

NVIDIA DRIVEWORKS

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1.2.400 Release Notes

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NVIDIA CONFIDENTIAL NVIDIA DRIVEWORKS

ABOUT THIS RELEASE

These release notes are for NVIDIA® DriveWorks 1.2.400.

1.1 HARDWARE INFORMATION

This release supports a specific host system and platform.

Recommended Host System

PC (x86 architecture) with a NVIDIA GPU (NVIDIA Maxwell[™] based GPU minimum, NVIDIA Pascal[™] based GPU)

NVIDIA DRIVE Platforms

This release supports these NVIDIA DRIVE[™] platforms:

► NVIDIA DRIVE PX 2

For details about these platforms, see the NVIDIA DRIVE 5.0 Linux Release Notes.

1.2 TOP ISSUES FIXED SINCE LAST RELEASE

- Sensor Indexer for Virtual RADAR test is failing with message "RadarVirtual: Out queue full, dropping packets." [200419281]
- Camera self-calibration is not working with lanes method. [200421239]

1.3 WHAT'S NEW

Recording tools

- Basic recording tool
- TextUI Recording tool
- GUI Recording tool

1.4 CONTENTS OF THIS RELEASE

This release includes:

- Installation README
- DriveWorks dynamic library and headers
- ► <u>Samples</u>
- Data for the samples
- ► <u>Tools</u>
- DNNs
 - DriveNet
 - LaneNet
 - OpenRoadNet
- DriveWorks References (documentation in HTML format), which covers:
 - Getting Started
 - DriveWorks Development Guide
 - DriveWorks API
 - Samples
 - Tools
 - Tutorials

1.5 SOFTWARE DEPENDENCIES

This release depends on the following software versions. NVIDIA SDK Manager installs these dependencies.

- ▶ NVIDIA DRIVE 5.0 Linux 5.0.10.3 for NVIDIA DRIVETM PX 2.
- Ubuntu Linux 16.04 (AMD64 distribution)
- CMake version 3.5
- ▶ gcc version version 4.8-4.9, which is used for cross-compilation on x86
- ► NVIDIA CUDA[®] version 9.2.78
- ▶ NVIDIA TensorRT[™] version 4.0.3
- CuDNN 7.x
- NVIDIA graphics driver version 396 is the suggested driver for X86 platforms.

DriveWorks also has the following dependency:

For access to the features in this release, you must upgrade to the latest NVIDIA DRIVE 5.0 PDK firmware. See the NVIDIA DRIVE 5.0 Linux Release Notes for the required firmware.

1.6 SAMPLES AND TOOLS

This section lists samples and tools included in this and earlier releases.

1.6.1 Samples

This release includes samples that demonstrate how to use the DriveWorks APIs. The following samples can run on the target platform or on the Linux host system.

Camera Sensor Samples

- ► USB Camera Capture
- GMSL Camera Capture
- Raw GMSL Camera Capture
- Multiple GMSL Camera Capture
- Video Replay
- Camera Seek

Other Sensor Samples

- Sensor Enumeration
- CAN Message Interpreter Based on DBC File
- CAN Bus Message Logger
- ► GPS Location Logger
- IMU Logger
- Lidar Point Clouds
- Lidar Accumulator
- Radar Point Clouds
- Simple Sensor Recording

Utility/Helper Sample

- Rendering Sample
- Rendering Engine Sample

Image, Color, and Rectification Processing Samples

- Camera Color Correction
- Image Capture
- Image Streamer Cross-Process
- Image Streamer Multi-Thread
- Image Streamer: Simple

- Video Rectification
- Software ISP (integrated into Raw GMSL Camera Capture)
- Stereo Disparity
- Stereo Rectifier

Vehicle Configuration and Motion Samples

- Dataspeed Bridge
- Egomotion
- Rig Configuration
- Iterative Closest Points
- VehicleIO
- Camera Calibration
- IMU Calibration
- Lidar Calibration

Occupancy Grid/Mapping Sample

Occupancy Grid Mapping

Vision Processing Samples

- Camera Tracker
- Camera Scaling Tracker
- Structure from Motion
- Camera Blindness Detection

