MI IVE API

Version 2.05

REVISION HISTORY

Revision No.	Description	Date
2.03	• Initial release	04/12/2018
2.04	• Added function descriptions in regard to MI_IVE_Bernsen, MI_IVE_LineFilterHor, MI_IVE_LineFilterVer, MI_IVE_NoiseRemoveHor, MI_IVE_NoiseRemoveVer, MI_IVE_AdpThresh, MI_IVE_Resize, MI_IVE_BAT, and MI_IVE_Acc	06/05/2019
2.05	• Added description of functions from list matrix_transform and image_dot • Added description of new input parameter for add function • Added description of new input mode for lbp function	10/09/2019

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The MI IVE module provides the following APIs:

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MI_IVE_Filter	Execute a 5x5 template filter task
MI_IVE_Csc	Execute a color space conversion task
MI_IVE_FilterAndCsc	Execute a composite task of template filter plus color space conversion
MI_IVE_Sobel	Execute a 5x5 template Sobel-like gradient calculation task
MI_IVE_MagAndAng	Execute a 5x5 template gradient magnitude and angle calculation task
MI_IVE_Dilate	Execute a Dilate task
MI_IVE_Erode	Execute an Erode task
MI_IVE_Thresh	Execute an image binarization task
MI_IVE_And	Execute an And task
MI_IVE_Sub	Execute a Subtract task
MI_IVE_Or	Execute an Or task
MI_IVE_Integ	Execute an integral graph statistics task
MI_IVE_Hist	Execute a histogram statistics task
MI_IVE_ThreshS16	Execute an S16 data to 8-bit data thresholding task
MI_IVE_ThreshU16	Execute a U16 data to U8 data thresholding task
MI_IVE_16BitTo8Bit	Execute a 16-bit data to 8-bit data linear transformation task
MI_IVE_OrdStatFilter	Execute a 3x3 template sequential statistic filtering task
MI_IVE_Map	Execute a Map (U8->U8 mapping assignment) task
MI_IVE_EqualizeHist	Execute a grayscale-image histogram equalization calculation task
MI_IVE_Add	Execute a weighted addition calculation task against two grayscale images
MI_IVE_Xor	Execute an XOR calculation task against two binary graphs
MI_IVE_Ncc	Execute a normalized cross-correlation calculation task against two images of the same resolution
MI_IVE_Ccl	Execute a connected region label task against binary images
MI_IVE_Gmm	Execute a GMM background modeling task
MI_IVE_CannyHysEdge	Execute a Canny strong edge extraction task against grayscale images

Name of API	Function
MI_IVE_CannyEdge	Execute the second half of Canny strong edge extraction task: connecting edge points to form a Canny edge map
MI_IVE_Lbp	Execute an LBP calculation task
MI_IVE_NormGrad	Execute a normalized gradient calculation task, in which the gradient average components are normalized to S8
MI_IVE_LkOpticalFlow	Execute a single layer LK optical flow calculation task
MI_IVE_Sad	Calculate 16-bit/8-bit SAD images of 4x4/8x8/16x16 blocks for two images, and threshold output for SAD
MI_IVE_Bernsen	Execute a Bernsen thresh task for 3x3 and 5x5 windows
MI_IVE_LineFilterHor	Execute a horizontal density filter task for binary images
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MI_IVE_AdpThresh	Execute an adaptive thresh task
MI_IVE_Resize	Execute an image scaling task
MI_IVE_BAT	Execute the horizontal or vertical alternating time for binary images
MI_IVE_Acc	Execute an accumulation task for two gray-scale images
MI_IVE_Matrix_Transform	Execute the operation of matrix multiplication
MI_IVE_Image_Dot	Execute the operation of dot product

1.1. MI_IVE_Create

- Function

  Create an IVE handle

- Syntax

  MI_IVE_HANDLE MI_IVE_Create(MI_IVE_HANDLE hHandle);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Must be an unused hHandle number. Parameter range: [0, MI_IVE_HANDLE_MAX)	Input

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

1.2. MI_IVE_Destroy

- Function

  Release an IVE handle

- Syntax

  MI_IVE_HANDLE MI_IVE_Destroy(MI_IVE_HANDLE hHandle);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

1.3. MI_IVE_Filter

➢ Function

Execute a 5x5 template filter task. By configuring different template coefficients, you can realize different filters.

➢ Syntax

MI_S32 MI_IVE_Filter(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_FilterCtrl_t *pstFltCtrl, MI_BOOL bInstant);

➢ Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstFltCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1, YUV420SP, YUV422SP	16 byte	64x64～1920x1024
pstDst	Same as pstSrc	16 byte	Same as pstSrc

NOTE: U8C1, YUV420SP, and YUV422SP are all members of MI_IVE_ImageType_e in short form. Other members will adopt the same naming rule throughout the rest of the document.

➢ Return Value

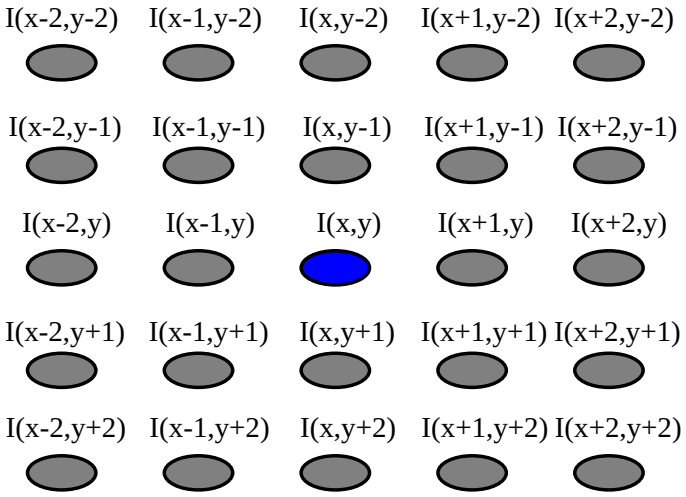
Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

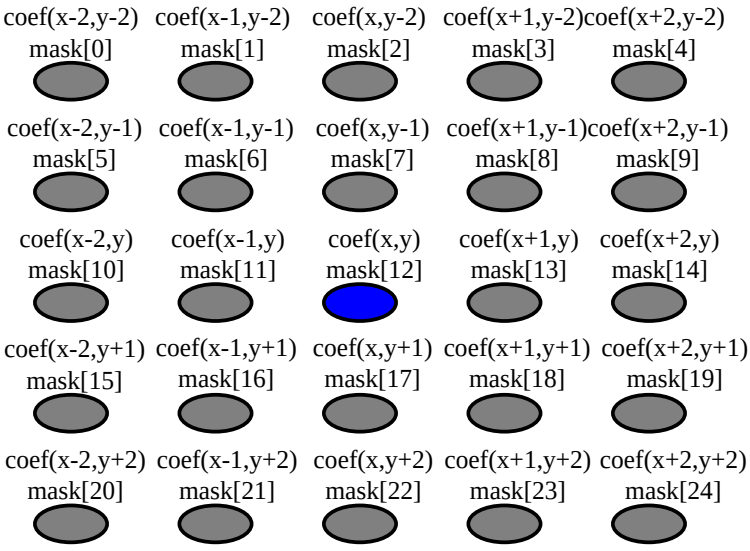
➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

- When the source data type is YUV420SP or YUV422SP, the output data stride must be consistent.
- For the filter calculation formula, please refer to the figure below.





$$I_{out}(x,y)=\{\sum_{-2\le i\le 2}\sum_{-2\le j\le 2} I_{in}(x+i,y+j)*coef\,(x+i,y+j)\}>>norm$$

Figure 1: Filter Calculation Formula

Where, $I(x,y)$ refers to pstSrc, $I_{out}(x,y)$ refers to pstDst, *coef* (mask) refers to as8Mask[MI_IVE_MASK_SIZE_5X5] in pstFltCtrl, and norm refers to u8Norm in pstFltCtrl.

- The classic Gaussian template is as illustrated below:

$$\begin{bmatrix}0&0&0&0&0\\0&1&2&1&0\\0&2&4&2&0\\0&1&2&1&0\\0&0&0&0&0\end{bmatrix}\quad u8Norm=4$$

$$\begin{bmatrix}1&2&3&2&1\\2&5&6&5&2\\3&6&8&6&3\\2&5&6&5&2\\1&2&3&2&1\end{bmatrix}*3\quad u8Norm=8$$

$$\begin{bmatrix}1&4&7&4&1\\4&16&26&16&4\\7&26&41&26&7\\4&16&26&16&4\\1&4&7&4&1\end{bmatrix}\quad u8Norm=8$$

MI_IVE_Data_t two-dimensional data stride refers to the number of bytes in one line of two-dimensional data, i.e., the case shown in Figure 2 where n=8.

MI_IVE_Data_t can be looked upon as an image with "pixels" presented in 8-bit addressing. In this light, the stride can be interpreted as the number of units in one line as calculated on the basis of "pixels" of an image or two-dimensional data.

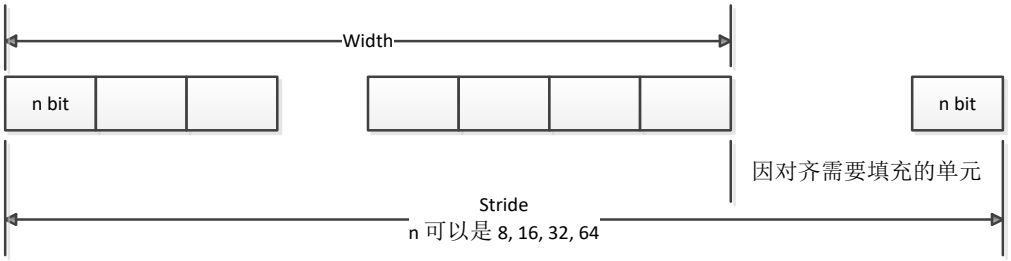


Figure 2: Data Stride

- Alignment

  For quick access to the start address of memory or data across rows, HW requires that the memory address or memory stride be a multiple of the alignment factor.

  - Data memory start address alignment

    The current IVE operator requires that the Input/Output be 1-, 2-, or 16-byte aligned. For detailed parameter requirement, please refer to the respective APIs.

- Stride alignment

  For generalized two-dimensional images, the stride of two-dimensional single-component data and one-dimensional array data must satisfy the 16 "pixel" alignment rule.

- Input/output data type (for detailed structure definition, please refer to Chapter 2 "IVE DATA TYPE")
  - Generalized two-dimensional image data

    For MI_IVE_Image_t, MI_IVE_SrcImage_t, and MI_IVE_DstImage_t, please refer to MI_IVE_ImageType_e for the image type.

    Note: Currently the width and height of the generalized two-dimensional image data for the operator input/output are even number.
  - Two-dimensional single-component data

    MI_IVE_Data_t, two-dimensional data in byte unit, is mainly used for DMA, etc. Depending on the image type, MI_IVE_Image_t can be converted into single or multiple MI_IVE_Data_t.
  - One-dimensional data

    MI_IVE_MemInfo_t, MI_IVE_SrcMemInfo_t, and MI_IVE_DstMemInfo_t are one-dimensional data such as histogram statistical data, GMM model data, and LK optical flow corner input, etc.

    generalized two-dimensional image type

Type	Image Description	Memory Address	Stride
E_MI_IVE_IMAGE_TYPE_U8C1	8-bit unsigned single channel image	Only u32PhyAddr[0] and pu8VirAddr[0] in MI_IVE_Image_t are used	Only u16Stride[0] is used

➢ Example

N/A.

➢ Related API

- MI_IVE_FilterAndCsc
- MI_IVE_OrdStatFilter

1.4. MI_IVE_Csc

➢ Function

Execute a color space conversion task for color space conversion with respect to YUV2RGB\YUV2HSV\YUV2LAB\RGB2YUV.

➢ Syntax

MI_S32 MI_IVE_Csc(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_CscCtrl_t *pstCscCtrl, MI_BOOL bInstant);

➢ Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstCscCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	YUV420SP, YUV422SP, U8C3_PLANAR, U8C3_PACKAGE	16 byte	64x64～1920x1080
pstDst	U8C3_PLANAR, U8C3_PACKAGE, YUV420SP, YUV422SP	16 byte	Same as pstSrc

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

- When the output data type is U8C3_PLANAR, YUV420SP or YUV422SP, the output data stride must be consistent.
- 12 work modes are supported. Different work mode has different output parameter range. For details, please refer to MI_IVE_CscMode_e.
- For YUV2HSV and YUV2LAB, please refer to the implementation method described in OpenCV library.
  The OpenCV mentioned throughout this document refers to OpenCV version 2.4.8.

- Example

  N/A.

- Related API

  MI_IVE_FilterAndCsc

1.5. MI_IVE_FilterAndCsc

- Function

  Execute a composite task of 5x5 template filter plus YUV2RGB color space conversion, to accomplish two functions by one single execution.

- Syntax

  MI_S32 MI_IVE_FilterAndCsc(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_FilterAndCscCtrl_t *pstFltCscCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Input image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstFltCscCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	YUV420SP, YUV422SP	16 byte	64x64～1920x1024
pstDst	U8C3_PLANAR, U8C3_PACKAGE	16 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a
- Note
  - When the output data type is U8C3_PLANAR, the output data stride must be consistent.
  - Only the four work modes of YUV2RGB are supported. For details, please refer to MI_IVE_CscMode_e.
- Example

  N/A.
- Related API

  MI_IVE_Filter

1.6. MI_IVE_Sobel

- Function

  Execute a 5x5 template Sobel-like gradient calculation task
- Syntax

  MI_S32 MI_IVE_Sobel(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDstH, MI_IVE_DstImage_t *pstDstV, MI_IVE_SobelCtrl_t *pstSobelCtrl, MI_BOOL bInstant);
- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDstH	Gradient component image H pointer gained by template filtering. According to pstSobelCtrl→eOutCtrl, this parameter cannot be null if output is required. Width and height same as pstSrc.	Output
pstDstV	Gradient component image V pointer gained by transposed template filtering. According to pstSobelCtrl→eOutCtrl, this parameter cannot be null if output is required. Width and height same as pstSrc.	Output
pstSobelCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1024
pstDstH	S16C1	16 byte	Same as pstSrc
pstDstV	S16C1	16 byte	Same as pstSrc

➢ Return Value

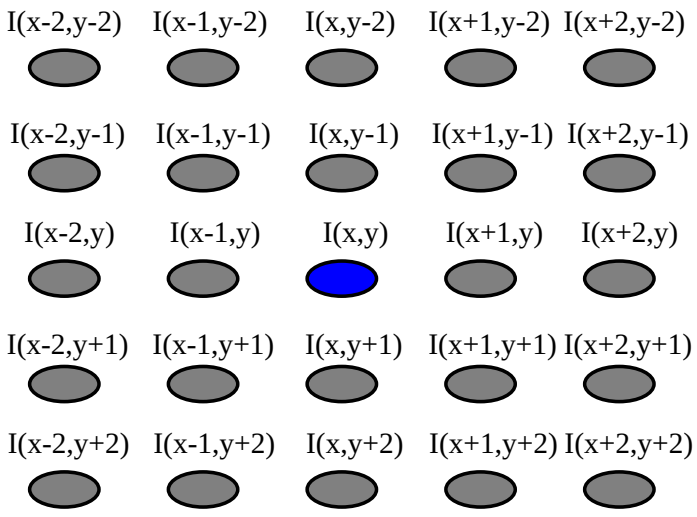
Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

- Three output modes are available for configuration. Please refer to MI_IVE_SobelOutCtrl_e.
- When the output mode is E_MI_IVE_SOBEL_OUT_CTRL_BOTH, the stride of pstDstH and the stride of pstDstV must be consistent.
- Sobel calculation formula is as shown in the figure below.



