Vision SDK
Stereo Vision

User Guide

IMPORTANT NOTICE

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1   Introduction

This document provides an overview of TI's stereo vision module for the TDA3x device families. The software module was developed using TI's Vision Software Development Kit (SDK), with special use case configurations to support stereo vision algorithms running on the devices DSP and EVE cores.

There are two stereo use cases that can be used with online stereo calibration, which is also one of use cases that we provide for stereo vision.

2   Online calibration use case

This use case is used to generate the rectification tables in LDC format for left and right cameras, and stored them in a SD card. Two stereo vision use cases in Sections 2.2 and 2.3 read them from a SD card for rectification.

```
Vision SDK Usecases,
-------------------
1: Single Camera Usecases
2: Multi-Camera LVDS Usecases
3: AVB RX Usecases, (TDA2x & TDA2Ex ONLY)
4: Dual Display Usecases, (TDA2x EVM ONLY)
5: ISS Usecases, (TDA3x ONLY)
6: TDA2x Stereo Usecases
7: Network RX/TX Usecases
9: RADAR Usecases
a: Miscellaneous test's

d: Rear View Panorama Use-cases

s: System Settings

x: Exit

Enter Choice:
```

Figure 1. Vision SDK Use Cases main menu

To run this use case, from the main menu in Figure 1, choose **4: ISS Usecases, (TDA3x ONLY)**. Then from the following ISS Usecases menu shown in Figure 2, choose **a: Stereo capture + ISS ISP + Auto Calibration**.

```
ISS Usecases (TDA3x ONLY)
-------------------------
1: 1CH ISS capture + ISS ISP + ISS LDC+VTNF + Display
2: 4CH ISS capture + ISS ISP + Simcop + Surround View (DSP1) +  Display
3: 1CH ISS capture (AR0132) + ISS ISP Monochrome +  Display
4: 3D SRV 4CH ISS capture + ISS ISP + DeWarp + Synthesis (DSP1) + Display
5: Surround View Calibration
6: 3D + 2D SRV 4CH ISS capture + ISS ISP + DeWarp + Synthesis (DSP1) + Display
7: 3D SRV 4CH ISS capture + ISS ISP + DeWarp + Synthesis (DSP1) + RearView + Display
8: Stereo capture + ISS ISP + Simcop + Display
9: Stereo capture + ISS ISP + Dewarp + Display
a: Stereo catpure + ISS ISP + Auto Calibration
b: Stereo capture + ISS ISP + Dewarp + Streaming + Display

x: Exit

Enter Choice:
```

Figure 2. ISS Usecases menu

Once the use case starts, the following menu will show up:

```
[IPU1-0]  ====================
[IPU1-0]  Chains Streo AutoRemap Run-time Menu
[IPU1-0]  ====================
[IPU1-0]
[IPU1-0]  0: Stop Chain
[IPU1-0]
[IPU1-0]  1: Reset frame number and capture stereo
[IPU1-0]
[IPU1-0]  2: Capture stereo
[IPU1-0]
[IPU1-0]  3: Generate remap tables
[IPU1-0]
[IPU1-0]  4: Store remap tables (Only for TDA3x)
[IPU1-0]
[IPU1-0]  p: Print Performance Statistics
[IPU1-0]
[IPU1-0]  Enter Choice:
[IPU1-0]
```

Figure 3. Stereo online calibration run-time menu

1: Reset frame number and capture stereo will remove all feature points collected previously, and collect new feature points from stereo input. **2: Capture Stereo** will collect new feature points without removing previous feature points. This option enables to collect feature points from multiple stereo inputs to have enough feature points for calibration. **3: Generate remap tables** will generate rectification tables in LDC format from collected feature points, and finally **4: Store remap tables** will store tables into a SD card.

Please note that we do not need any chart to collect feature points. This stereo calibration is applied using feature points from natural images. But it is recommended to get enough features across a whole image area. That's why it is allowed to collect features from multiple stereo inputs. Maximum number of features the stereo calibration algorithm uses is set to 2000.

To run this use case, make sure that FATFS should be enabled. For TDA3x EVM, we have to set 3 parameters in `/vision_sdk/apps/configs/$(MAKECONFIG)/cfg.mk` as follows. Note that **NSP_TFDTP_INCLUDE** is disabled for TDA3x EVM since FATFS and TFDTP cannot be enabled simultaneously in TDA3x EVM. However, both can be enabled for TDA3x RVP.

```
# Supported values: ipu1_0 ipu1_1 none
NDK_PROC_TO_USE=ipu1_1

#Used to control TFDTP stack (supported only when NDK_PROC_TO_USE = ipu1_1)
NSP_TFDTP_INCLUDE=none

# Supported values: ipu1_0 none
FATFS_PROC_TO_USE=ipu1_0
```

3 Stereo use case

This use case simply outputs integer-pel disparities and displays color-coded disparity map on a HDMI screen. The rectification tables are read from a SD card, which is produced by online stereo calibration use case. Because of that FATFS should be enabled as well for this use case.

To run this use case, from the ISS Usecases menu shown in Figure 2, choose **9: Stereo capture + ISS ISP + Dewarp + Display.**

4 Stereo use case with data streaming using TFDTP

This use case is mainly for TDA3x RVP. In addition to color-coded disparity map, jt packs 7-bit integer-pel disparity and 4-bit sub-pel disparity along with 5-bit confidence value, which is again converted to 3D point cloud and occupancy grid.

With this use case, it is also possible to stream out the following data into PC using TI Fast Data Transfer Protocol (TFDTP):

- A sequence of rectified stereo (left and right) images
- A sequence of 3D point cloud
- A sequence of 3D occupancy grid map

To stream out these data, we have to run a network tool on PC. For example, we can stream out rectified stereo images by

```
network_rx.exe  --host_ip  <ip_addr>  --taget_ip  <ip_addr>  -useftdtp  –files
<stereo_file_name>
```

Note that host_ip is an IP address of PC where a file will be stored and target_ip is an IP address of TDA3x. Similarly 3D point cloud and 3D OG map can be stored by

```
network_rx.exe --host_ip <ip_addr> --taget_ip <ip_addr> --port 7001 -useftdtp
–files <pointcloud_file_name>
```

```
network_rx.exe --host_ip <ip_addr> --taget_ip <ip_addr> --port 7002 -useftdtp
–files <og_file_name>
```

It should be noted that TDFTP should be enabled for this use case. For TDA3x EVM, we have to set 3 parameters in /vision_sdk/apps/configs/$(MAKECONFIG)/cfg.mk as follows. Note that **FATFS_PROC_TO_USE** is disabled for TDA3x EVM since FATFS and TFDTP cannot be enabled simultaneously in TDA3x EVM. Since rectification table cannot be read from SD card in TDA3x EVM, the rectification should be stored in dewarp_stereo_ldc_lut.h. TDA3x RVP has no issue because both can be enabled. That's why this use case is mainly for TDA3x RVP.

```
# Supported values: ipu1_0 ipu1_1 none
NDK_PROC_TO_USE=ipu1_1
```

```
#Used to control TFDTP stack (supported only when NDK_PROC_TO_USE = ipu1_1)
NSP_TFDTP_INCLUDE=yes
```

```
# Supported values: ipu1_0 none
FATFS_PROC_TO_USE=none
```

5   Revision History

Version	Date	Revision History
0.1	28th March 2018	Initial version