Deep Neural Network (DNN) Detection Samples

- Basic Object Detector
- Basic Object Tracker
- DriveNet
- DriveNetNCameras
- Free Space Detection (OpenRoadNet)
- Lane Detection (LaneNet)

HD Map Samples

- ► HD Maps Access
- ► HD Maps Map-Tracker

Planning and Control Samples

► HD Maps Lane-Planner

Communication Samples

Socket Inter-Process Communication

Other Samples

► Hello World

1.6.2 Tools

This release includes the following tools. With the exceptions noted below, these tools can be used only on host Linux (x86) systems:

- Camera Calibration
 - Graph Calibration
 - Calibrated Graph to Rig
 - Intrinsics Constraints
 - Intrinsics Validator
- IMU Calibration
- ► LRAW Conversion Tool: RAW Output
- LRAW Preview Extraction Tool
- Recording Tools
 - Basic Recording tool
 - GUI Recording tool (Recorder-qtgui)
 - Text-UI Recording tool (Recorder-tui)
- Post-Recording Tools
 - Postrecord Checker
 - Recording Chopping Tool
- Video Exporter
- Data-Mapping Tools
 - DW Maps to KML Converter
 - DW Maps Inspection
- Rig Viewer
- Sensor Indexer
- TensorRT Optimization, supported on the target platform and the host Linux system

1.6.3 Supported Sensors

The following list shows the sensors supported in this release. This list shows sensor models that have been validated.

GMSL Cameras (NVIDIA DRIVE platforms only)

- Sekonix AR0231 (RGGB, RCCB sensors), which are referenced with these logical names:
 - ar0231-rccb-bae-sf3324

- ar0231-rccb-bae-sf3325
- ar0231-grbg-ae-sd3321
- ar0231-rccb-ae-sf3324
- ar0231-rccb-ae-sf3325
- ar0231-rccb-ae-ss3322
- ar0231-rccb-bae-ss3322
- ar0231-rccb-ae-ss3323
- ar0231-rccb-bae-ss3323
- ▶ ov10635
- ov10640-bggr-ae-svc210
- ov10640-bggr-ae-svc212

USB Cameras

- ► USB
- Point Grey

CAN Bus

SocketCAN

GPS

- Xsens MTi-G-710 (serial based NMEA protocol + USB proprietary)
- Xsens MTI_G-710 (native)
- NovAtel SPAN-IGM (native)

Lidar

- Quanergy M8 (M8-1 Rev B, M8-1 Rev C), untested in this release
- ► IBEO LUX (LUX 4)
- Velodyne VPL16
- ► Velodyne HDL32E
- Velodyne HDL64E, untested in this release
- ▶ Velodyne VLP16 hi-Res
- Velodyne VLP32C

Radar

- Delphi ESR2.5
- Continental ARS430
- Continental ARS430 CAN

IMU

- Xsens MTi-G-710 (serial based NMEA Protocol + USB proprietary)
- Xsens MTi-G-710 (native)
- Novatel SPAN-IGM (native)
- Dataspeed (CAN)

1.7 DOCUMENTATION IN THIS RELEASE

The following lists the documentation included in this release.

Document	Description	
NVIDIA_DriveWorks_SDK_Release_Notes_1.2.400.pdf	This document.	
Installed on the host Linux system at:	Contains NVIDIA DriveWorks HTML- based documentation that covers: DriveWorks	
<pre>\usr\local\driveworks- 1.2.400\doc\nvdwx_html</pre>		

2.0 **SETUP**

Before you can use NVIDIA[®] DriveWorks, you must install it and set it up. If you installed with NVIDIA SDK Manager, manual installation is unnecessary.