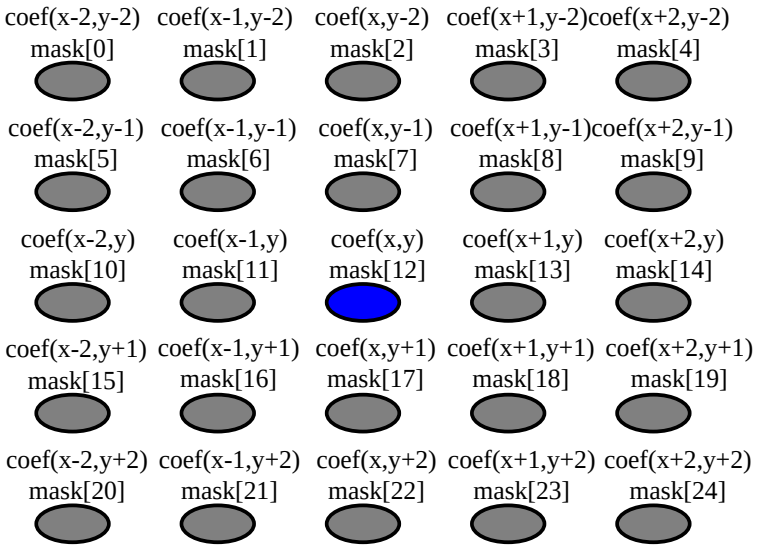


Figure 3: Sobel Calculation Formula

$$H_{out}(x,y) = \sum_{-2\le i\le 2}\sum_{-2\le j\le 2} I(x+i,y+j) * coef\,(x+i,y+j)$$
$$V_{out}(x,y) = \sum_{-2\le i\le 2}\sum_{-2\le j\le 2} I(x+i,y+j) * coef\,(x+i,y+j)$$

Where, I (x, y) refers to pstSrc, Hout(x, y) refers to pstDstH, Vout(x, y) refers to pstDstV, and coef (mask) refers to as8Mask[MI_IVE_MASK_SIZE_5X5] in pstSobelCtrl.

Sobel template

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 1 & 0 \\ 0 & -2 & 0 & 2 & 0 \\ 0 & -1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & -2 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 2 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} -1 & -2 & 0 & 2 & 1 \\ -4 & -8 & 0 & 8 & 4 \\ -6 & -12 & 0 & 12 & 6 \\ -4 & -8 & 0 & 8 & 4 \\ -1 & -2 & 0 & 2 & 1 \end{bmatrix} \quad \begin{bmatrix} -1 & -4 & -6 & -4 & -1 \\ -2 & -8 & -12 & -8 & -2 \\ 0 & 0 & 0 & 0 & 0 \\ 2 & 8 & 12 & 8 & 2 \\ 1 & 4 & 6 & 4 & 1 \end{bmatrix}$$

Scharr template

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -3 & 0 & 3 & 0 \\ 0 & -10 & 0 & 10 & 0 \\ 0 & -3 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -3 & -10 & -3 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 3 & 10 & 3 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Laplace template

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & -4 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 \\ 0 & -1 & 4 & -1 & 0 \\ 0 & 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & -8 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \quad \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & -1 & -1 & 0 \\ 0 & -1 & 8 & -1 & 0 \\ 0 & -1 & -1 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

- Example

  N/A.

- Related API

  - MI_IVE_MagAndAng
  - MI_IVE_NormGrad

1.7. MI_IVE_MagAndAng

- Function

  Execute a 5x5 template gradient magnitude and angle calculation task.

- Syntax

  MI_S32 MI_IVE_MagAndAng(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDstMag, MI_IVE_DstImage_t *pstDstAng, MI_IVE_MagAndAngCtrl_t *pstMagAndAngCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDstMag	Output magnitude image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstDstAng	Output angle image pointer. According to pstMagAndAngCtrl→eOutCtrl, this	Output

Parameter Name	Description	Input/Output
	parameter cannot be null if output is required. Width and height same as pstSrc.	
pstMagAndAngCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1024
pstDstMag	U16C1	16 byte	Same as pstSrc
pstDstAng	U8C1	16 byte	Same as pstSrc

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Note

- Two output modes can be configured. For details, please refer to MI_IVE_MagAndAngOutCtrl_e.
- When the output mode is E_MI_IVE_MAG_AND_ANG_OUT_CTRL_MAG_AND_ANG, the stride of pstDstMag and the stride of pstDstAng must be consistent.
- User can utilize pstMagAndAngCtrl→u16Thr to do thresholding operation against magnitude map (to achieve EOH), the calculation formula is as follows:

$$Mag(x,y) = \begin{cases} 0 & Mag(x,y) < \text{u16Thr} \\ Mag(x,y) & Mag(x,y) \geq \text{u16Thr} \end{cases}$$

Where, Mag(x, y) refers to pstDstMag.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

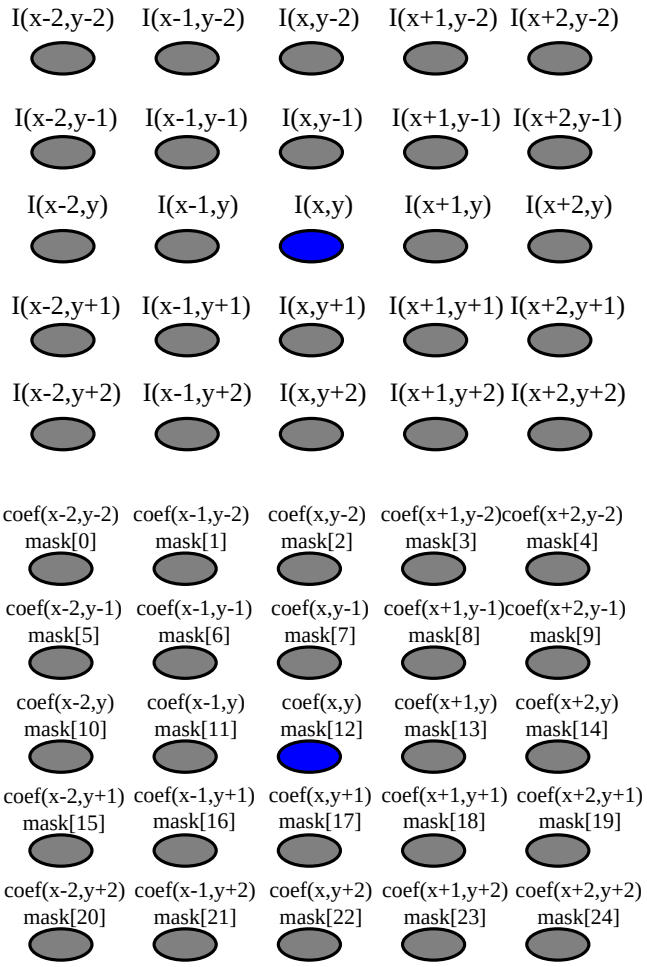
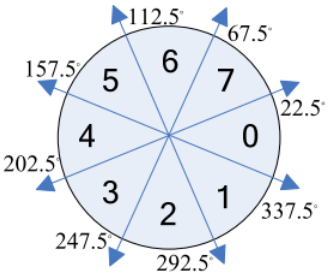


Figure 4: MagAndAng Calculation

$$H_{out}(x,y)=\sum_{-2\le i\le 2}\sum_{-2\le j\le 2} I(x+i,y+j)*coef(x+i,y+j)$$

$$V_{out}(x,y)=\sum_{-2\le i\le 2}\sum_{-2\le j\le 2} I(x+i,y+j)*coef(x+i,y+j)$$

$$Mag(x,y)=abs(H_{out}(x,y)+abs(V_{out}(x,y))$$



θ(x, y) takes the direction value corresponding to 0 to 7 in the above figure according to Hout(x, y), Vout(x, y) and arctan(Vout/Hout).θ(x,y).

Where, I(x,y) refers to pstSrc, Mag(x,y) refers to pstDstMag, θ(x,y) refers to pstDstAng, and coef(mask) refers to as8Mask[MI_IVE_MASK_SIZE_5X5] in pstMagAndAngCtrl.

- Example

  N/A.

- Related API

  - MI_IVE_CannyHysEdge
  - MI_IVE_CannyEdge
  - MI_IVE_Sobel

1.8. MI_IVE_Dilate

- Function

  Execute a binary image 5x5 template dilating task.

- Syntax

  MI_S32 MI_IVE_Dilate(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_DilateCtrl_t *pstDilateCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstDilateCtrl	Control info pointer.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1 binary image	16 byte	64x64～1920x1024
pstDst	U8C1 binary image	16 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

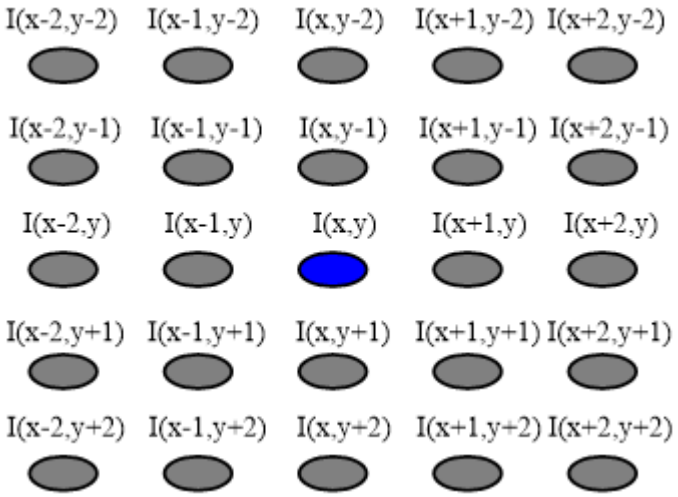
- Note

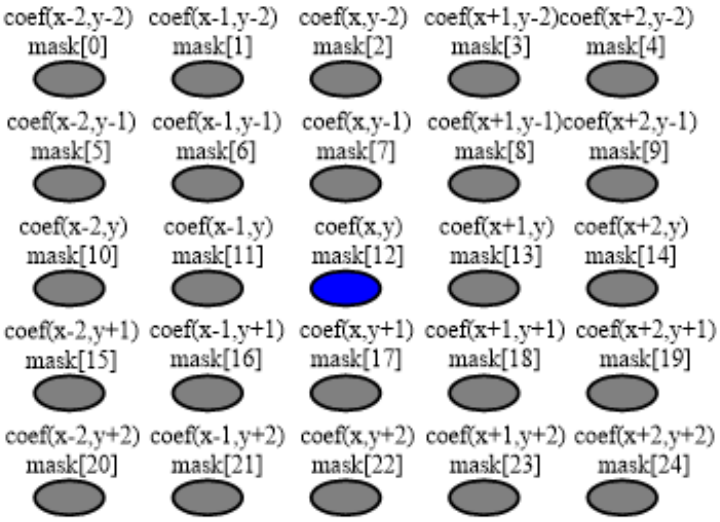
The template coefficient can only be 0 or 255.

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 255 & 0 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 0 & 255 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 255 & 255 & 255 & 0 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 0 & 255 & 255 & 255 & 0 \end{bmatrix} \begin{bmatrix} 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \end{bmatrix}$$

Figure 5: Dilate Calculation Formula





$$I_{out}(x,y) = \underset{-2\le i\le 2}{O}\left(\underset{-2\le j\le 2}{O}\left(f(i,j)\right)\right)$$

Where,

$$f(i,j) = I(x-i,y-j)\,\&\,coef(x-i,y-j)$$

$$\underset{-2\le k\le 2}{O}\left(g(k)\right) = g(-2)\,|\,g(-1)\,|\,g(0)\,|\,g(1)\,|\,g(2)$$

In the formula | is a bit or operation, & is a bit and operation, and % is a remainder operation. I(x,y) refers to pstSrc, Iout (x,y) refers to pstDst, and coef(mask) refers to au8Mask[MI_IVE_MASK_SIZE_5X5] in pstDilateCtrl.

- Example

N/A.

- Related API

  - MI_IVE_Erode
  - MI_IVE_OrdStatFilter

1.9. MI_IVE_Erode

- Function

Execute a binary image 5x5 template erosion task.

- Syntax

MI_S32 MI_IVE_Erode(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_ErodeCtrl_t *pstErodeCtrl,MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstErodeCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1 binary image	16 byte	64x64～1920x1024
pstDst	U8C1 binary image	16 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The template coefficient can only be 0 or 255.

