

Vision Toolbox for MATLAB

Release Notes

**Embedded Target for the S32V234 Family of Automotive Vision Processors
Version 1.1.0**

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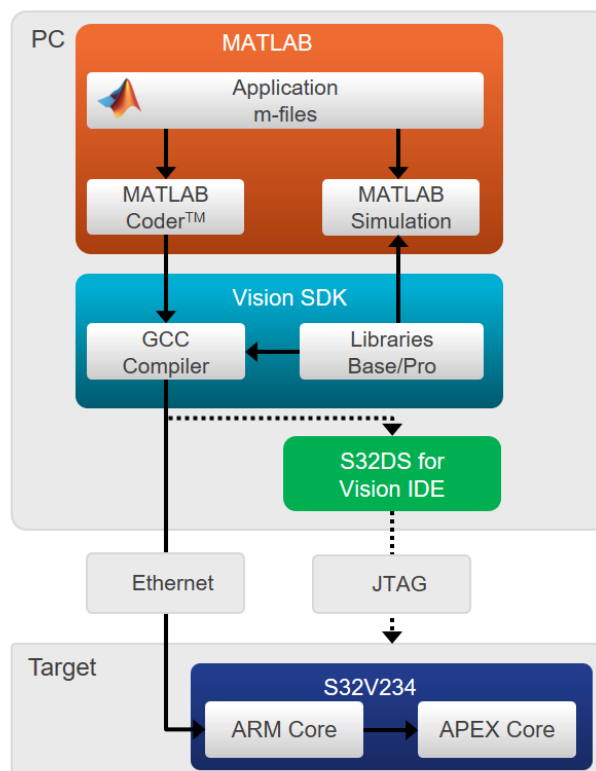
1 What is New

This release of [NPX Vision Toolbox version 1.1.0](#) for MATLAB is designed to support the S32V234 Automotive Vision Processors for automatic code generation and NXP target deployment of vision applications for S32V234 directly from MATLAB environment.

NOTE With this new release, the versioning scheme has been reverted from <year>.<release#> to <x.y.z>. The previous release 2018.R1 is equivalent to version 1.0.0

The NXP Vision Toolbox allows the following software development flows:

- Implementation and simulation of Computer Vision applications in MATLAB environment using MATLAB built-in Vision Classes or NXP Vision Toolbox MEX wrappers for NXP Vision SDK classes
- Implementation and simulation of Machine Learning applications in MATLAB environment using Deep Learning Toolbox
- Automatic code generation from MATLAB m-scripts to C++ code
- Application deployment on NXP S32V234 evaluation boards (SBC and EVB) via Ethernet port directly from MATLAB environment.
- Application debugging via S32 Design Studio for Vision



For more information please check the Vision Toolbox quick start guide or watch [this](#) webinar

[NXP Vision Toolbox version 1.1.0](#) new features compared with previous release (2018.R1):

- Automatic Code Generation support for MathWorks **pretrained CCN**. Users can deploy SqueezeNet, AlexNet and GoogLeNet applications on S32V234 microprocessor ARM A53 cores.
- All the code generated from NXP Vision Toolbox is based on **NXP Vision Software Development Kit for S32V234 RTM 1.3.0** that can be obtained from [here](#).
- Add support for MATLAB **2018b** and **2019a**
- Add support for cascade classifiers trained from OpenCV, using **HAAR** and **LBP** features.
- Add support for **KALMAN** Filter to track detections
- Enhance the **nxp.s32v234** object target support for the S32V234EVB and S32V234SBC evaluation boards. The board configuration is supported via s32v234 object which can be used similar with **raspi** MATLAB standard object;
- **Ready to run examples and applications** to exercise the A53/APU/ISP cores and learn how to program those IP directly from MATLAB m-scripts. Example library include:
 - Update Face/Pedestrian/Lane detection applications that runs in Simulation or S32V Evaluation board on both A53/APU cores;
 - Add new examples for feature detections using ROI and Kalman Filter;
 - Add new examples for CNN;

For more details please refer to the following chapters.