2.1 INSTALLING DRIVEWORKS ON THE LINUX HOST

To install NVIDIA DriveWorks on the Linux host:

1. Copy the following files to your Linux host system:

```
driveworks-<vsn+build>-linux-amd64-ubuntu1604.deb
driveworks_data-<vsn+build>-linux-amd64-ubuntu1604.deb
driveworks_samples-<vsn+build>-linux-amd64-ubuntu1604.deb
driveworks_cross_linux-<vsn+build>-linux-5.0.10.2.deb
```

2. Enter:

\$ sudo dpkg -i driveworks-<vsn+build>-drive-linux-amd64-ubuntu1604.deb

This installs NVIDIA DriveWorks into the following folder, which is the main installation folder on the host:

/usr/local/driveworks-<vsn+build>/

3. Enter:

```
$ sudo dpkg -i driveworks_data-<vsn+build>-linux-amd64-ubuntu1604.deb
$ sudo dpkg -i driveworks_samples-<vsn+build>-linux-amd64-ubuntu1604.deb
```

This installs DriveWorks sample data.

4. Enter:

\$ sudo dpkg -i driveworks_cross_linux-<vsn+build>-drive-x-5.0.10.2.deb

This installs DriveWorks samples cross compilation libraries for NVIDIA DRIVE platforms.

3.0 IMPLEMENTATION NOTES

This section provides implementation and support information specific to this release.

3.1 CAMERA LAUNCH

If the camera fails to launch for DriveWorks, verify that the AURIX firmware version and update is consistent with the version information in the *NVIDIA DRIVE 5.0 Linux Release Notes*. For guidance on updating the firmware version, see *NVIDIA DRIVE 5.0 Linux Development Guide*. [200418804]

3.2 MAP SUPPORT

The DriveWorks mapping tools help with localization implementations.

3.2.1 DriveWorks Map Derived from TomTom HD Map

DriveWorks provides a map API and a map sample application. The sample application consumes map data derived from an HD map that TomTom provided. The map data is in DriveWorks format. With the map data, the application mimics a car driving along a GPS path, visualizing the map around the car.

For information on the map formats that DriveWorks supports, contact your NVIDIA account manager. To obtain TomTom HD map data, email. For other map vendors, contact the vendor.

3.2.2 DW Maps to KML Conversion

For guidance on converting map data to DriveWorks format, see "DW Maps to KML Converter Tool" in the "Tools" section of *NVIDIA DriveWorks SDK Reference*.

3.3 GMSL CAMERAS

The DriveWorks API provides a higher-level abstraction of the low level NvMedia libraries that expose various engines in the Tegra SoC, including the GMSL cameras. All camera models and modes supported by NvMedia are also supported by DriveWorks.

This release (1.2.400) supports the following camera types:

- ► ar0231-rccb-bae-sf3324
- ► ar0231-rccb-bae-sf3325
- ar0231-grbg-ae-sd3321
- ► ar0231-rccb-ae-sf3324
- ► ar0231-rccb-ae-sf3325
- ► ar0231-rccb-ae-ss3322
- ar0231-rccb-bae-ss3322
- ar0231-rccb-ae-ss3323
- ar0231-rccb-bae-ss3323
- ▶ ov10635
- ov10640-bggr-ae-svc210
- ► ov10640-bggr-ae-svc212

3.4 TENSORRT AND CUDNN LINKING REQUIREMENTS

In this NVIDIA DriveWorks release, TensorRT and CuDNN have been upgraded to the versions shown in <u>Software Dependencies</u>. To ensure compatibility, user applications compiled in earlier DriveWorks releases must be relinked against these versions.

3.5 ICP DROPS

ICP drops can appear at the beginning or end of a recording session.

3.5.1 At the Beginning of a Sessions

ICP drops and large timestamps difference at the very beginning of a session are expected. [200372205]

3.5.2 During Shutdown

During GMSL camera shutdown, ICP Frame Drop warning messages might appear, which are safe to ignore [200258061]:

- CameraGMSL: Frame: 75 CaptureTimestamp: 447361976 ICP DROP
- CameraGMSL: Frame: 76 CaptureTimestamp: 447395313 ICP DROP

4.0 KNOWN ISSUES

This section provides details about issues that were discovered during development and QA but not resolved prior to this release.

4.1 DRIVEWORKS

The following system-related issues were noted in this release.