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 255 & 0 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 0 & 255 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 255 & 255 & 255 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 255 & 255 & 255 & 0 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 0 & 255 & 255 & 255 & 0 \end{bmatrix} \begin{bmatrix} 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \\ 255 & 255 & 255 & 255 & 255 \end{bmatrix}$$

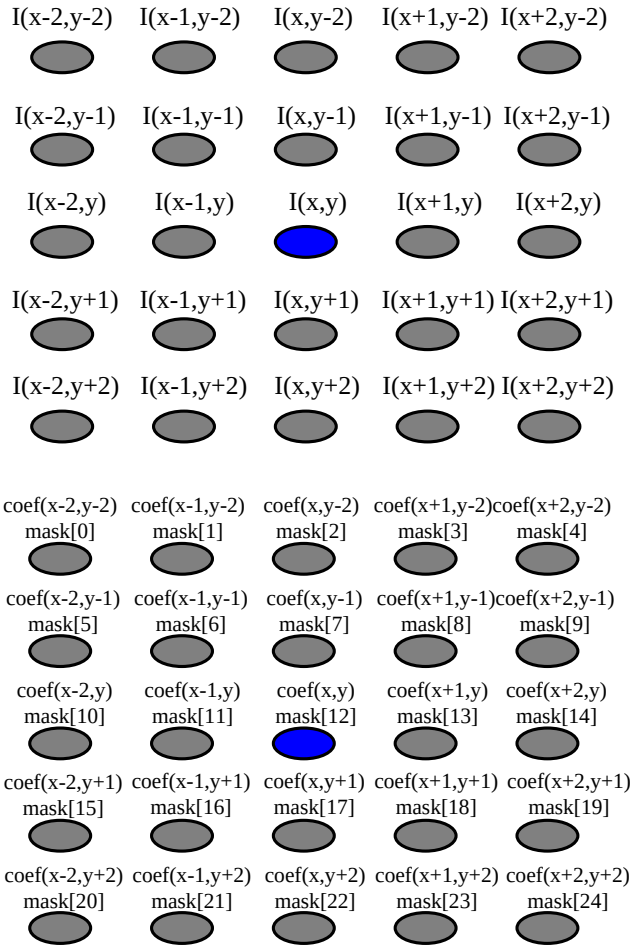


Figure 6: Erode Calculation Formula

$$I_{out}(x,y) = \underset{-2\le i\le 2}{O}\left(\underset{-2\le j\le 2}{O}\left(f(i,j)\right)\right)$$

Where,

$$f(i,j) = I(x-i,y-j)\,|\,\left(255 - coef(x-i,y-j)\right)$$

$$\underset{-2\le k\le 2}{O}\left(g(k)\right) = g(-2)\,\&\,g(-1)\,\&\,g(0)\,\&\,g(1)\,\&\,g(2),$$

In the formula | is a bit or operation, & is a bit and operation, and % is a remainder operation. $I(x, y)$ refers to pstSrc, $I_{out}(x, y)$ refers to pstDst, and *coef* (mask) refers to au8Mask[MI_IVE_MASK_SIZE_5X5] in pstErodeCtrl.

- Example

  N/A.

- Related API

  - MI_IVE_Dilate
  - MI_IVE_OrdStatFilter

1.10. MI_IVE_Thresh

- Function

  Execute a grayscale image thresholding task.

- Syntax

  MI_S32 MI_IVE_Thresh(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_ThreshCtrl_t *pstThrCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstThrCtrl	Control info pointer.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	1 byte	64x64～1920x1080
pstDst	U8C1	1 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  - 8 operation modes are available for configuration. For details, please refer to MI_IVE_ThreshMode_e.

- The calculation formula is as follows:

E_MI_IVE_THRESH_MODE_BINARY:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & \text{I(x , y)} \le \text{lowThr}\\ \text{maxVal} & \text{I(x , y)} > \text{lowThr}\end{cases}$$

midVal, highThr do not require to be assigned.

E_MI_IVE_THRESH_MODE_TRUNC:

$$I_{out}(x,y)=\begin{cases}\text{I(x, y)} & \text{I(x , y)} \le \text{lowThr}\\ \text{maxVal} & \text{I(x , y)} > \text{lowThr}\end{cases}$$

minVal, midVal, highThr do not require to be assigned.

E_MI_IVE_THRESH_MODE_TO_MINVAL:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & \text{I(x , y)} \le \text{lowThr}\\ \text{I(x , y)} & \text{I(x , y)} > \text{lowThr}\end{cases}$$

midVal, maxVal, highThr do not require to be assigned.

E_MI_IVE_THRESH_MODE_MIN_MID_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & \text{I(x , y)} \le \text{lowThr}\\ \text{midVal} & \text{lowThr} \le \text{I(x , y)} \le \text{highThr}\\ \text{maxVal} & \text{I(x , y)} > \text{highThr}\end{cases}$$

E_MI_IVE_THRESH_MODE_ORI_MID_MAX:

$$I_{out}(x,y)=\begin{cases}\text{I(x , y)} & \text{I(x , y)} \le \text{lowThr}\\ \text{midVal} & \text{lowThr} \le \text{I(x , y)} \le \text{highThr}\\ \text{maxVal} & \text{I(x , y)} > \text{highThr}\end{cases}$$

minVal does not require to be assigned.

E_MI_IVE_THRESH_MODE_MIN_MID_ORI:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & \text{I(x , y)} \le \text{lowThr}\\ \text{midVal} & \text{lowThr} \le \text{I(x , y)} \le \text{highThr}\\ \text{I(x , y)} & \text{I(x , y)} > \text{highThr}\end{cases}$$

maxVal does not require to be assigned.

E_MI_IVE_THRESH_MODE_MIN_ORI_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & \text{I(x , y)} \le \text{lowThr}\\ \text{I(x , y)} & \text{lowThr} \le \text{I(x , y)} \le \text{highThr}\\ \text{maxVal} & \text{I(x , y)} > \text{highThr}\end{cases}$$

midVal does not require to be assigned.

E_MI_IVE_THRESH_MODE_ORI_MID_ORI:

$$I_{out}(x,y)=\begin{cases} I(x,y) & I(x,y)\le lowThr \\ midVal & lowThr\le I(x,y)\le highThr \\ I(x,y) & I(x,y)>highThr \end{cases}$$

minVal, maxVal do not require to be assigned

Where, I(x,y) refers to pstSrc, Iout(x,y) refers to pstDst, and mode, lowThr, highThr, minVal, midVal and maxVal refer respectively to eMode, u8LowThr, u8HighThr, u8MinVal, u8MidVal and u8MaxVal in pstThrCtrl. Please refer to Figure 7 for the detailed illustration.

- u8MinVal, u8MidVal and u8MaxVal in pstThrCtrl do not need to satisfy the size relationship signified by the variable name.

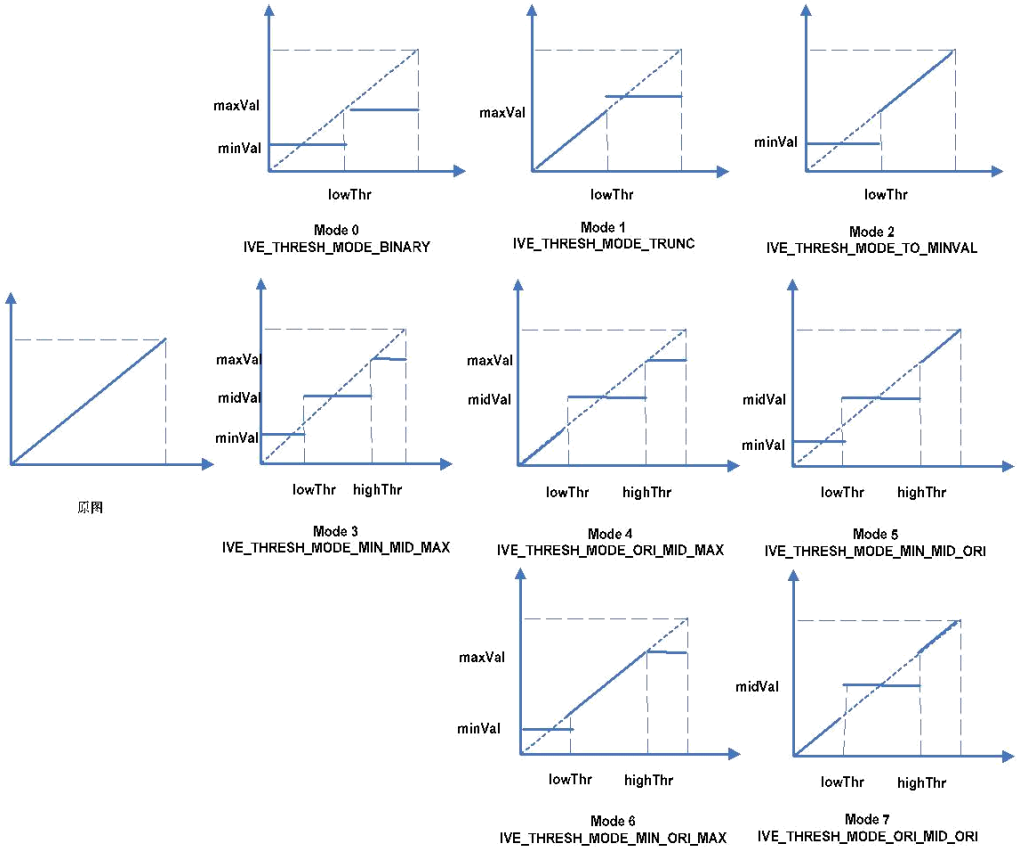


Figure 7: 8 Thresholding Modes

➢ Example

N/A.

➢ Related API

- MI_IVE_ThreshS16
- MI_IVE_ThreshU16

1.11. MI_IVE_And

- Function

  Execute an AND task against two binary images.

- Syntax

  MI_S32 MI_IVE_And(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstDst, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source image 1 pointer. Cannot be null.	Input
pstSrc2	Source image 2 pointer. Cannot be null. Width and height same as pstSrc1.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc1.	Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	U8C1 binary image	1 byte	64x64～1920x1080
pstSrc2	U8C1 binary image	1 byte	Same as pstSrc1
pstDst	U8C1 binary image	1 byte	Same as pstSrc1

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The calculation formula is as follows:

$$\mathbf{I}_{\text{out}}(x, y) = \mathbf{I}_{\text{src1}}(x, y) \,\&\, \mathbf{I}_{\text{src2}}(x, y)$$

Where, (,) 1 *I x y src refers to* pstSrc1, (,) 2 *I x y src refers to* pstSrc2, and *I* (*x*, *y*) *out* refers to pstDst

- Example

N/A.

- Related API

  - MI_IVE_Or
  - MI_IVE_Xor

1.12. MI_IVE_Sub

- Function

Execute a SUBTRACT task against two grayscale images.

- Syntax

MI_S32 MI_IVE_Sub(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstDst, MI_IVE_SubCtrl_t *pstSubCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source image 1 pointer. Cannot be null.	Input
pstSrc2	Source image 2 pointer. Cannot be null. Width and height same as pstSrc1.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc1.	Output
pstSubCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	U8C1	1 byte	64x64～1920x1080
pstSrc2	U8C1	1 byte	Same as pstSrc1
pstDst	U8C1, S8C1	1 byte	Same as pstSrc1

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note
  - Two output formats are available for configuration. For details, please refer to MI_IVE_SubMode_e.
  - E_MI_IVE_SUB_MODE_ABS
    calculation formula: $I_{out}(x,y)=abs(I_{src1}(x,y)I_{src2}(x,y))$
    Output format: U8C1
  - E_MI_IVE_SUB_MODE_SHIFT
    calculation formula: $I_{out}(x,y)=(I_{src1}(x,y)I_{src2}(x,y))>>1$
    Output format: S8C1
    where, $I_{src1}(x,y)$ refers to pstSrc1, $I_{src2}(x,y)$ refers to pstSrc2, and $I_{out}(x,y)$ refers to pstDst.

- Example

  N/A.

- Related API

  MI_IVE_Add

1.13. MI_IVE_Or

- Function

  Execute an OR task against two binary images.

- Syntax

MI_S32 MI_IVE_Or(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstDst, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source image 1 pointer. Cannot be null.	Input
pstSrc2	Source image 2 pointer. Cannot be null. Width and height same as pstSrc1.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc1.	Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	U8C1	1 byte	64x64～1920x1080
pstSrc2	U8C1	1 byte	Same as pstSrc1
pstDst	U8C1	1 byte	Same as pstSrc1

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The calculation formula is as follows:

$I_{out}(x,y)=I_{src1}(x,y)|I_{src2}(x,y)$

Where, $I_{src1}(x,y)$ refers to pstSrc1, $I_{src2}(x,y)$ refers to pstSrc2, and $I_{out}(x,y)$ refers to pstDst.

➢ Example

N/A.

➢ Related API

- MI_IVE_And
- MI_IVE_Xor

1.14. MI_IVE_Integ

➢ Function

Execute an integral graph statistics task against grayscale images.

➢ Syntax

MI_S32 MI_IVE_Integ(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_IntegCtrl_t *pstIntegCtrl, MI_BOOL bInstant);

➢ Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstIntegCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	32x16～1920x1080
pstDst	U32C1, U64C1	16 byte	Same as pstSrc

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note
  - For E_MI_IVE_INTEG_OUT_CTRL_COMBINE, the combined output mode, the output image type must be E_MI_IVE_IMAGE_TYPE_U64C1. The calculation formula is as follows:

$$I_{sum}(x, y) = \sum_{i\geq 0}^{i\leq x}\sum_{j\geq 0}^{j\leq y} I(i, j)$$

$$I_{sq}(x, y) = \sum_{i\geq 0}^{i\leq x}\sum_{j\geq 0}^{j\leq y} (I(i, j) \bullet I(i, j))$$

$$I_{out}(x, y) = (I_{sq}(x, y) << 28) \mid (I_{sum}(x, y) \,\&\, 0xFFFFFFF)$$

  - For E_MI_IVE_INTEG_OUT_CTRL_SUM, integral graph output mode, the output image type must be E_MI_IVE_IMAGE_TYPE_U32C1. The calculation formula is as follows:

$$I_{sum}(x, y) = \sum_{i\geq 0}^{i\leq x}\sum_{j\geq 0}^{j\leq y} I(i, j)$$

$$I_{out}(x, y) = I_{sum}(x, y)$$

  - For E_MI_IVE_INTEG_OUT_CTRL_SQSUM, square and integral graph output mode, the output image type must be E_MI_IVE_IMAGE_TYPE_U64C1. The calculation formula is as follows:

$$I_{sq}(x, y) = \sum_{i\geq 0}^{i\leq x}\sum_{j\geq 0}^{j\leq y} (I(i, j) \bullet I(i, j))$$

$$I_{out}(x, y) = I_{sq}(x, y)$$

    Where, $I(x,y)$ refers to pstSrc, and $I_{OUT}(x,y)$ refers to pstDst.

- Example

  N/A.

- Related API

  N/A.

1.15. MI_IVE_Hist

- Function

  Execute a histogram statistics task.

- Syntax

MI_S32 MI_IVE_Hist(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstMemInfo_t *pstDst, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output data pointer. Cannot be null. The memory should at least has 1024 bytes.	Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1080
pstDst	-	16 byte	-

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The calculation formula is as follows:

$$I_{out}(x) = \sum_{i}\sum_{j}((I(i,j) == x)?1:0) \quad x = 0...255$$

Where, I(i,j) refers to pstSrc, and Iout(x) refers to pstDst.

- Note

N/A.

➢ Related API

N/A.

1.16. MI_IVE_ThreshS16

➢ Function

Execute an S16 data to 8-bit data thresholding task.

