than the ones on valid detections, thanks to the "Flag" filter.

TIP

Cascade the *LeddarTech Filter* components to add more than one filter.

LEDDARTECH SENSOR TO REAL OBJECTS

The *LeddarTech Sensor to Real Objects* component converts the distances, amplitudes, and segments to a Real Object. In RTMaps, a Real Object represents a 3D object in real-world coordinates (x, y, z, dimensions, object type, color, etc.). This component is useful to display the detections in a 3D Viewer or to input into further processing components, among other benefits.

LEDDARTECH SENSOR TO IMAGE

The *LeddarTech Sensor to Image* component allows the user to generate an image from the inputted data.

TIP

A component *Projection2* (included in the build-in package *RTMaps 3D*) can be used to transform the detections into 2D coordinates.

LEDDARTECH TEXT OVERLAY

The *LeddarTech Text Overlay* component is used to add some text next to the bounding box. Read the [Application #2: Overlaid Information](#) to learn more about this useful component.

TIP

By default, the *LeddarTech Text Overlay* component uses the color provided by the bounding box. Use the *LeddarTech 3D Colorizer* to dynamically change the text's color based on the distance at which the detection occurs.

LEDDARTECH 3D COLORIZER

The *LeddarTech 3D Colorizer* component applies a colormap on the input based on the minimal and maximal distance specified by the user.



Want LeddarTech's D-Tec sensor in RTMaps? Use the [LeddarTech SDK2](#) package instead, also available through Intempora's integrated distribution platform.

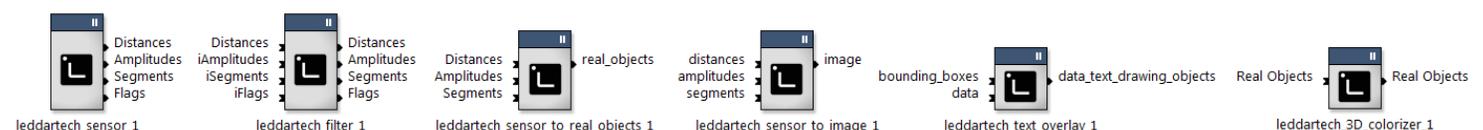


Figure 1 The six components included in LeddarTech's package for RTMaps.

THE POWER OF LEDDARTECH'S® SOLID-STATE SCANNING LIDARS: ENABLED

APPLICATION #1: REAL DATA DISPLAYED IN 3D

In this first application, data from a LeddarTech sensor is output in a 3D viewer.

The *LeddarTech Sensor* component manages the retrieval of the data from the sensor used and input in the component *LeddarTech Sensor to Real Objects* the distances, amplitudes, and segments. The resolution of the sensor must be specified along with the horizontal field of view and vertical field of view in order to have the proper pixels aspect.

For demonstration purposes, a *LeddarTech 3D Colorizer* is added to ease the detection visualization. Finally, the colorized Real Objects are inputted to the 3D Viewer.

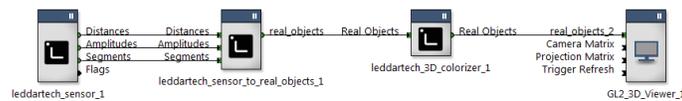


Figure 2 The RTMaps diagram used for Application #1.

If the connection to the sensor is not working, make sure that the appropriate parameters are in the *LeddarTech Sensor* component.

TIP

Parameters can be validated using LeddarTech's proprietary software for sensor configuration and data visualisation, LeddarConfigurator, which can be downloaded at <https://leddartech.com>.

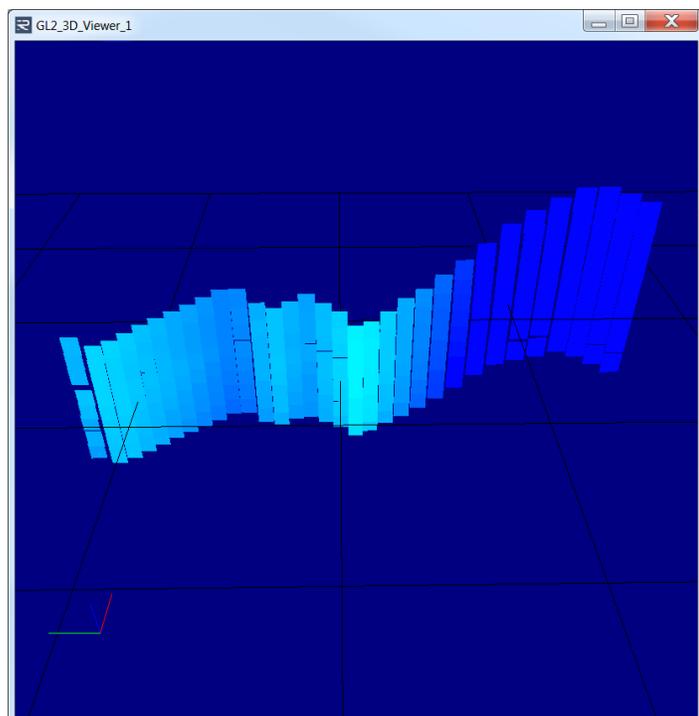


Figure 4 The result of Application #1.