Issue		New	Past
1.	Sample sfm hang observed with default dataset. [200440446]	~	
2.	The Jitters for sensors do not meet expected target. [200440476]	~	
3.	In Distributed Recording, cameras in slave mode may fail to initialize [200442652]	~	
4.	Display appear stretched out on Lilliput 7" Xavier B displays. The resolution must be corrected. [2230483]	~	

5.0 ABOUT EARLIER RELEASES

This section lists the earlier releases for NVIDIA® DriveWorks.

06 FEB 2018, 0.6.67

What's new

Listed here are the features added since the 0.6.54 release on 08 December 2017. This release also resolves several outstanding issues, as described in <u>Top Issues Fixed Since Last Release</u>. For a list of all features, see <u>Features</u> in these notes.

New Features:

- Automatic use of iGPU to record LRAW. See <u>Recording in LRAW Format</u> in these release notes.
- Rebuilt networks to support new version of TensorRT.

Top Issues Fixed Since Last Release

- [200356528] Host timestamps of the sensors in DriveWorks do not match host (PDK) timestamps of the system.
- [200365781] lraw recording issue with recorder-qt for configuration 3 camera with 15fps on iGPU.
- [2031070] ar0144 is still listed as supported sensors in sample_sensor_info.

08 DEC 2017, 0.6.54

What's New

This release adds the following features. It also resolves several outstanding issues, as described in <u>Top Issues Fixed Since Last Release</u>. For a list of all features, see <u>Features</u> in these notes.

New Features:

- DNN: Improved DNNs
- Sensors: Conti radars
- Sensors: Lidar Accumulator and improved Lidar API
- Vehicle Configuration and Motion
- Module: Egomotion (Fast)
- Module: Ethernet Lidar Plugin
- Module: Ethernet Radar Plugin

New Samples

- Lidar Accumulator
- Software ISP
- Custom GMSL Camera
- Camera Scaling Tracker
- Camera Calibration
- VehicleIO
- Iterative Closest Planes (ICP)
- Camera Seek
- Image Streamer Cross

New Tools

► Rig Viewer

Top Issues Fixed Since Last Release

- [1918927] UDP packets are defective on high CAN load, when CAN messages have only a 1-millisecond gap. When the messages have a 5-millisecond gap, UDP packets are good.
- [1963601/200327532] Pink color output preview for raw recordings with rev.7 ar0231 cameras.
- [200286355,1917596,1914323] PTP Timestamping and synchronization issues with CAN/GPS/IMU sensors.
- [1887016] Synchronized timestamp jitter.
- [200298765] Objects tracked in dwDetector sample are not tagged serially, whereas tracker sample tracks the objects and marks serially.

26 JULY 2017, 0.3 ADDITIONAL RELEASE

What's New

Some known issues have been resolved. Additionally, this release adds the following features.

New Features

- ► AR0231 Rev7 camera support
- ▶ PTP synchronization across two NVIDIA DRIVE PX 2 platforms

Top Issues Fixed Since Last Release

- Recorder: Sometimes recording fails via recorder due to permission issue error. [1917432]
- sample_imu_logger need to run with 'root' user to get working. [1873966]
- ▶ VLAN config for NVIDIA DRIVE PX 2 Tegra-Aurix TACP network. [1866665]
- FreeSpaceNet & LaneNet samples fails due to "DW_CUDA_ERROR" & "DW_INTERNAL_ERROR". [200327086]
- Sample stereo disparity and rectifier applications crash. [200315124]
- "--help" option not working for some sample applications. [200315110]
- In the canbus logger sample, the filter, file, and hwtime options do not work.
 [200314672]
- One core API is not exposed to public head file. [200310311]
- Invalid read of size 1 while running sample_sensors_info. [200309114]
- Need UI labels to validate boundary in car space metric unit when rig xml is provided.
 [200296594]
- API implementation required to get current dwBoxTracker2DtrackingPriority. [200294871]

22 MAY 2017, 0.3

What's New

Some known issues have been resolved. Additionally, this release adds the following features.