➢ Syntax

MI_S32 MI_IVE_ThreshS16(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_ThreshS16Ctrl_t *pstThrS16Ctrl, MI_BOOL bInstant);

➢ Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, RGN_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstThrS16Ctrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	S16C1	2 byte	64x64～1920x1080
pstDst	U8C1, S8C1	1 byte	Same as pstSrc

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

- 4 operation modes are available for configuration. For details, please refer to MI_IVE_ThreshS16Mode_e.
- Calculation formula:

E_MI_IVE_THRESH_S16_MODE_S16_TO_S8_MIN_MID_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & (\text{I}(x,y)\le \text{lowThr})\\ \text{midVal} & (\text{lowThr}<\text{I}(x,y)\le \text{highThr})\\ \text{maxVal} & (\text{I}(x,y)>\text{highThr})\end{cases}$$

Requirement: -32768≤lowThr ≤ highThr ≤32767;
-128≤ minVal, midVal, maxVal ≤127.

E_MI_IVE_THRESH_S16_MODE_S16_TO_S8_MIN_ORI_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & (\text{I}(x,y)\le \text{lowThr})\\ \text{I}(x,y) & (\text{lowThr}<\text{I}(x,y)\le \text{highThr})\\ \text{maxVal} & (\text{I}(x,y)>\text{highThr})\end{cases}$$

Requirement: -129≤lowThr ≤ highThr ≤127;
-128≤ minVal, maxVal ≤127;

E_MI_IVE_THRESH_S16_MODE_S16_TO_U8_MIN_MID_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & (\text{I}(x,y)\le \text{lowThr})\\ \text{midVal} & (\text{lowThr}<\text{I}(x,y)\le \text{highThr})\\ \text{maxVal} & (\text{I}(x,y)>\text{highThr})\end{cases}$$

Requirement: -32768≤lowThr ≤ highThr ≤32767;
0≤ minVal, midVal, maxVal ≤255.

E_MI_IVE_THRESH_S16_MODE_S16_TO_U8_MIN_ORI_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & (\text{I}(x,y)\le \text{lowThr})\\ \text{I}(x,y) & (\text{lowThr}<\text{I}(x,y)\le \text{highThr})\\ \text{maxVal} & (\text{I}(x,y)>\text{highThr})\end{cases}$$

Requirement: -1≤lowThr ≤ highThr ≤255;
0≤ minVal, maxVal ≤255.

Where, I(x,y) refers to pstSrc, Iout (x,y) refers to pstDst, and mode, lowThr, highThr, minVal, midVal and maxVal refer respectively to eMode, s16LowThr, s16HighThr, un8MinVal, un8MidVal and un8MaxVal in pstThrS16Ctrl.

- un8MinVal, un8MidVal and un8MaxVal in pstThrS16Ctrl do not need to satisfy the size relationship signified by the variable name.

➢ Example

N/A.

➢ Related API

- MI_IVE_ThreshU16
- MI_IVE_16BitTo8Bit

1.17. MI_IVE_ThreshU16

➢ Function

Execute a U16 data to U8 data thresholding task.

➢ Syntax

MI_S32 MI_IVE_ThreshU16(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_ThreshU16Ctrl_t *pstThrU16Ctrl, MI_BOOL bInstant);

➢ Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstThrU16Ctrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U16C1	2 byte	64x64～1920x1080
pstDst	U8C1	1 byte	Same as pstSrc

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

- Two operation modes are available for configuration. For details, please refer to MI_IVE_ThreshU16Mode_e.
- Calculation formula:

E_MI_IVE_THRESH_U16_MODE_U16_TO_U8_MIN_MID_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & (\text{I}(\text{x},\text{y})\le \text{lowThr})\\ \text{midVal} & (\text{lowThr}<\text{I}(\text{x},\text{y})\le \text{highThr})\\ \text{maxVal} & (\text{I}(\text{x},\text{y})>\text{highThr})\end{cases}$$

Requirement: 0≤ *lowThr* ≤ *highThr* ≤65535;

E_MI_IVE_THRESH_U16_MODE_U16_TO_U8_MIN_ORI_MAX:

$$I_{out}(x,y)=\begin{cases}\text{minVal} & (\text{I}(\text{x},\text{y})\le \text{lowThr})\\ \text{I}(\text{x},\text{y}) & (\text{lowThr}<\text{I}(\text{x},\text{y})\le \text{highThr})\\ \text{maxVal} & (\text{I}(\text{x},\text{y})>\text{highThr})\end{cases}$$

Requirement: 0≤ *lowThr* ≤ *highThr* r≤255;

Where, $I(x,y)$ refers to pstSrc, $I_{out}(x,y)$ refers to pstDst, and mode, lowThr, highThr, minVal, midVal and maxVal refer respectively to eMode, u16LowThr, u16HighThr, u8MinVal, u8MidVal and u8MaxVal in pstThrU16Ctrl.

u8MinVal, u8MidVal and u8MaxVal in pstThrU16Ctrl do not need to satisfy the size relationship signified by the variable name.

➢ Example

N/A.

➢ Related API

- MI_IVE_ThreshS16
- MI_IVE_16BitTo8Bit

1.18. MI_IVE_16BitTo8Bit

➢ Function

Execute a 16-bit image data to 8-bit image data linear transformation task.

- Syntax

MI_S32 MI_IVE_16BitTo8Bit(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_16bitTo8BitCtrl_t *pst16BitTo8BitCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pst16BitTo8BitCtrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U16C1, S16C1	2 byte	64x64～1920x1080
pstDst	U8C1, S8C1	1 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  - 4 modes are available for configuration. For details, please refer to MI_IVE_16BitTo8BitMode_e.

- Calculation formula:

E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_S8:

$$I_{out}(x,y)=\begin{cases}-128 & (\frac{a}{b}I(x,y)<-128)\\ \frac{a}{b}I(x,y) & (-128\le\frac{a}{b}I(x,y)\le 127)\\ 127 & (\frac{a}{b}I(x,y)>127)\end{cases}$$

E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_U8_ABS:

$$I_{out}(x,y)=\begin{cases}\left|\frac{a}{b}I(x,y)\right| & (\left|\frac{a}{b}I(x,y)\right|\le 255)\\ 255 & (\left|\frac{a}{b}I(x,y)\right|>255)\end{cases}$$

E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_U8_BIAS:

$$I_{out}(x,y)=\begin{cases}0 & (\frac{a}{b}I(x,y)+bais<0)\\ \frac{a}{b}I(x,y)+bais & (0\le\frac{a}{b}I(x,y)+bais\le 255)\\ 255 & (\frac{a}{b}I(x,y)+bais>255)\end{cases}$$

E_MI_IVE_16BIT_TO_8BIT_MODE_U16_TO_U8:

$$I_{out}(x,y)=\begin{cases}0 & (\frac{a}{b}I(x,y)<0)\\ \frac{a}{b}I(x,y) & (0\le\frac{a}{b}I(x,y)\le 255)\\ 255 & (\frac{a}{b}I(x,y)>255)\end{cases}$$

Where, I(x,y) refers to pstSrc, Iout(x,y) refers to pstDst, and mode, a, b and bias refer respectively to eMode, u8Numerator, u16Denominator, and s8Bias in pst16BitTo8BitCtrl.

Requirement: u8Numerator ≤ u16Denominator, and u16Denominator≠0.

➢ Related API

- MI_IVE_ThreshS16
- MI_IVE_ThreshU16

1.19. MI_IVE_OrdStatFilter

➢ Function

Execute a 3x3 template sequential statistic filtering task. Median, Max, and Min filters are supported.

- Syntax

MI_S32 MI_IVE_OrdStatFilter(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_OrdStatFilter_t *pstOrdStatFltCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstOrdStatFltCtrl	Control parameter pointerCannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1024
pstDst	U8C1	16 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  - Three filter modes are available for configuration. For details, please refer to MI_IVE_OrdStatFilterMode_e.

- Calculation formula:

E_MI_IVE_ORD_STAT_FILTER_MODE_MEDIAN:

$$I_{out}(x,y) = \underset{-1\le i\le 1,-1\le j\le 1}{\text{median}}\{I(x+i,y+j)\}$$

E_MI_IVE_ORD_STAT_FILTER_MODE_MAX:

$$I_{out}(x,y) = \underset{-1\le i\le 1,-1\le j\le 1}{\max}\{I(x+i,y+j)\}$$

E_MI_IVE_ORD_STAT_FILTER_MODE_MIN:

$$I_{out}(x,y) = \underset{-1\le i\le 1,-1\le j\le 1}{\min}\{I(x+i,y+j)\}$$

Where, $I(x,y)$ refers to pstSrc and $I_{out}(x,y)$ refers to pstDst.

➢ Example

N/A.

➢ Related API

- MI_IVE_Filter
- MI_IVE_Dilate
- MI_IVE_Erode

1.20. MI_IVE_Map

➢ Function

Execute a Map (mapping assignment) task, by looking up the Map to look for the value for each pixel of the source image in the lookup table, and assigning to the target image the value in the corresponding pixel lookup table. U8C1→U8C1 mode mapping is supported.

➢ Syntax

MI_S32 MI_IVE_Map(MI_IVE_HANDLE hHandle,MI_IVE_SrcImage_t *pstSrc, MI_IVE_SrcMemInfo_t *pstMap, MI_IVE_DstImage_t *pstDst, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstMap	Mapping table info pointer. Cannot be null. The memory should at least have the size of (MI_IVE_MapLutMem_t).	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	1 byte	64x64～1920x1080
pstMap	-	16 byte	-
pstDst	U8C1	1 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The calculation formula is as follows:

$$I_{out}(x, y) = map[I(x, y)]$$

Where, $I(x,y)$ refers to pstSrc, $I_{Out}(x,y)$ refers to pstDst, and *map* refers to pstMap.

- Example

N/A.

- Related API

  N/A.

1.21. MI_IVE_EqualizeHist

- Function

  Execute a grayscale-image histogram equalization calculation task.

- Syntax

  MI_S32 MI_IVE_EqualizeHist(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MI_IVE_EqualizeHistCtrl_t *pstEqualizeHistCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstEqualizeHistCtrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1080
pstDst	U8C1	16 byte	Same as pstSrc
pstEqualizeHistCtrl→stMem	-	16 byte	-

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a
- Note

  stMem in pstEqualizeHistCtrl should at least have the size of (MI_IVE_EqualizeHistCtrlMem_t) and agree with the histogram equalization calculation process.
- Example

  N/A.
- Related API

  N/A.

1.22. MI_IVE_Add

- Function

  Execute a weighted addition calculation task against two grayscale images.
- Syntax

  MI_S32 MI_IVE_Add(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1,MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstDst, MI_IVE_AddCtrl_t *pstAddCtrl, MI_BOOL bInstant);
- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source image 1 pointer. Cannot be null.	Input
pstSrc2	Source image 2 pointer. Cannot be null. Width and height same as pstSrc1.	Input
pstDst	Output image pointer. Width and height same as pstSrc1; Cannot be null.	Output
pstAddCtrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	U8C1	1 byte	64x64～1920x1080
pstSrc2	U8C1	1 byte	Same as pstSrc
pstDst	U8C1	1 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The calculation formula is as follows:

$$I_{out}(x,y) = x * I_{src1}(x,y) + y * I_{src2}(x,y)$$

Where, $I_1(i,j)$ refers to pstSrc1, $I_2(i,j)$ refers to pstSrc2, $I_{out}(i,j)$ refers to pstDst, and x, y *refer to* u0q16X and u0q16Y in pstAddCtrl. It is required that $0<x<1$, $0<y<1$ and $x+y=1$ before the fixed point.

- Example

N/A.

- Related API

MI_IVE_Sub

1.23. MI_IVE_Xor

- Function

Execute an XOR calculation task against two binary graphs.

- Syntax

MI_S32 MI_IVE_Xor(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstDst, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source image 1 pointer. Cannot be null.	Input
pstSrc2	Source image 1 pointer. Cannot be null. Width and height same as pstSrc1.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc1.	Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	U8C1	1 byte	64x64～1920x1080
pstSrc2	U8C1	1 byte	Same as pstSrc
pstDst	U8C1	1 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The calculation formula is as follows:

$$I_{out}(x,y) = I_{src1}(x,y) \wedge I_{src2}(x,y)$$

Where, $I_{src1}(x,y)$ refers to pstSrc1, $I_{src2}(x,y)$ refers to pstSrc2, and $I_{dst}(x,y)$ refers to pstDst.

- Example

N/A.

➢ Related API

- MI_IVE_And
- MI_IVE_Or

1.24. MI_IVE_Ncc

➢ Function

Execute a normalized cross-correlation calculation task against two grayscale images of the same resolution.

➢ Syntax

MI_S32 MI_IVE_Ncc(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstMemInfo_t *pstDst, MI_BOOL bInstant);

➢ Return Value

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source 1 image pointer. Cannot be null.	Input
pstSrc2	Source 2 image pointer. Cannot be null. Width and height same as pstSrc1.	Input
pstDst	Output data pointer. Cannot be null. The memory should at least have the size of (MI_IVE_NccDstMem_t).	Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	U8C1	1 byte	32x32～1920x1080
pstSrc2	U8C1	1 byte	Same as pstSrc
pstDst	-	16 byte	-

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

The calculation formula is as follows:

$$NCC(\mathrm{I}_{src1},\mathrm{I}_{src2}) = \frac{\sum_{i=1}^{w}\sum_{j=1}^{h}(I_{src1}(i,j)*I_{src2}(i,j))}{\sqrt{\sum_{i=1}^{w}\sum_{j=1}^{h}(I^{2}_{src1}(i,j))}\sqrt{\sum_{i=1}^{w}\sum_{j=1}^{h}(I^{2}_{src2}(i,j))}}$$

The numerator of the formula above, the two denominators before the square root, i.e. pstDst→u64 numerator, pstDst→u64 QuadSum1, and pstDst→u64 QuadSum2 refer to the following of the above formula:

$$\sum_{i=1}^{w}\sum_{j=1}^{h}(I_{src1}(i,j)*I_{src2}(i,j)),\quad \sum_{i=1}^{w}\sum_{j=1}^{h}(I^{2}_{src1}(i,j)),\quad \sum_{i=1}^{w}\sum_{j=1}^{h}(I^{2}_{src2}(i,j))$$

➢ Example

N/A.

➢ Related API

N/A.

1.25. MI_IVE_Ccl

➢ Function

Execute a connected region label task against binary images.

➢ Syntax

MI_S32 MI_IVE_Ccl(MI_IVE_HANDLE hHandle, MI_IVE_Image_t *pstSrcDst, MI_IVE_DstMemInfo_t *pstBlob, MI_IVE_CclCtrl_t *pstCclCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrcDst	Source image pointer. Connected region is labelged on the source image, i.e. source image is also the labelged image output. Cannot be null.	Input, Output
pstBlob	Connected region info pointer. Cannot be null. The memory should at least have the size of (MI_IVE_CcBlob_t), and output at most 254 valid connected regions.	Output
pstCclCtrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrcDst	U8C1	16 byte	-
pstBlob	-	16 byte	-

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

Connected region information is kept in pstBlob→astRegion.

pstBlob→u8RegionNum represents the number of valid connected regions, 254 at most supported. The area size of the valid connected region is larger than pstBlob→u16CurAreaThr, and the label is the subscript of the pstBlob→astRegion array element +1. The valid connected region is not necessarily stored consecutively in the array; instead, it can be intermittently distributed in the array.