2 Vision Toolbox Features

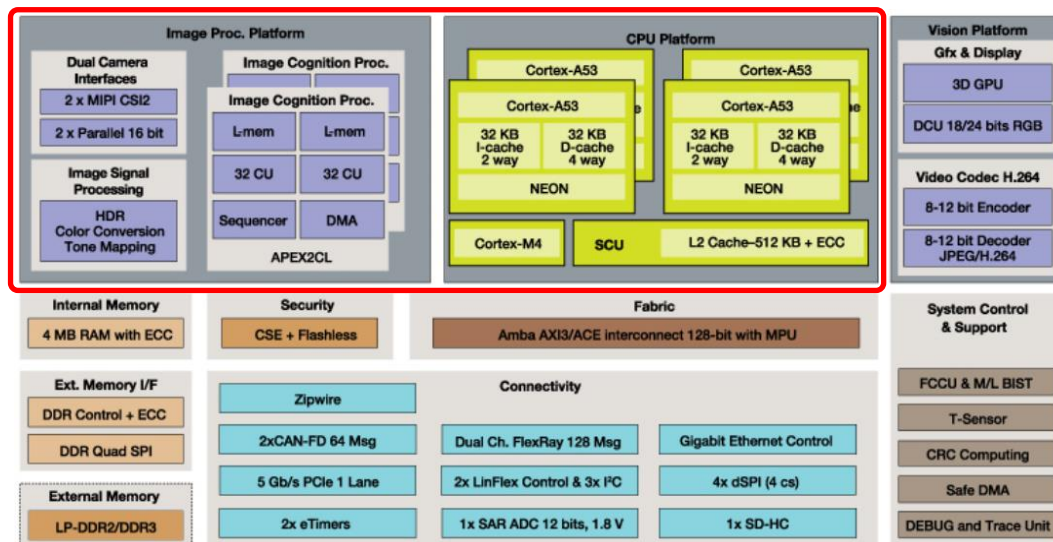
2.1 Packages & Derivatives

The NXP Vision Toolbox version 1.1.0 supports:

- NXP [S32V234](#) Vision Processor.
- Testing and validation has been completed on production qualified parts mounted on [S32V234 Evaluation Board](#) and [SBC-S32V234 Evaluation Board](#) equipped with a [S32V-SonyCam](#)

2.2 Code Generation

NXP Vision Toolbox support code generation for the devices and functions highlighted on top of the S32V234 block diagram below:



2.3 Functions and Kernels

The NXP Vision Toolbox for S32V234 kernels organization follows the Vision SDK implementation and supports several component libraries:

- Arithmetic kernels - provide basic operators for element-wise addition, subtraction, multiplication, division and arithmetic shifting
- Comparison kernels - provide basic element-wise comparison operators like less than, less-than-or-equal, binary AND operator and binary descriptor matches
- Conversion kernels - support conversion from 16 to 8 bit and from RGB format to grayscale
- Display kernels - provide examples of marking an image at certain points as overlay or in a certain color channel.
- Feature detection - provides two corner detection algorithms FAST9 and Harris corner detection

- Filtering - offers kernels for general purpose filtering, and also the most used filters like Gaussian filtering, gradient computation, non-maximum suppression and saturation
- Geometry - provides geometric transformations, like rotations and bilinear interpolation and also a replacement for indirect inputs, called offset selection
- Morphology - example of a morphological dilation operator.
- Object detection - two object detection algorithms: Haar cascade and LBP (local binary pattern) cascade
- Optimization - implementation of the Integral Image (SAT) kernel and a SAT-based box filter.
- Resizing - provides downsampling and upsampling kernels (gives examples of size changes inside a filter)
- Statistics - provides kernels for statistics computations, such as a Histogram kernel, a vector-to-scalar reduction kernel and an accumulation kernel.

To use any of these kernels in the MATLAB m-script functions use:

```
nxpvt.apu.<kernel_name>(args1, ...)
```

2.4 S32V234 Example Library

S32V234 Examples Library represents a collection of MATLAB models that let you test and run complex applications. These examples are grouped in different layers that mimics a typical development flow.

The main functionalities supported are:

- Vision Applications;
- CNN Applications;
- APEX Kernels;
- APEX Computer Vision;
- S32V234 IO Examples;

The MATLAB models shown as examples are enhanced with a comprehensive description to help users understand better the functionality that is exercised, hardware setup instructions whenever are necessary and a result validation section.