New features:

- Support for Novatel dGPS
- ▶ Support for Ethernet-based Radar sensors Continental ARS430 and Delphi ESR2.5
- Sensor seeking for Lidar and Radar
- ► Maps (See <u>Map Support</u>.)
- ▶ Free Space Detector module for computing freespace using OpenRoadNet
- Disparity maps from two images of a stereo pair
- Inter-process communication module

New samples:

- ► Maps (See <u>Map Support</u>.)
- Hello World
- DriveNet N-Cameras
- DriveNet multi GPU
- Radar point clouds
- Stereo rectifier
- Stereo disparity
- HD Maps access
- Socket inter-process communication
- ImageStreamer, multi- and single- threaded

Enhanced samples:

 DriveNet sample is now trained on more weather conditions, front-facing cameras, and more locales. (See <u>DriveNet Sample</u> in these release notes.)

Top Issues Fixed Since Last Release

- sample_lidar_replay in combination with a lidar IBEO_LUX locks up after about 40-60 minutes of continual use. [1870649]
- The error message "EndpointXsensUSB: subscriber XsensUSB experiencing data loss, buffer is full " occurs when there is no valid GPS signal available. [1873960]
- Network with multiple UPD Lidar sensors must use different ports to differentiate sensors. [1861145]

- Calibration tool: failure to indicate vehicle dimensions and master camera position can result in correct calibration but an incorrect visualization, where the vehicle appears extremely off-center with respect to the generated topview. [200271561]
- Tone mapping from RAW cameras is missing. The input image data is outside of the representable range of the display. [200263295/1883193]
- Recorder-qt: Attempting to record on a full disk might result on a crash. [1873356]
- Recorder-qt: It is not possible to intermix different camera types on the same CSI port. [1873342]
- Package libusb-1.0 is required to get 'XSENS GPS/IMU' to work and must be installed on NVIDIA DRIVE PX 2 via apt-get install. [1873960/1873954]
- When NTP is enabled, the kernel clock used by RM sync-point timestamping is not adjusted. This affects CAN bus timestamping. [1851023]
- On rare occasions, CAN messages may be captured out of order. [1837876]
- Sample_camera_gmls and sample_camera_multiple_gmls sporadically fail to start. Observed less than once in 100 executions. [200276484]
- Touch on Recorder-qt, start/stop recording does not respond to touch event at 4K HDMI Display. [1862409]
- ▶ When CAN device is not enumerated, logger fails to generate any error. [1897845]

24 FEB 2017, 0.2.1

What's New

• Some known issues have been resolved.

Top Issues Fixed Since Last Release

- [200261963] Unable to generate top view image on x86 Ubuntu with calibration_tool using intrinsic calibration
- ► [1852724] Latency of ~7 seconds observed in Lidar (Velodyne) replay, tested with 'sample_lidar_replay'. This issue does not occur with other Lidar makes.
- ▶ [1857207] Errors with sample_drivenet on dGPU.
- ▶ [1857015] Cross-Compilation through DriveInstall for NVIDIA DRIVE PX 2.
- ▶ [1854366] Rev.6 RCCB Camera not supported.

21 DEC 2016, 0.2.0

What's New

- Support for dGPU
- Adds Point Grey camera support
- Adds Velodyne Lidars support
- Adds Lane Detection sample
- ▶ The DriveNet demo now takes camera input
- DriveNet and Object tracking module
- Lane Detection
- Structure from Motion with pose optimization
- Color Correction
- Support for wider range of sensors

Top Issues Fixed Since Last Release

- [200236990] With user NVIDIA, the tacp app fails with segmentation fault on the second attempt.
- [200224805] System may crash and X framework may reboot when running GMSL start and stop stress scenario.
- [200213131] Error messages may be seen when running sample triangulation sample on NVIDIA DRIVE CX 2.
- [1816210] Alonso package does not install driveworks.dll and cuDNN into the tools folder.
- ▶ [1793272] Display flickering occurs when running IPP RAW with slave option.
- ▶ [1789857] Recorder tool does not output CAN data.
- ► [1785239] Messages lost on CAN0 channel with message "mttcan c310000.mttcan can0: mttcan_poll_ir: some msgs lost on in Q0".
- [DRIV-504] Opening and saving calibration .xml file in the calibration tool might sometimes result in duplicated entries in the .xml file.
- [DRIV-510] TopView rendering of the results in the calibration tool is mirrored in x and y directions.
- [DRIV-503] Computation of the inverse polynomial coefficients of the OCAM camera model in the intrinsic calibration tool produces sometimes numerically unstable results.
- [1786897] AurixCAN is currently not supported, an updated to Aurix firmware is required. Fix will be provided on availability of new Aurix firmware.