If pstBlob→s8LabelStatus is 0, the label task is successful (one label one area); if pstBlob→s8LabelStatus is -1, some error has occurred in the label task (multiple labels assigned to one area or multiple area sharing one label). For the latter case, if the correct label is required, relabelging based on the external rectangle information in pstBlob will be necessary. Whether the labelging is successful or not, the external rectangle information in the connected region remains correct and applicable.

The connected region for output will use pstCclCtrl→u16InitAreaThr for filtering. Area size smaller than or equal to pstCclCtrl→u16InitAreaThr will be marked as 0.

When the number of connected regions exceeds 254, pstCclCtrl→u16InitAreaThr function will be used to exclude smaller connected regions. If pstCclCtrl→u16InitAreaThr does not help exclude any connected region, pstCclCtrl→u16Step will be taken as the step to increase the connected region size threshold value.

The final area size threshold value is saved in pstBlob→u16CurAreaThr. You can use the index 254 to record the excluded connected region size.

- Example

N/A.

- Related API

N/A.

1.26. MI_IVE_Gmm

- Function

Execute a GMM background modelling task. Grayscale image is supported by RGB_PACKAGE image GMM background modelling. The Gaussian model number is 3 or 5.

- Syntax

MI_S32 MI_IVE_Gmm(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstFg, MI_IVE_DstImage_t *pstBg, MI_IVE_MemInfo_t *pstModel,MI_IVE_GmmCtrl_t *pstGmmCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstFg	Foreground image pointer. Cannot be null. Width and height same as pstSrc.	Output

Parameter Name	Description	Input/Output
pstBg	Background image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstModel	GMM modelling parameter pointer. Cannot be null.	Input, Output
pstGmmCtrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1, U8C3_PACKAGE	16 byte	-
pstFg	U8C1 binary image	16 byte	-
pstBg	Same as pstSrc	16 byte	-
pstModel	-	16 byte	-

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

The GMM implementation reference MOG and MOG2 of OpenCV.

The source image types supported are U8C1 and U8C3_PACKAGE, which are used respectively for GMM background modelling of grayscale images and RGB images.

Foreground images are binary images, the only valid type of which is U8C1. Background images are consistent in type with source images.

Grayscale image GMM employs n (n=3 or 5) Gaussian models. The memory allocation of pstModel is as illustrated below.

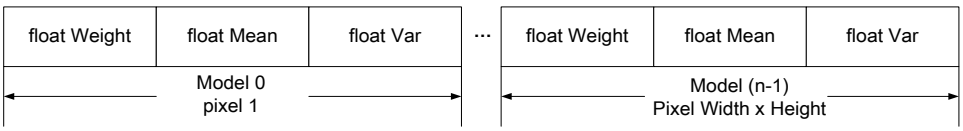


Figure 8: Grayscale Image GMM Model Memory Allocation

A single Gaussian model parameter for a pixel uses 2 bytes for weight, 2 bytes for mean, and 3 bytes for var. Hence, the memory size to be allocated to pstModel is:

pstModel→u32Size = 7 * pstSrc→u16Width * pstSrc→u16Height * pstGmmCtrl→u8ModeNum

RGB image GMM employs n (n=3 or 5) Gaussian models. The memory allocation of pstModel is as illustrated below.

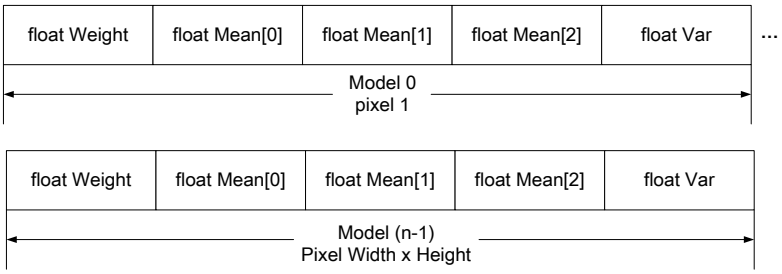


Figure 9: RGB Image GMM Model Memory Allocation

A single Gaussian model parameter for a pixel uses 4 bytes for weight, 4*3 bytes for mean[3], and 4 bytes for var. Hence, the memory size to be allocated to pstModel is:

pstModel→u32Size = 20 * pstSrc→u16Width * pstSrc→u16Height * pstGmmCtrl→u8ModeNum

- Example

N/A.

- Related API

N/A.

1.27. MI_IVE_CannyHysEdge

- Function

Execute the first half of Canny edge extraction task against grayscale images: Gradient, gradient amplitude calculation, hysteresis thresholding and non-maximum suppression.

- Syntax

MI_S32 MI_IVE_CannyHysEdge(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstEdge, MI_IVE_DstMemInfo_t *pstStack, MI_IVE_CannyHysEdgeCtrl_t *pstCannyHysEdgeCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstEdge	Strong and weak edge mark image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstStack	Strong edge point coordinate stack. Cannot be null. Memory should at least be: pstSrc→u16Width * pstSrc→u16Height * (sizeof(MI_IVE_PointU16_t)) + sizeof(MI_IVE_CannyStackSize_t)	Output
pstCannyHysEdgeCtrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1024
pstEdge	U8C1	16 byte	Same as pstSrc
pstStack	-	16 byte	-
pstCannyHysEdgeCtrl→stMem	-	16 byte	-

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  pstEdge has only three values: 0, 1, and 2

  0 means weak edge point.

  1 means non-edge point

  2 means strong edge point.

  pstStack stores the coordinate information of strong edge point.

  pstCannyHysEdgeCtrl→stMem requires at least the following memory size: pstCannyHysEdgeCtrl→stMem.u32Size

  = IveGetStride(pstSrc→u16Width, MI_IVE_STRIDE_ALIGN)* 3 * pstSrc→u16Height.

  After completing the task, you must call the MI_IVE_CannyEdge function to output the Canny edge image.

- Example

  N/A.

- Related API

  MI_IVE_CannyEdge

1.28. MI_IVE_CannyEdge

- Function

  Execute the second half of Canny edge extraction task against grayscale images: connecting edge points to form a Canny edge map.

- Syntax

  MI_S32 MI_IVE_CannyEdge(MI_IVE_HANDLE hHandle, MI_IVE_Image_t *pstEdge, MI_IVE_MemInfo_t *pstStack, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstEdge	Strong and weak edge mark image pointer when used as an input; edge binary image pointer when used as an output. Cannot be null.	Input, Output
pstStack	Strong edge point coordinate stack. Cannot be null.	Input, Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstEdge	U8C1	16 byte	64x64～1920x1024
pstStack	-	16 byte	-

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  Before using the interface, you must call MI_IVE_CannyHysEdge first. When the MI_IVE_CannyHysEdge task is finished, you can use the MI_IVE_CannyHysEdge pstEdge, pstStack output as the parameter input of the interface.

- Example

  N/A.

- Related API

  MI_IVE_CannyHysEdge

1.29. MI_IVE_Lbp

- Function

  Execute an LBP calculation task.

- Syntax

  MI_S32 MI_IVE_Lbp(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstDst, MI_IVE_LbpCtrrl_t *pstLbpCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source image pointer. Cannot be null.	Input
pstSrc2	Source image pointer. Cannot be null. If input channel mode is U8C1，it's can be null.	Input
pstDst	Output image pointer. Cannot be null. Width and height same as pstSrc.	Output
pstLbpCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64~1920x1024
pstDst	U8C1	16 byte	64x64~1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  The LBP calculation formula is as illustrated in the following figure.

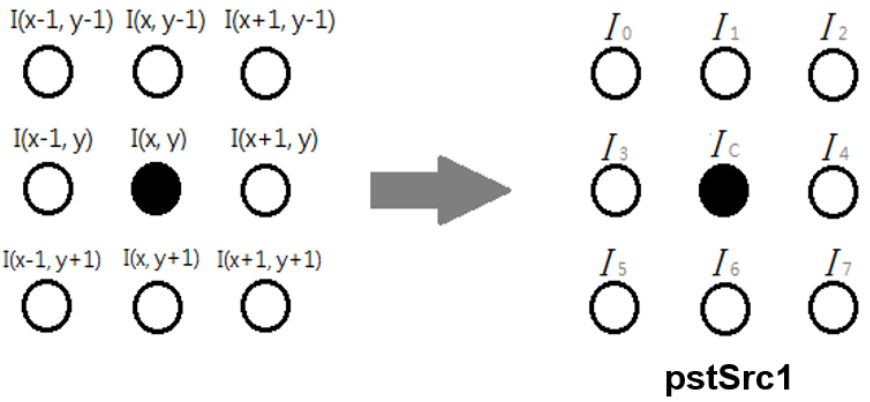


Figure 10: LBP Calculation Formula with mode E_MI_IVE_LBP_CHAL_MODE_U8C1

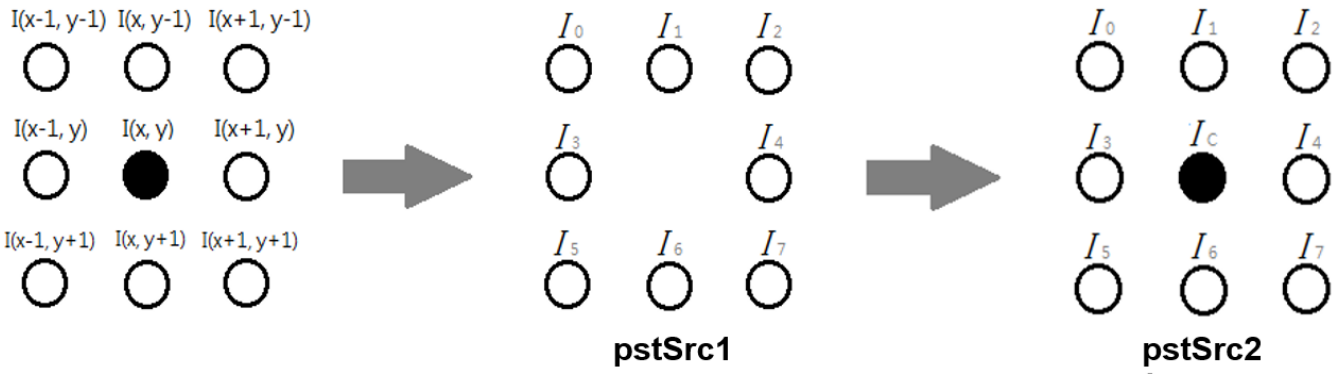


Figure 11: LBP Calculation Formula with mode E_MI_IVE_LBP_CHAL_MODE_U8C1

E_MI_IVE_LBP_CMP_NORMAL

$$lbp(x,y)=\sum_{i=0}^{7}((I_i-I_c)>=thr)<<(7-i),thr\in[-128,127];$$

E_MI_IVE_LBP_CMP_ABS

$$lbp(x,y)=\sum_{i=0}^{7}(abs(I_i-I_c)>=thr)<<(7-i),thr\in[0,255]$$

E_MI_IVE_LBP_CMP_MODE_ABS_MUL

$$lbp(x,y)=\sum_{i=0}^{7}\left(abs\left(I_i-I_c\right)\geq thr\times I_c\right)\ll(7-i),thr\in[0,1]$$

Where U8C1 mode, *I*(*x*,*y*) refers to pstSrc1, *lpb*(*x*,*y*) refers to pstDst, and *thr* refers to pstLbpCtrl→un8BitThr. Where U8C2 mode, I_c refers to pstScr2.

- Example

N/A.

- Related API

  N/A.

1.30. MI_IVE_NormGrad

- Function

  Execute a normalized gradient calculation task, in which the gradient average components are normalized to S8.

- Syntax

  MI_S32 MI_IVE_NormGrad(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDstH, MI_IVE_DstImage_t *pstDstV, MI_IVE_DstImage_t *pstDstHV, MI_IVE_NormGradCtrl_t *pstNormGradCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDstH	Gradient component image H pointer gained by template filtering and normalization to S8. According to pstNormGradCtrl→eOutCtrl, this parameter cannot be null if output is required.	Output
pstDstV	Gradient component image V pointer gained by transposed template filtering and normalization to S8. According to pstNormGradCtrl→eOutCtrl, this parameter cannot be null if output is required.	Output
pstDstHV	Image pointer gained by template and transposed template filtering and normalization to S8. The image pointer is saved in package format. According to pstNormGradCtrl→eOutCtrl, this parameter cannot be null if output is required.	Output
pstNormGradCtrl	Control info pointer.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1024
pstDstH	S8C1	16 byte	Same as pstSrc

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstDstV	S8C1	16 byte	Same as pstSrc
pstDstHV	S8C2_PACKAGE	16 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  The output modes of the control parameter are as follows:

  For E_MI_IVE_NORM_GRAD_OUT_CTRL_HOR_AND_VER, pstDstH and pstDstV pointers cannot be null and the strides thereof should be consistent.

  For E_MI_IVE_NORM_GRAD_OUT_CTRL_HOR, pstDstH cannot be null.

  For E_MI_IVE_NORM_GRAD_OUT_CTRL_VER, pstDstV cannot be null.

  For E_MI_IVE_NORM_GRAD_OUT_CTRL_COMBINE, pstDstHV cannot be null.

- Example

  N/A.

- Related API

  MI_IVE_Sobel

1.31. MI_IVE_LkOpticalFlow

- Function

  Execute a single layer LK optical flow calculation task.

- Syntax

  MI_S32 MI_IVE_LKOpticalFlow(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrcPre, MI_IVE_SrcImage_t *pstSrcCur, MI_IVE_SrcMemInfo_t *pstPoint, MI_IVE_MemInfo_t *pstMv, MI_IVE_LkOpticalFlowCtrl_t *pstLkOptiFlowCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrcPre	Previous image pointer. Cannot be null.	Input
pstSrcCur	Current image pointer. Cannot be null. Width and height same as pstSrcPre.	Input
pstPoint	Current pyramid layer initial feature point coordinate. Cannot be null. The coordinate can only be of the type MI_IVE_PointS25Q7_t. The memory should at least have the size below: pstLkOptiFlowCtrl→u16CornerNum * sizeof(MI_IVE_PointS25Q7_t).	Input
pstMv	Corresponds to pstPoint feature point motion displacement vector. Cannot be null. The first calculation needs to be initialized to 0 input; the subsequent layer calculation should input the motion displacement vector calculated by the upper layer. The displacement can only be of the type MI_IVE_MvS9Q7_t. The memory should at least have the size below: pstLkOptiFlowCtrl→u16CornerNum * sizeof(MI_IVE_MvS9Q7_t)	Input, Output
pstLkOptiFlowCtrl	Control parameter pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrcPre	U8C1	16 byte	64x64～720x576
pstSrcCur	U8C1	16 byte	Same as pstSrcPre

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

In solving the following optical flow equation, only 7x7 pixels around the feature point are used to calculate the corresponding I_x, I_y, I_t.

$$\begin{bmatrix} \sum I_x^2 & \sum I_x I_y \\ \sum I_x I_y & \sum I_y^2 \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} -\sum I_x I_t \\ -\sum I_y I_t \end{bmatrix}$$

Where, I_x, I_y, I_t refer respectively to the partial derivation of the current image in the x, y direction and the difference between the current image and the previous image.