APPLICATION #2: OVERLAID INFORMATION

In this second application, data from a LeddarTech M16 sensor is output in 2D, and the distance at which the detection occurs for the given pixel is also displayed along with the detection itself.

The *Still Image File Player* from the built-in package *RTMaps Image Files Codec* handles the black image onto which the detections will be displayed.

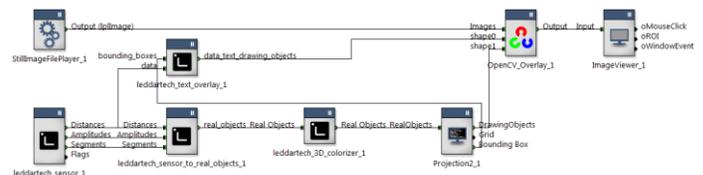


Figure 4 The RTMaps diagram used for Application #2.

As in **Application #1: Real Data Displayed in 3D**, the *LeddarTech Sensor* component provides the detections required to convert the distances, amplitudes, and segments into Real Objects.

Once colorized, the data is inputted in the *Projection2* component (from the build-in package *RTMaps 3D*). OpenGL-like calibration parameters must be filled along with the horizontal and vertical resolution, according to the chosen still image to be played. The "Output Bounding Box" option needs to be checked.

The *LeddarTech Text Overlay* component requires two inputs: the bounding boxes from *Projection2* and the data to display. It is possible to use any of distances, amplitudes, segments or flags from the *LeddarTech Sensor*.

The *OpenCV Overlay* component from the *RTMaps Image Processing OpenCV* package overlays the still image with the Drawing Objects from *LeddarTech Text Overlay* and from *Projection2*.

Finally, the resulting image is shown using an *Image Viewer* component.

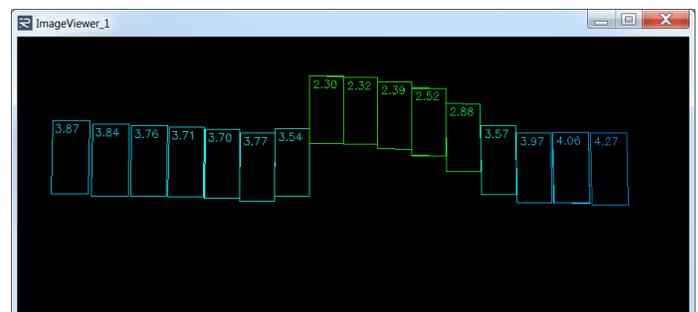


Figure 5 The result of Application #2.

APPLICATION #3: LIDAR DATA FUSION WITH A CAMERA

In this last application, the RGB pixels from a camera are projected on colored detections from a LeddarTech® sensor data.

This camera-LiDAR data fusion is not state-of-the-art but is very helpful for fast prototyping and testing. Nevertheless, the *OpenCV Calibration* component is used to correct the spherical aberrations of the camera lens. It will also provide the intrinsic and extrinsic calibration. To first generate these files, use the mode “Run calibration procedures, save calibration files and undistort” with a printed chessboard of your choice. Secondly, change the mode to “Load calibration files and undistort” to inject the calibrated image in the RTMaps diagram.

TIP

In order to keep this application simple, the camera is placed on top of the LeddarTech sensor, so the projection is straightforward to input in the eponym component. In *Projection2* component, change the parameter “Projection matrix entry method” to “3x4 matrix input” to input the extrinsic calibration file of the camera.

As in **Application #2: Overlaid Information**, the *LeddarTech Sensor* component provides the colored detections that are projected in a 2D pixel-coordinates system by the *Projection2* component.

LeddarTech’s sensors can provide multi-echo within the same pixel, hence a *LeddarTech Filter* component only keeps the closest detection (within a pixel) and those from the demerging process are discarded.

INFORMATION

The RTMaps component *Projection2* from the *RTMaps 3D* package can transform a 3D object (a Real Object) in world-coordinates into a 2D object in pixel coordinates (Drawing Object, in RTMaps) in order to overlay such a 3D object onto an image. This image typically comes from a camera stream, hence requiring the user to know the sensors calibration information, commonly as a projection matrix.