5 OCT 2016, 0.1.2

What's New

AURIX CAN is supported

Top Issues Fixed Since Last Release

- ▶ [200239220] Object Tracker/Detector sample using TensorRT model does not work.
- [200238960] Sample Object Detector/Tracker samples use TensorRT path, even if you specify CAFFE as the input.
- ▶ [200237773] Sample Object Detector/Tracker does not work due to segmentation fault.
- [200237742] Demo DriveNet application aborts with message "***stack smashing detected***".
- [200232097] Video playback on LCD display is very slow when running the Demo DriveNet app.
- ▶ [200222956] Some public methods of DriveWorks are not implemented.
- [200219373] Output window hang is occasionally observed when running multiple GMSL samples.
- [1815418] Frame drops during video replay on NVIDIA DRIVE PX 2.
- [1814475] Shared libraries in Linux/Vibrante have symbol conflicts.
- ▶ [1814464] Video replay does not replay all frames.
- ▶ [1808169] TensorRT related samples do not work on x86 Ubuntu with dGPU GTX 1060.
- [1794781] Multiple GMSL cameras on Tegra B flicker while slave.
- ▶ [1792478] Camera failure when using both Tegras.
- [1791990] GMSL camera on DriveWorks.
- ► [1769206] Continuous error spew "falcon 15340000.vic: nvhost_ioctl_channel_submit: failed with err 8" when running VisionWorks StereoMatching.

8 AUG 2016, 0.1.1

What's New

- DriveNet demo available on Linux Platform
- DriveNet demo is not restricted to provided videos only
- Screenshot capability in sample_multiple_camera_gmsl, by pressing 's'
- Rendering of text supports newline and tab characters
- Support for GL->CPU image streamer
- ► Add support of encoding/creating CAN messages using user specified DBC file
- Add support for Sekonix AR0231 cameras RGGB
- Add support for parallel usage of cameras from TegraA and TegraB using –slave option when running GMSL camera samples on TegraB

Top Issues Fixed Since Last Release

- ► [record] Fix sample record
- ▶ [sample] Fix raw file output in camera_replay
- ▶ [LIDAR] Fix Quanergy timestamp difference for recording and playback
- ▶ [image streamer] Fix YUV -> RGBA default alpha value from 0 to 255
- ▶ [DriveNet] MD5 signature check disabled in the DriveNet demo + compile for Linux
- [CAN] ensure not losing messages on high CPU load
- ▶ [CAN] changed .CAN format to store fixed size CAN messages, 22 bytes
- [CAN] when not using read(), but doing readRaw() and processFrame() resulted in overfill
- [CAN] encode CAN messages with help of DBC file
- [bbox tracker] bug fixes and API improvements
- [DriveNet] updated DriveNet network to a faster one, limit sample to 30fps
- [multiple camera gmsl] Screenshot capability in (multiple_)gmsl samples
- [multiple camera gmsl] selector mask issue solved, any subset of cameras can be used
- [multiple camera gmsl] times out, instead of just hanging if camera fails
- [renderer] add support for newline and tab characters
- [image streamer] Adds stub of missing method, removes linker error for `dwImageStreamer_postGL` and `dwImageStreamer_waitPostedGL`.
- [image streamer] support for GL->CPU imagestreamer
- [camera gmsl] add input for slave option to be used on TegraB
- ▶ [camera gmsl] support for AR0231 + pdk 25.11.03
- ▶ [GPS] make sure GPS works if only GPGGA packets are present
- [calibration tool] Fix a bug in exporting VEHICLE fields in rig configuration files

16 JUN 2016, 0.1.0

What's New

- DriveWorks dynamic library and headers
- ► HTML API documentation
- ► Samples
- ► Tools
- Data for the samples
- DriveNet binary demo

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