Let's take the following 3-layer pyramid LK optical flow calculation as an example. The width and height of the image of each layer must be half the width and height of the image of its upper layer. The calculation method is as shown in the following figure.

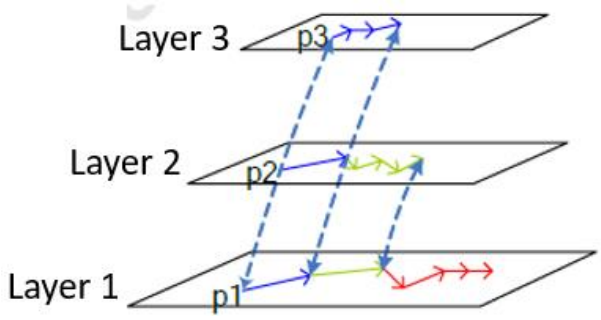


Figure 12: 3-Layer Pyramid LK Optical Flow Calculation

The 3-layer pyramid feature points corresponding to the coordinates p0, p1, p2 are calculated based on the input feature point coordinate:

The displacement mv2 on the second layer is obtained by calling LK operator with p2 and mv2 with initial 0 as the input.

The displacement mv1 on the first layer is obtained by calling LK operator with p1 and mv2 as the input.

The displacement mv0 on the 0th layer is obtained by calling LK operator with p0 and mv1 as the input.

If the 0th layer is not the original image, the true displacement mv of the LK optical flow can be obtained according to the proportional relationship between the 0th layer and the original image.

Design and usage restrictions: Each feature point is calculated only by the data of the fixed size window centered on the feature point. If the feature point displacement target point exceeds the fixed size window during the iterative calculation process, the calculation optical flow would fail.

- Example

N/A.

- Related API

N/A.

1.32. MI_IVE_Sad

- Function

  Calculate 16-bit/8-bit SAD images of 4x4/8x8/16x16 blocks for two images, and threshold output for SAD

- Syntax

  MI_S32 MI_IVE_Sad(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstSad, MI_IVE_DstImage_t *pstThr, MI_IVE_SadCtrl_t *pstSadCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Source image 1 pointer. Cannot be null.	Input
pstSrc2	Source image 2 pointer. Cannot be null. Width and height same as pstSrc1.	Input
pstSad	Output SAD image pointer. According to pstSadCtrl→eOutCtrl, this parameter cannot be null if output is required. According to pstSadCtrl→eMode, refers to 4x4, 8x8, and 16x16 block modes, the width and height thereof being 1/4, 1/8, and 1/16 of pstSrc1 respectively.	Output
pstThr	Output SAD thresholding image pointer. According to pstSadCtrl→eOutCtrl, this parameter cannot be null if output is required. According to pstSadCtrl→eMode, refers to 4x4, 8x8, and 16x16 block modes, the width and height thereof being 1/4, 1/8, and 1/16 of pstSrc1 respectively.	Output
pstSadCtrl	Control info pointer. Cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	U8C1	1 byte	64x64～1920x1080
pstSrc2	U8C1	1 byte	Same as pstSrc1
pstSad	U8C1, U16C1	16 byte	According to pstSadCtrl→eMode, refers to 4x4, 8x8, and 16x16 block modes, the width and height

Parameter Name	Supported Image Type	Address Alignment	Resolution
			thereof being 1/4, 1/8, and 1/16 of pstSrc1 respectively.
pstThr	U8C1	16 byte	According to pstSadCtrl→eMode, refers to 4x4, 8x8, 16x16 block modes, the width and height thereof being 1/4, 1/8, and 1/16 of pstSrc1 respectively.

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

The calculation formula is as follows:

$$SAD_{out}(x,y) = \sum_{i=0}^{M-1}\sum_{j=0}^{M-1} abs(I_{src1}(M*x+i, M*y+j) - I_{src2}(M*x+i, M*y+j))$$

$$\mathrm{Thr}(x,y) = \begin{cases} minVal \cdots O(x,y) \leq Thresh \\ maxVal \cdots O(x,y) > Thresh \end{cases}$$

Where, I_{src1} refers to pstSrc1, I_{src2} refers to pstSrc2, $SAD_{Out}(x,y)$ refers to pstSad; M is related to pstSadCtrl→eMode, and represents 4, 8, and 16 when referring to E_MI_IVE_SAD_MODE_MB_4X4, E_MI_IVE_SAD_MODE_MB_8X8, and E_MI_IVE_SAD_MODE_MB_16X16; $THR_{Out}(x,y)$ refers to pstThr; *Thr*, *minVal* and *maxVal* refer respectively to pstSadCtrl→u16Thr, pstSadCtrl→u8MinVal and pstSadCtrl→u8MaxVal.

➢ Example

N/A.

➢ Related API

N/A.

1.33. MI_IVE_Bernsen

- Function

  Execute a Bernsen thresh task for the 3x3 and 5x5 windows.

- Syntax

  MI_S32 MI_IVE_Bernsen(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst,MVE_IVE_BernsenCtrl_t *pstBernsenCtrl,MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Source image pointer. Cannot be null.	Input
pstDst	Pointer to the output image template. It cannot be null. The height and width are the same as those of pstSrc.	Output
pstBernsenCtrl	Pointer to the control parameter. It cannot be null.	Output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1024
pstDst	S8C1	16 byte	Same as pstSrc

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  Two modes are supported. For details, see MVE_IVE_BernsenMode_e.

The following are related formulas:

– MVE_BERNSEN_MODE_NORMAL

$$T(x,y)=0.5\times\left(\max_{-\omega\le i\le\omega,-\omega\le j\le\omega} I(x+i,y+j)+\min_{-\omega\le i\le\omega,-\omega\le j\le\omega} I(x+i,y+j)\right)$$

$$I_{out}(x,y)=\begin{cases}0 & I(x,y)<T(x,y)\\ 1 & I(x,y)\ge T(x,y)\end{cases}$$

No value needs to be assigned to pstBernsenCtrl->u8Thr.

– MVE_BERNSEN_MODE_THRESH

$$T(x,y)=0.5\times\left(\max_{\substack{-\omega\le i\le\omega\\-\omega\le j\le\omega}} I(x+i,y+j)+\min_{\substack{-\omega\le i\le\omega\\-\omega\le j\le\omega}} I(x+i,y+j)\right)$$

$$I_{out}(x,y)=\begin{cases}0 & I(x,y)<0.5\times(T(x,y)+Thr)\\ 1 & I(x,y)\ge 0.5\times(T(x,y)+Thr)\end{cases}$$

I(x,y) corresponds to pstSrc, Iout(x,y) corresponds to pstDst, and Thr corresponds to u8thr in pstBernsenCtrl.

➢ Example

N/A.

➢ Related API

N/A.

1.34. MI_IVE_LineFilterHor

➢ Function

Execute a horizontal density filter task for binary images.

➢ Syntax

MI_S32 MI_IVE_LineFilterHor(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrcDst, MVE_IVE_LineFilterHorCtrl_t *pstLineFilterHorCtrl, MI_BOOL bInstant);

➢ Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrcDst	Pointer to the source image or the output after processing. It cannot be null.	Input / Output
pstLineFilterHorCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrcDst	U8C1 binary image	16 byte	64x64～1920x1024

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

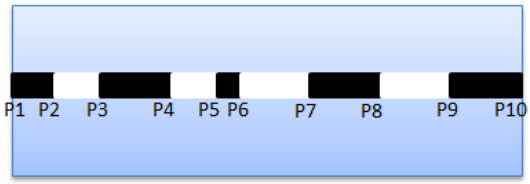
- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

The images are counted in the horizontal direction. Each line consists of line segments that appear alternatively (white line segments) and gaps between the line segments (black line segments). The length of a black line segment is satisfied the following condition, the block line segment is set to a white line segment.

The following is the calculation principle:

Step 1: Horizontal scan the binary image, and record the result, as shown in the figure below.



Step 2: Assume the current gap is line_black56, if conform to the condition as below, the black line segment will be set to a white line segment.

Condition 1: line_black34 > thr1

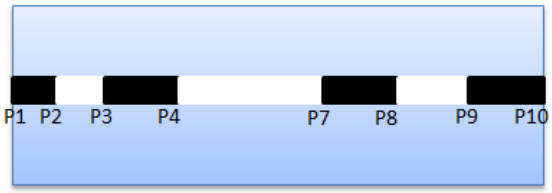
Condition 2: line_black78 > thr1

Condition 3: (line_white45 + line_black56 + line_white67) <= (line_white45 + line_white67)×thr2

Condition 4: (line_white45 + line_white67) > 1

Step 3: Following these step (step 1 and step 2), until handle the whole binary image.

The result is shown in figure below.



Step 4: Horizontal scan the binary image again. According to the relationship between the white line segment and black line segment, transform the black line segment into the white line segment.

Step 5: Assume the current gap is line_black34, if conform to the condition as below, the black line segment will be set to a white line segment.

Condition 1: line_block34 < thr3

Condition 2: line_white47 > 2×thr3

Condition 3: line_white23 > 9

Condition 4: line_white23 < 3×thr3

Step 6: Following these step (step 4 and step 5), until handle the whole binary image.

- Example

N/A.

- Related API

N/A.

1.35. MI_IVE_LineFilterVer

- Function

Execute a vertical density filter task for binary images.

- Syntax

MI_S32 MI_IVE_LineFilterVer(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrcDst, MVE_IVE_LineFilterVerCtrl_t *pstLineFilterVerCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrcDst	Pointer to the source image or the output after processing. It cannot be null.	Input / Output
pstLineFilterVerCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrcDst	U8C1 binary image	16 byte	64x64～1920x1024

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

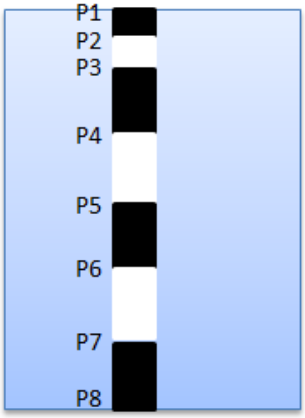
➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

The images are counted in the vertical direction. Each line consists of line segments that appear alternatively white line segments and gaps between the line segments (black line segments). The length of a black line segment is satisfied the following condition, the block line segment is set to a white line segment.
The following is the calculation principle:

Step 1 : Vertical scan the binary image, and record the result, as shown in the figure below.



Step 2: Assume the current gap is line_black56, if conform to the condition as below, the black line segment will be set to a white line segment.

Condition 1 : line_black56 < thr

Condition 2 : line_black67 > 6 & line_whitr67 < 25

Condition 3 : line_white45 < 12

Step 3 : Following these step (step 1 and step 2), until handle the whole binary image.

- Example

  N/A.

- Related API

  N/A.

1.36. MI_IVE_NoiseRemoveHor

- Function

  Execute a horizontal noise removal task for binary images.

- Syntax

  MI_S32 MI_IVE_NoiseRemoveHor(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrcDst, MVE_IVE_NoiseRemoveHorCtrl_t *pstNoiseRemoveHorCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrcDst	Pointer to the source image or the output after processing. It cannot be null.	Input / Output
pstNoiseRemoveHorCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrcDst	U8C1 binary image	16 byte	64x64～1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  The images are counted in the horizontal direction. Each line consists of line segments that appear alternatively (white line segments) and gaps between the line segments (black line segments). The length of a line segment is smaller than the thr1 or bigger than the thr2, the line segment is set to a gap.

- Example

  N/A.

- Related API

  N/A.

1.37. MI_IVE_NoiseRemoveVer

- Function

  Execute a vertical noise removal task for binary images.

- Syntax

  MI_S32 MI_IVE_NoiseRemoveHor(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrcDst, MVE_IVE_NoiseRemoveVerCtrl_t *pstNoiseRemoveVerCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrcDst	Pointer to the source image or the output after processing. It cannot be null.	Input / Output
pstNoiseRemoveVerCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrcDst	U8C1 binary image	16 byte	64x64～1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  The images are counted in the vertical direction. Each line consists of line segments that appear alternatively (white line segments) and gaps between the line segments (black line segments). The length of a line segment is smaller than the thr1 or bigger than the thr2, the line segment is set to a gap.

- Example

  N/A.

- Related API

  N/A.

1.38. MI_IVE_AdpThresh

- Function

  Execute an adaptive thresh task.

- Syntax

  MI_S32 MI_IVE_AdpThresh(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_SrcImage_t *pstInteg, MI_IVE_DstImage_t *pstDst, MVE_IVE_AdpThreshCtrl_t *pstAdpThrCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Pointer to the source image or the output after processing. It cannot be null.	Input
pstInteg	Pointer to the integral image of the source image. It cannot be null.	Input
pstDst	Pointer to the target binary image. It cannot be null.	output
pstAdpThrCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1	16 byte	64x64～1920x1024
pstInteg	U32C1	16 byte	64x64～1920x1024
pstDst	U8C1	16 byte	64x64～1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The following is the formula:

$$T(x,y)=\frac{1}{w\times h}\times\sum_{i=-h/2}^{h/2}\sum_{j=-w/2}^{w/2}I(x+i,y+j)$$

w = u8HalfMaskx

h = u8HalfMasky

$$RateThr = u8RateThr/10$$

$$Offset = s16Offset$$

$$ValueThr = u8ValueThr$$

$$I_{out}(x,y)=\begin{cases}0 & I(x,y)\le(T(x,y)\times RateThr)-Offset \quad \&\ I(x,y)<ValueThr\\ 1 & I(x,y)>(T(x,y)\times RateThr)-Offset \quad \|\ I(x,y)\ge ValueThr\end{cases}$$

I(x, y) corresponds to pstSrc, Iout(x,y) corresponds to pstDst, W , h , RateThr , 0ffset and ValueThr correspond to u8HalfMaskx , u8HalfMasky , u8RateThr , s16Offset and u8ValueThr in pstAdpThrCtrl. The integrogram pstInteg is adopted to rapidly calculate the area by using.

$$\sum_{i=-h/2}^{h/2} \sum_{j=-w/2}^{w/2} I(x+i, y+j)$$

- Example

  N/A.

- Related API

  N/A.