3 Prerequisites

3.1 OSES Supported

The NXP Vision Toolbox is supported only on PC with Windows OS. For a flowless development experience the minimum recommended PC platform is:

- Windows® 7/10 64bit Operating System
- At least 2 GHz CPU Speed
- At least 4 GB of RAM
- At least 20 GB of free disk space.
- Internet connectivity for web downloads.

Operating System Supported	SP Level	64-bit
Windows 7	SP1	X
Windows 10		X

3.2 MATLAB Required and Recommended Products

The NXP Vision Toolbox for S32V234 requires the following MathWorks products to be installed. Make sure you have a valid license for the products marked as “Required”

Product	Version Compatibility	Required or Recommended
MATLAB	R2018a or newer	Required
MATLAB Coder	R2018a or newer	Required
Embedded Coder	R2018a or newer	Required
Image Processing Toolbox	R2018a or newer	Required
Computer Vision System Toolbox	R2018a or newer	Required
Embedded Coder Support Package for ARM Cortex-A Processors	R2018a or newer	Required
Computer Vision System Toolbox OpenCV Interface	R2018a or newer	Required
Deep Learning Toolbox	R2018a or newer	Required for CNN code generation
MATLAB Support Package for USB Webcams	R2018a or newer	Recommended for webcam usage in simulations

Image Acquisition Toolbox Support Package for OS Generic Video Interface	R2018a or newer	Recommended for webcam usage in simulations
Deep Learning Toolbox™ Model for SqueezeNet Network	R2018a or newer	Recommended for CNN code generation
Deep Learning Toolbox™ Model for AlexNet Network	R2018a or newer	Recommended for CNN code generation
Deep Learning Toolbox™ Model for GoogLeNet Network	R2018a or newer	Recommended for CNN code generation
MATLAB Coder Interface for Deep Learning Libraries Deep Learning Toolbox	R2018a or newer	Recommended for CNN code generation

Due to code generation performance issues the NXP Vision Toolbox uses a special feature `row-major` that has been introduced in [MATLAB Coder 2018a](#). This feature allows better code generation that is compatible with embedded systems designed to store the arrays in row-major format avoiding this way unnecessary copies or transposes between MATLAB and Vision SDK APIs.

3.3 Build Tools

The NXP Vision Toolbox supports code generation for the NXP ARM GNU and NXP APU compilers.

Compiler	Versions Tested
NXP ARM GNU Compiler	NXP GCC 6.3.1
NXP APU Compiler	V1.0 build 530

The target compilers used for NXP Vision Toolbox needs to be configured. Use the notation below to setup these compiler environment or user variables. Ensure that such variables are defined to compiler path value as shown below:

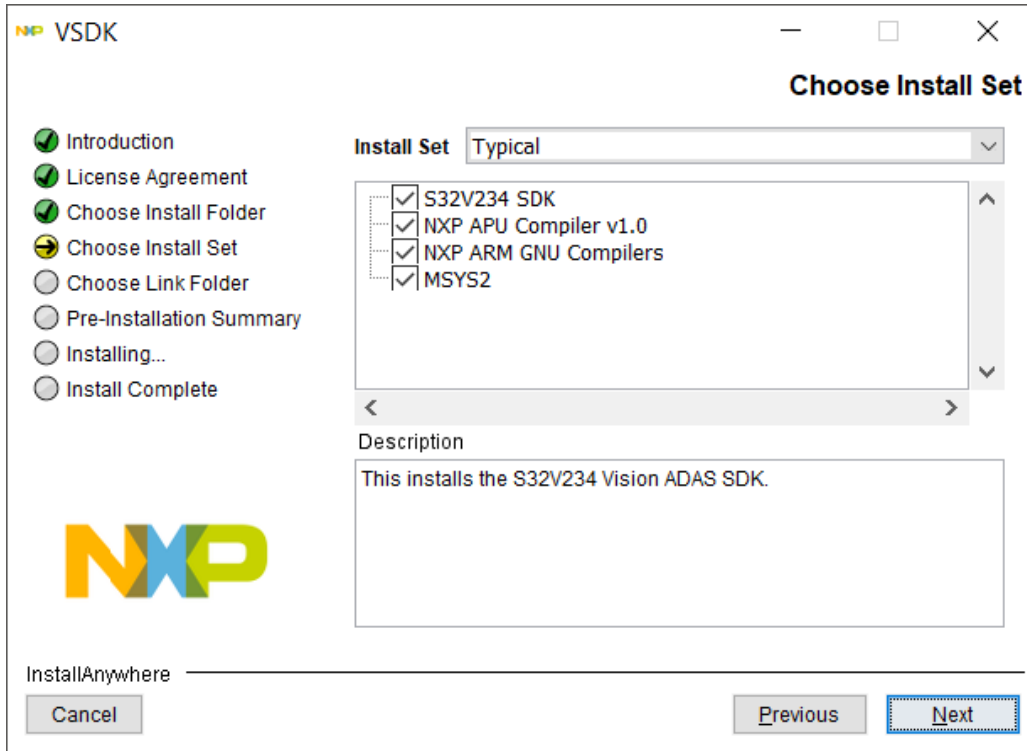
```

APU_TOOLS= C:/NXP/APU_Compiler_v1.0
S32V234_SDK_ROOT = C:/NXP/VisionSDK_S32V2xx_RTM_1_3_0/s32v234_sdk