The output of the *Projection2* component is used for overlaying in *OpenCV Overlay* with the camera image, where the color of the inputted bounding box is overridden and filled with black.

An *OpenCV Logical* component performs a XOR operation between the camera image and the overlay of the black detections with the camera. The result of this operation is the LiDAR detections overlaid with the camera pixels, on a black background.

Finally, the last step is to add the colored bounding boxes. To do so, the bounding boxes from the *Projection2* component and the output of the *OpenCV Logical* are overlaid to produce the expected result.

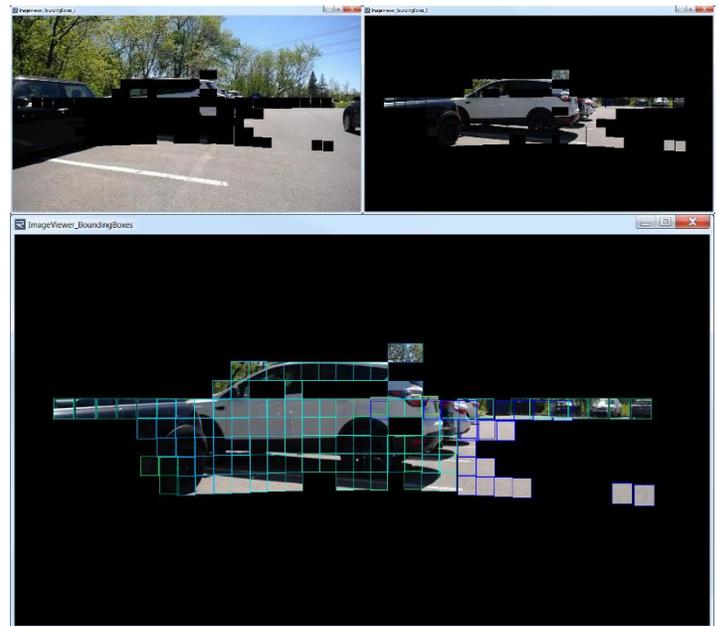


Figure 7 Top Left: The output of the overlaid camera pixels and the LiDAR bounding boxes. Top Right: output of the logical XOR between the camera image and the overlay of the black detections with the camera. Bottom: result of Application #3.

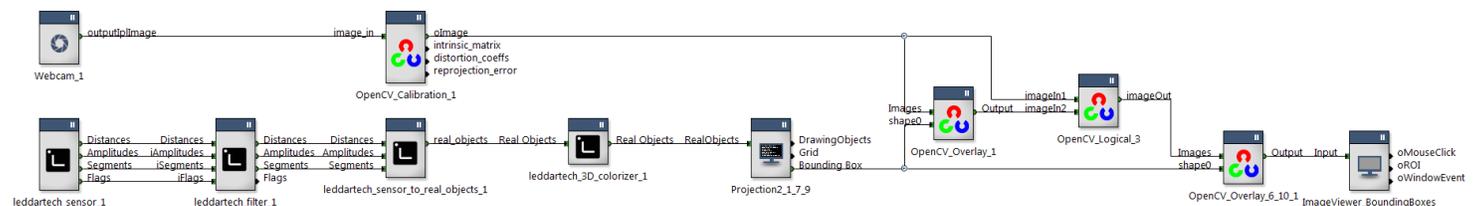


Figure 6 The RTMaps diagram used for Application #3.

FUTURE OUTLOOK

The collaboration between LeddarTech and Intempora enables real-time applications for the mobility industry, such as autonomous shuttles. These applications will shorten the deployment roadmap for integrators and provide the framework to drive value to the overall architecture of autonomous driving.



Leddar® ECOSYSTEM

The Leddar® Ecosystem is comprised of a select group of world-class suppliers that support customers development with the LeddarEngine™ by providing components, such as emitters, receivers, micromirrors, microprocessors and software-development tools. These suppliers are prequalified for integration with LeddarCore® SoCs to ensure maximum design agility and reduced technical risks. The ecosystem provides customers with a faster, safer path to high-volume commercial deployments.



About LeddarTech

LeddarTech is the industry leader behind the most versatile, scalable auto and mobility LiDAR platform based on the unique LeddarEngine. The company is responsible for several innovations in cutting-edge mobility remote-sensing applications, its patented technologies enhancing ADAS/AD capabilities for automobiles, trucks, buses, delivery vehicles, robotaxis and shuttles.



LeddarTech Head Office

4535 Wilfrid-Hamel Blvd., Suite 240
Quebec City (QC), G1P 2J7
Canada

Phone: 1-418-653-9000
Toll Free: 1-855-865-9900
Fax: 1-418-653-9099

leddartech.com

CANADA

Quebec City
Montreal
Toronto

USA

Detroit
Austin

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