1.39. MI_IVE_Resize

- Function

  Execute an image scaling task.

- Syntax

  MI_S32 MI_IVE_Resize(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstImage_t *pstDst, MVE_IVE_ResizeCtrl_t * pstResizeCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Pointer to the source image or the output after processing. It cannot be null.	Input
pstDst	Pointer to the target binary image. It cannot be null.	output
pstResizeCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1, U8C3_PLANAR, U8C3_PACKAGE and YUV420SP	16 byte	64x64～1920x1024
pstDst	U8C1, U8C3_PLANAR, U8C3_PACKAGE and YUV420SP	16 byte	64x64～1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  Resize is implemented by referring standard bilinear method.

- Example

  N/A.

- Related API

  N/A.

1.40. MI_IVE_Bat

- Function

  Execute the horizontal or vertical alternating time for binary images.

- Syntax

  MI_S32 MI_IVE_BAT (MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc, MI_IVE_DstMemInfo_t *pstDstH, MI_IVE_DstMemInfo_t *pstDstV, MVE_IVE_BatCtrl_t *pstCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc	Pointer to the source image. It cannot be null.	Input
pstDstH	Pointer to the horizontal output image. It cannot be null.	output
pstDstV	Pointer to the vertical output image. It cannot be null.	output
pstCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc	U8C1 binary image	16 byte	64x64～1920x1024
pstDstH	U8C1 binary image	16 byte	64x64～1920x1024
pstDstV	U8C1 binary image	16 byte	64x64～1920x1024

➢ Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

➢ Requirement

- Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
- Library: libive.a

➢ Note

Horizontal(vertical) scan the input binary image, when found the adjacent value are different, the result of horizontal(vertical) alternating time h(v) will plus 1, the final horizontal output O(h) and vertical output O(v) as follows :

$$O(h) = \begin{cases} 1, h \geq u16HorTimes \\ 0, h < u16HorTimes \end{cases}$$

$$O(v) = \begin{cases} 1, v \geq u16VerTimes \\ 0, v < u16VerTimes \end{cases}$$

➢ Example

N/A.

➢ Related API

N/A.

1.41. MI_IVE_Acc

➢ Function

Execute an accumulation task for two gray-scale images.

- Syntax

MI_S32 MI_IVE_Acc (MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t * pstSrc0, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_DstImage_t *pstDst, MVE_IVE_AccCtrl_t * pstAccCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc0	Pointer to the source image or the output after processing. It cannot be null.	Input
pstSrc1	Pointer to the source image or the output after processing. It cannot be null.	Input
pstDst	Pointer to the target binary image. It cannot be null.	output
pstAccCtrl	Pointer to the control parameter. It cannot be null.	Input
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc0	U8C1	16 byte	64x64～1920x1024
pstSrc1	U8C1	16 byte	64x64～1920x1024
pstDst	U8C1	16 byte	64x64～1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement

  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

E_MI_IVE_ACC_MODE_INCREASE

$$I_{out}(x,y) = I_{src0}(x,y) + I_{src1}(x,y)$$

E_MI_IVE_ACC_MODE_DECREASE

$$I_{out}(x,y) = I_{src0}(x,y) - I_{src1}(x,y)$$

E_MI_IVE_ACC_MODE_INCREASE_MAP_255TO1

$$I_{out}(x,y) = I_{src0}(x,y) + (I_{src1}(x,y) \,\&\, 0x1)$$

- Example

N/A.

- Related API

N/A.

1.42. MI_IVE_Matrix_Transform

- Function

Execute the operation of matrix multiplication

- Syntax

MI_S32 MI_IVE_Matrix_Transform(MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_SrcImage_t *pstSrc3, MI_IVE_DstImage_t *pstDst1, MI_IVE_DstImage_t *pstDst2, MI_IVE_DstImage_t *pstDst3, MI_IVE_MatrTranfCtrl_t *pstMatrTranfCtrl, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Pointer to the source image. It cannot be null.	Input
pstSrc2	Pointer to the source image. It cannot be null.	Input
pstSrc3	Pointer to the source image. It cannot be null.	Input
pstDst1	Pointer to the output image. It cannot be null.	output
pstDst2	Pointer to the output image. It cannot be null.	output
pstDst3	Pointer to the output image. It cannot be null.	output
pstMatrTranfCtrl	Pointer to the control parameter. It cannot be	Input

Parameter Name	Description	Input/Output
	null.	
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	S32C1	16 byte	64x64～1920x1024
pstSrc2	S32C1	16 byte	64x64～1920x1024
pstSrc3	S32C1	16 byte	64x64～1920x1024
pstDst1	S32C1	16 byte	64x64～1920x1024
pstDst2	S32C1	16 byte	64x64～1920x1024
pstDst3	S32C1	16 byte	64x64～1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

  The matrix_transform calculation formula is as illustrated in the following figure.

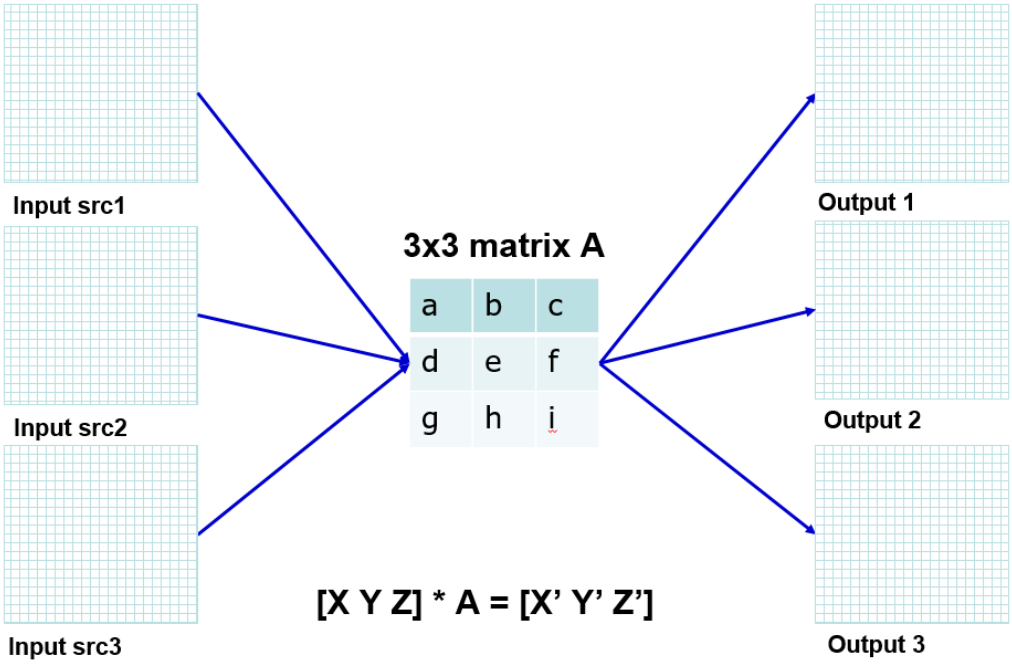


Figure 13: Illustration of matrix_transform calculation formula

Each input and output element consists of 16 integer, 15 decimal and 1 sign.
Each input element of matrix consists of 1 integer, 14 decimal and 1 sign.

- Example

N/A.

- Related API

N/A.

1.43. MI_IVE_Image_Dot

- Function

Execute the operation of dot product.

- Syntax

MI_S32 MI_IVE_ Image_Dot (MI_IVE_HANDLE hHandle, MI_IVE_SrcImage_t *pstSrc1, MI_IVE_SrcImage_t *pstSrc2, MI_IVE_DstImage_t *pstDst, MI_BOOL bInstant);

- Parameter

Parameter Name	Description	Input/Output
hHandle	Regional handle number. Parameter range: [0, MI_IVE_HANDLE_MAX).	Input
pstSrc1	Pointer to the source image. It cannot be null.	Input

Parameter Name	Description	Input/Output
pstSrc2	Pointer to the source image. It cannot be null.	Input
pstDst	Pointer to the output image. It cannot be null.	output
bInstant	Reserved.	Input

Parameter Name	Supported Image Type	Address Alignment	Resolution
pstSrc1	S32C1	16 byte	64x64～1920x1024
pstSrc2	S32C1	16 byte	64x64～1920x1024
pstDst	S32C1	16 byte	64x64～1920x1024

- Return Value

Return Value	Description
0	Successful.
Non-zero	Failed. Please refer to Error Codes.

- Requirement
  - Header: mi_comm_ive.h, mi_ive.h, mi_ive.h
  - Library: libive.a

- Note

The calculation formula is as follows:

$$I_{out} = I_{src1}(x,y) \times I_{src2}(x,y)$$

Each input and output element consists of 16 integer, 15 decimal and 1 sign.

- Example

N/A.

- Related API

N/A.

2. IVE DATA TYPE

The table below lists the data structure definitions of the related IVE data types:

MI_IVE_HIST_NUM	Defines histogram statistics bin number
MI_IVE_MAP_NUM	Defines number of mapping lookup table entries
MI_IVE_MAX_REGION_NUM	Defines maximum number of connected regions
MI_IVE_ST_MAX_CORNER_NUM	Defines maximum number of Shi-Tomasi-like corners
MI_IVE_ImageType_e	Defines image types supported by generalized two-dimensional images
MI_IVE_Image_t	Defines generalized two-dimensional image information
MI_IVE_SrcImage_t	Defines source image
MI_IVE_DstImage_t	Defines output image
MI_IVE_Data_t	Defines two-dimensional image information in byte unit
MI_IVE_SrcData_t	Defines two-dimensional source data information in byte unit
MI_IVE_DstData_t	Defines two-dimensional output data information in byte unit
MI_IVE_MemInfo_t	Defines one-dimensional data memory information
MI_IVE_SrcMemInfo_t	Defines one-dimensional source data
MI_IVE_DstMemInfo_t	Defines one-dimensional output data
MI_IVE_Length8bit_u	Defines 8-bit data union
MI_IVE_PointU16_t	Defines U16 point information structure
MI_IVE_PointS25Q7_t	Defines S25Q7 fixed point information structure
MI_IVE_Rect_t	Defines U16 rectangle information structure
MI_IVE_FilterCtrl_t	Defines template filter control information
MI_IVE_CscMode_e	Defines color space conversion mode
MI_IVE_CscCtrl_t	Defines color space conversion control information
MI_IVE_FilterAndCscCtrl_t	Defines template filter plus color space conversion composite function control information
MI_IVE_SobelOutCtrl_e	Defines Sobel output control information
MI_IVE_SobelCtrl_t	Defines Sobel edge extraction control information
MI_IVE_MagAndAngOutCtrl_e	Defines Canny edge magnitude and angle calculation output format
MI_IVE_MagAndAngCtrl_t	Defines Canny edge magnitude and angle calculation control information
MI_IVE_DilateCtrl_t:	Defines Dilate control information
MI_IVE_ErodeCtrl_t	Defines Erode control information
MI_IVE_ThreshMode_e	Defines image binarization output format

MI_IVE_ThreshCtrl_t	Defines image binarization control information
MI_IVE_SubMode_e	Defines image subtraction output format
MI_IVE_SubCtrl_t	Defines image subtraction control parameter
MI_IVE_IntegOutCtrl_e	Defines integral map output control parameter
MI_IVE_IntegCtrl_t	Defines integral map calculation control parameter
MI_IVE_ThreshS16Mode_e	Defines 16-bit signed image thresholding mode
MI_IVE_ThreshS16Ctrl_t	Defines 16-bit signed image thresholding control parameter
MI_IVE_ThreshU16Mode_e:	Defines 16-bit unsigned image thresholding mode
MI_IVE_ThreshU16Ctrl_t	Defines 16-bit unsigned image thresholding control parameter
MI_IVE_16BitTo8BitMode_e	Defines 16-bit image to 8-bit image conversion mode
MI_IVE_16bitTo8BitCtrl_t	Defines 16-bit image to 8-bit image conversion control parameter
MI_IVE_OrdStatFilterMode_e	Defines sequential statistic filtering mode
MI_IVE_OrdStatFilterCtrl_t	Defines sequential statistic filtering control parameter
MI_IVE_MapLutMem_t	Defines Map operator lookup table memory information
MI_IVE_EqualizeHistCtrlMem_t	Defines histogram equalization auxiliary memory
MI_IVE_EqualizeHistCtrl_t:	Defines histogram equalization control parameter
MI_IVE_AddMode_e	Define the add calculation mode
MI_IVE_AddCtrl_t	Defines image weighted addition control parameter
MI_IVE_NccDstMem_t	Defines NCC output memory information
MI_IVE_Region_t	Defines connected region information
MI_IVE_CcBlob_t	Defines connected region label output information
MI_IVE_CclMode_e	Defines connected region mode
MI_IVE_CclCtrl_t:	Defines connected region label control parameter
MI_IVE_GmmCtrl_t	Defines GMM background modelling control parameter
MI_IVE_CannyStackSize_t	Defines strong edge point stack size structure in Canny edge first-half calculation
MI_IVE_CannyHysEdgeCtrl_t	Defines control parameter in Canny edge first-half calculation
MI_IVE_LbpCmpMode_e	Defines LBP calculation comparison mode.
MI_IVE_LbpChalMode_e	Define LBP input channel mode
MI_IVE_LbpCtrrl_t	Defines LBP texture calculation control parameter
MI_IVE_NormGradOutCtrl_e	Defines normalized gradient information calculation task output control enumeration type
IVE_NormGradCtrl_t	Defines normalized gradient information calculation control parameter
MI_IVE_MvS9Q7_t	Defines displacement structure
MI_IVE_LkOpticalFlowCtrl_t	Defines LK optical flow calculation control parameter
MI_IVE_SadMode_e	Defines SAD calculation mode

MI_IVE_SadOutCtrl_e	Defines SAD output control mode
MI_IVE_SadCtrl_t	Defines SAD control parameter
MVE_IVE_BernsenCtrl_t	Defines Bernsen thresh control parameters.
MVE_IVE_BernsenMode_e	Defines the Bernsen thresh mode.
MVE_IVE_LineFilterHorCtrl_t	Defines control parameters for filtering the horizontal density of binary images.
MVE_IVE_LineFilterVerCtrl_t	Defines control parameters for filtering the vertical density of binary images.
MVE_IVE_NoiseRemoveHorCtrl_t	Defines the horizontal noise removal control parameter for the binary image.
MVE_IVE_NoiseRemoveVerCtrl_t	Defines the vertical noise removal control parameter for the binary image.
MVE_IVE_AdpThreshCtrl_t	Defines adaptive thresh control parameters.
MVE_IVE_ResizeCtrl_t	Define the resize control parameter
MVE_IVE_ResizeMode_e	Define the resize input image mode
MVE_IVE_BatCtrl_t	Define the bat control parameter
MVE_IVE_BatMode_e	Define the bat output control mode
MVE_IVE_AccCtrl_t	Define the acc control parameter
MVE_IVE_AccMode_e	Define the acc input control mode
MI_IVE_MatrTranfMode_e	Define the input channel mode of matrix transform
MI_IVE_MatrTranfCtrl_t	Define the control parameters of matrix transform.