```


3.4 Vision SDK package

All the code generated by NXP Vision Toolbox is based on [S32V234 Vision SDK 1.3.0 package](#). This software package is also free of charge and apart of optimized kernels and libraries for the S32V automotive vision processors, it also contains the build tools to cross-compile the MATLAB generated code to ARM A53 and APEX cores. All Vision SDK components must be installed prior of using the NXP Vision Toolbox for S32V234



NOTE If you have installed previous versions of the Vision SDKs, make sure the paths are set correctly to point towards version 1.3.0. The NXP Vision Toolbox version 1.1.0 works in sync with specific VSDK versions.

4 Vision Toolbox Extras

NXP's Vision Toolbox enables additional functionalities that are not MCU specific but could help faster prototyping, validation and verification of the developed models.

4.1 Evaluation Board Support

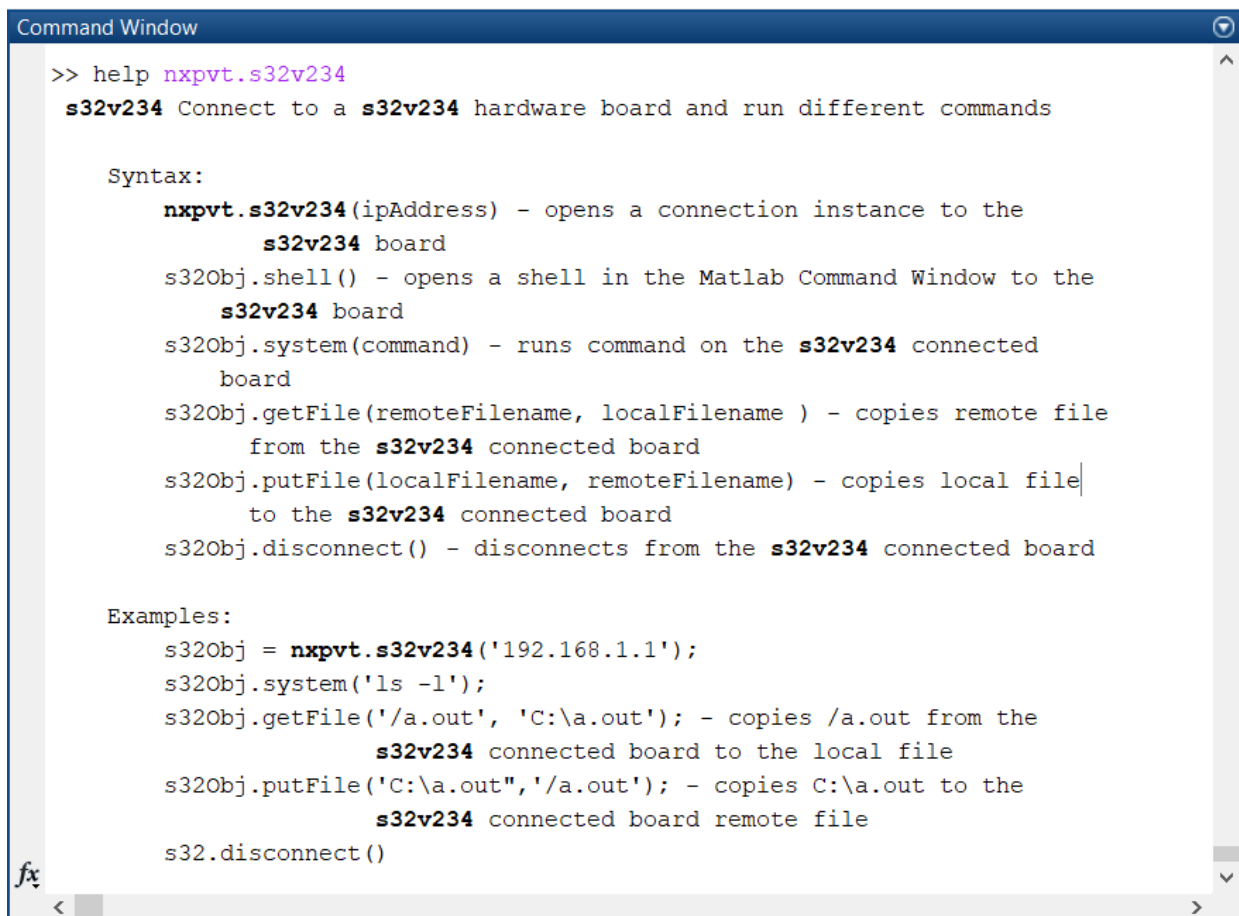
The NXP Vision Toolbox has built in capabilities to configure the SD-Card directly from Windows OS. A Linux OS configured to boot up the S32V234 platform to enable the Eth, ISP, ACF and other various drivers and modules is needed for running embedded vision algorithms.

NXP Vision Toolbox facilitates:

- Easy SD-Card configuration directly from Windows OS via pre-build bootable image
- `nxpvt_create_target()` function for configuration directly from MATLAB

4.2 Target Connection

The NXP Vision Toolbox has built in capabilities to connect and configure the S32V234 microprocessor and NXP evaluation boards. Use `nxpvt.s32v234` object to download and control the target. The list of supported functionalities is shown below:



```
Command Window
>> help nxpvt.s32v234
s32v234 Connect to a s32v234 hardware board and run different commands

Syntax:
  nxpvt.s32v234(ipAddress) - opens a connection instance to the
    s32v234 board
  s32obj.shell() - opens a shell in the Matlab Command Window to the
    s32v234 board
  s32obj.system(command) - runs command on the s32v234 connected
    board
  s32obj.getFile(remoteFilename, localFilename) - copies remote file
    from the s32v234 connected board
  s32obj.putFile(localFilename, remoteFilename) - copies local file
    to the s32v234 connected board
  s32obj.disconnect() - disconnects from the s32v234 connected board

Examples:
  s32obj = nxpvt.s32v234('192.168.1.1');
  s32obj.system('ls -l');
  s32obj.getFile('/a.out', 'C:\a.out'); - copies /a.out from the
    s32v234 connected board to the local file
  s32obj.putFile('C:\a.out', '/a.out'); - copies C:\a.out to the
    s32v234 connected board remote file
  s32.disconnect()
```

5 Known Limitations

This release contains some limitations in terms of code generations:

- 4 classes from VSDK 1.3.0 BASE are not supported for Code Generation nor MEX Simulation: `ColorConverterHT`, `ConvolveFilterHT`, `DerivativeXFilterHT`, `SobelXFilterHT`
- Limited support for VSDK 1.3.0 PRO classes: only `Resize` and `Remap` are supported for code generation and MEX simulation
- Avoid any paths that includes spaces. Please install your MATLAB and VisionSDK related software into short paths without spaces.

6 Support Information

To order NXP products, consult your local sales representative.

For technical support please sign on to the following NXP's Model-Based Design Toolbox Community: <https://community.nxp.com/community/mbdt>

How to Reach Us:

Home Page:

www.nxp.com

Web Support:

www.nxp.com/support

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