2.1. Fixed Point Data Type

Description

Defines fixed point data type.

Defines

```
typedef    unsigned char     MI_U0Q8;
typedef    unsigned char     MI_U1Q7;
typedef    unsigned char     MI_U5Q3;
typedef    unsigned short    MI_U0Q16;
typedef    unsigned short    MI_U4Q12;
typedef    unsigned short    MI_U6Q10;
typedef    unsigned short    MI_U8Q8;
typedef    unsigned short    MI_U14Q2;
typedef    unsigned short    MI_U12Q4;
typedef    short             MI_S14Q2;
typedef    short             MI_S9Q7;
typedef    unsigned int      MI_U22Q10;
typedef    unsigned int      MI_U25Q7;
typedef    int               MI_S25Q7;
typedef    unsigned short    MI_U8Q4F4;   /*8bits unsigned integer, 4bits decimal
                                            fraction, 4bits flag bits*/
```

Member

Member Code	Description
MI_U0Q8	0 bit for integer part, and 8 bits for decimal part. Represented in document as UQ0.8.
MI_U1Q7	High-order 1-bit unsigned data for integer part, and low-order 7 bits for decimal part. Represented in document as UQ1.7.
MI_U5Q3	High-order 5-bit unsigned data for integer part, and low-order 3 bits for decimal part. Represented in document as UQ5.3.
MI_U0Q16	0 bit for integer part, and 16 bits for decimal part. Represented in document as UQ0.16.
MI_U4Q12	High-order 4-bit unsigned data for integer part, and low-order 12 bits for decimal part. Represented in document as UQ4.12.
MI_U6Q10	High-order 6-bit unsigned data for integer part, and low-order 10 bits for decimal part. Represented in document as UQ6.10.
MI_U8Q8	High-order 8-bit unsigned data for integer part, and low-order 8 bits for decimal part. Represented in document as UQ8.8.
MI_U14Q2	High-order 14-bit unsigned data for integer part, and low-order 2 bits for decimal part. Represented in document as UQ14.2.
MI_U12Q4	High-order 12-bit unsigned data for integer part, and low-order 4 bits for decimal part. Represented in document as UQ12.4.

Member Code	Description
MI_S14Q2	High-order 14-bit signed data for integer part, and low-order 2 bits for decimal part. Represented in document as SQ14.2.
MI_S9Q7	High-order 9-bit signed data for integer part, and low-order 7 bits for decimal part. Represented in document as SQ9.7.
MI_U22Q10	High-order 22-bit unsigned data for integer part, and low-order 10 bits for decimal part. Represented in document as UQ22.10.
MI_U25Q7	High-order 25-bit unsigned data for integer part, and low-order 7 bits for decimal part. Represented in document as UQ25.7.
MI_S25Q7	High-order 25-bit signed data for integer part, and low-order 7 bits for decimal part. Represented in document as SQ25.7.
MI_U8Q4F4	High-order 8-bit unsigned data for integer part, middle 4 bits for decimal part, and low-order 4 bits for flagging. Represented in document as UQF8.4.4.

Note

MI_UxQyFz\MI_SxQy:

- The x after the letter U means x bits of unsigned data are used for integer part.
- The x after the letter S means x bits of signed data are used for integer part.
- The y after the letter Q means y bits of data are used for decimal part.
- The z after the letter F means z bits are used for flagging.
- Highest bit on the leftmost side and lowest bit on the rightmost side.

Related Data Type and Interface

N/A.

2.2. MI_IVE_HIST_NUM

Description

Defines histogram statistics bin number.

Defines

```
#define MI_IVE_HIST_NUM  256
```

Member

N/A.

Note

N/A.

Related Data Type and Interface

N/A.

2.3. MI_IVE_MAP_NUM

Description

Defines number of mapping lookup table entries.

Defines

#define MI_IVE_MAP_NUM 256

Member

N/A.

Note

N/A.

Related Data Type and Interface

N/A.

2.4. MI_IVE_MAX_REGION_NUM

Description

Defines maximum number of connected regions.

Defines

#define MI_IVE_MAX_REGION_NUM 255

Member

N/A.

Note

N/A.

Related Data Type and Interface

N/A.

2.5. MI_IVE_ST_MAX_CORNER_NUM

Description

Defines maximum number of Shi-Tomasi-like corners.

Defines

#define MI_IVE_ST_MAX_CORNER_NUM 200

Member

N/A.

Note

N/A.

Related Data Type and Interface

N/A.

2.6. MI_IVE_MASK_SIZE_5X5

Description

Defines mask size.

Defines

```
#define MI_IVE_MASK_SIZE_5X5 25
```

Member

N/A.

Note

N/A.

Related Data Type and Interface

N/A.

2.7. MI_IVE_CANNY_STACK_RESERVED_SIZE

Description

Defines Canny stack reserved size.

Defines

```
#define MI_IVE_CANNY_STACK_RESERVED_SIZE 12
```

Member

N/A.

Note

N/A.

Related Data Type and Interface

N/A.

2.8. MI_IVE_ImageType_e

Description

Defines image types supported by generalized two-dimensional images.

Defines

```
typedef enum
{
    E_MI_IVE_IMAGE_TYPE_U8C1            =0x0,
    E_MI_IVE_IMAGE_TYPE_S8C1            =0x1,
    E_MI_IVE_IMAGE_TYPE_YUV420SP        =0x2, /*YUV420 SemiPlanar*/
    E_MI_IVE_IMAGE_TYPE_YUV422SP        =0x3, /*YUV422 SemiPlanar*/
    E_MI_IVE_IMAGE_TYPE_YUV420P         =0x4, /*YUV420 Planar*/
    E_MI_IVE_IMAGE_TYPE_YUV422P         =0x5, /*YUV422 planar*/
    E_MI_IVE_IMAGE_TYPE_S8C2_PACKAGE =0x6,
    E_MI_IVE_IMAGE_TYPE_S8C2_PLANAR  =0x7,
    E_MI_IVE_IMAGE_TYPE_S16C1           =0x8,
    E_MI_IVE_IMAGE_TYPE_U16C1           =0x9,
    E_MI_IVE_IMAGE_TYPE_U8C3_PACKAGE =0xa,
    E_MI_IVE_IMAGE_TYPE_U8C3_PLANAR  =0xb,
    E_MI_IVE_IMAGE_TYPE_S32C1           =0xc,
    E_MI_IVE_IMAGE_TYPE_U32C1           =0xd,
    E_MI_IVE_IMAGE_TYPE_S64C1           =0xe,
    E_MI_IVE_IMAGE_TYPE_U64C1           =0xf,
    E_MI_IVE_IMAGE_TYPE_BUTT
}MI_IVE_ImageType_e;
```

Member

Member Code	Description
E_MI_IVE_IMAGE_TYPE_U8C1	Single-channel image, in which each pixel is represented by one 8-bit unsigned data entry.
E_MI_IVE_IMAGE_TYPE_S8C1	Single-channel image, in which each pixel is represented by one 8-bit signed data entry.
E_MI_IVE_IMAGE_TYPE_YUV420SP	Image in YUV420 semiplanar format.
E_MI_IVE_IMAGE_TYPE_YUV422SP	Image in YUV422 semiplanar format.
E_MI_IVE_IMAGE_TYPE_YUV420P	Image in YUV420 planar format.
E_MI_IVE_IMAGE_TYPE_YUV422P	Image in YUV422 planar format.
E_MI_IVE_IMAGE_TYPE_S8C2_PACKAGE	Dual-channel image in package format, in which each pixel is represented by two 8-bit signed data entries.
E_MI_IVE_IMAGE_TYPE_S8C2_PLANAR	Dual-channel image in planar format, in which each pixel is represented by two 8-bit signed data entries.
E_MI_IVE_IMAGE_TYPE_S16C1	Single-channel image, in which each pixel is represented by one 16-bit signed data entry.
E_MI_IVE_IMAGE_TYPE_U16C1	Single-channel image, in which each pixel is represented by one 16-bit unsigned data entry.

Member Code	Description
E_MI_IVE_IMAGE_TYPE_U8C3_PACKAGE	3-channel image in package format, in which each pixel is represented by three 8-bit unsigned data entries.
E_MI_IVE_IMAGE_TYPE_U8C3_PLANAR	3-channel image in planar format, in which each pixel is represented by three 8-bit unsigned data entries.
E_MI_IVE_IMAGE_TYPE_S32C1	Single-channel image, in which each pixel is represented by one 32-bit signed data entry.
E_MI_IVE_IMAGE_TYPE_U32C1	Single-channel image, in which each pixel is represented by one 32-bit unsigned data entry.
E_MI_IVE_IMAGE_TYPE_S64C1	Single-channel image, in which each pixel is represented by one 64-bit signed data entry.
E_MI_IVE_IMAGE_TYPE_U64C1	Single-channel image, in which each pixel is represented by one 64-bit unsigned data entry.

Note

N/A.

Related Data Type and Interface

MI_IVE_Image_t
MI_IVE_SrcImage_t
MI_IVE_DstImage_t

2.9. MI_IVE_Image_t

Description

Defines generalized two-dimensional image information.

Defines

```
typedef struct MI_IVE_Image_s
{
    MI_IVE_ImageType_e eType;
    MI_PHY aphyPhyAddr[3];
    MI_U8 *apu8VirAddr[3];
    MI_U16 au16Stride[3];
    MI_U16 u16Width;
    MI_U16 u16Height;
    MI_U16 u16Reserved;      /*Can be used such as elemSize*/
}MI_IVE_Image_t;
```

Member

Member Code	Description
enType	Generalized image type.
aphyPhyAddr[3]	Generalized image physical address array.
apu8VirAddr[3]	Generalized image virtual address array.
au16Stride[3]	Generalized image stride.
u16Width	Generalized image width.
u16Height	Generalized image height.
u16Reserved	Reserved.

Note

Different operators have different requirements as to the alignment of image input/output address.
u16Width, u16Height and u16Stride are all in pixel unit.

Related Data Type and Interface

MI_IVE_ImageType_e
MI_IVE_SrcImage_t
MI_IVE_DstImage_t

2.10. MI_IVE_SrcImage_t

Description

Defines source image.

Defines

typedef MI_IVE_Image_t MI_IVE_SrcImage_t;

Member

N/A.

Note

N/A.

Related Data Type and Interface

MI_IVE_Image_t
MI_IVE_DstImage_t

2.11. MI_IVE_DstImage_t

Description

Defines output image.

Defines

typedef MI_IVE_Image_t MI_IVE_DstImage_t;

Member

N/A.

Note

N/A.

Related Data Type and Interface

MI_IVE_Image_t
MI_IVE_SrcImage_t

2.12. MI_IVE_Data_t

Description

Defines two-dimensional data information in byte unit.

Defines

```
typedef struct MI_IVE_Data_s
{
    MI_PHY phyPhyAddr;      /*Physical address of the data*/
    MI_U8 *pu8VirAddr;
    MI_U16 u16Stride;    /*Data stride by byte*/
    MI_U16 u16Height;   /*Data height by byte*/
    MI_U16 u16Width;    /*Data width by byte*/
    MI_U16 u16Reserved;
}MI_IVE_Data_t;
```

Member

Member Code	Description
phyPhyAddr	Image physical address.
pu8VirAddr	Image virtual address.
u16Stride	Image stride.
u16Height	Image width.
u16Width	Image height.
u16Reserved	Reserved.

Note

Represents two-dimensional data in byte unit; can be converted with MI_IVE_Image_t image.

Related Data Type and Interface

N/A.

2.13. MI_IVE_SrcData_t

Description

Defines two-dimensional source data information in byte unit

Defines

typedef MI_IVE_Data_t MI_IVE_SrcData_t;

Member

N/A.

Note

N/A.

Related Data Type and Interface

MI_IVE_Image_t
MI_IVE_DstData_t

2.14. MI_IVE_DstData_t

Description

Defines two-dimensional output data information in byte unit.

Defines

typedef MI_IVE_Data_t MI_IVE_DstData_t;

Member

N/A.

Note

N/A.

Related Data Type and Interface

MI_IVE_Image_t
MI_IVE_SrcImage_t

2.15. MI_IVE_MemInfo_t

Description

Defines one-dimensional data memory information.

Defines

```
typedef struct MI_IVE_MemInfo_s
{
    MI_PHY
    phyPhyAddr;
    MI_U8 *pu8VirAddr;
    MI_U32 u32Size;
}MI_IVE_MemInfo_t;
```

Member

Member Code	Description
phyPhyAddr	One-dimensional data physical address.
pu8VirAddr	One-dimensional data virtual address.
u32Size	One-dimensional data byte size.

Note

N/A.

Related Data Type and Interface

MI_IVE_SrcMemInfo_t
MI_IVE_DstMemInfo_t

2.16. MI_IVE_SrcMemInfo_t

Description

Defines one-dimensional source data.

Defines

```
typedef MI_IVE_MemInfo_t MI_IVE_SrcMemInfo_t;
```

Member

N/A.

Note

N/A.

Related Data Type and Interface

MI_IVE_MemInfo_t
MI_IVE_DstMemInfo_t

2.17. MI_IVE_DstMemInfo_t

Description

Defines one-dimensional output data.

Defines

typedef MI_IVE_MemInfo_t MI_IVE_DstMemInfo_t;

Member

N/A.

Note

N/A.

Related Data Type and Interface

MI_IVE_MemInfo_t
MI_IVE_SrcMemInfo_t

2.18. MI_IVE_Length8bit_u

Description

Defines 8-bit data union.

Defines

```
typedef union
{
    MI_S8
    s8Val;
    MI_U8
    u8Val;
} MI_IVE_Length8bit_u;
```

Member

Member Code	Description
s8Val	Signed 8-bit value.
u8Val	Unsigned 8-bit value.

Note

N/A.

Related Data Type and Interface

N/A.

2.19. MI_IVE_PointU16_t

Description

Defines U16 point information structure.

Defines

```
typedef struct MI_IVE_PointU16_s
{
        MI_U16
         u16X;
        MI_U16
         u16Y;
}MI_IVE_PointU16_t;
```

Member

Member Code	Description
u16X	x coordinate of point.
u16Y	y coordinate of point.

Note

N/A.

Related Data Type and Interface

N/A.

2.20. MI_IVE_PointS25Q7_t

Description

Defines S25Q7 fixed-point information structure.

Defines

```
typedef struct MI_IVE_PointS25Q7_s
{
        MI_S25Q7   s25q7X;              /*X coordinate*/
        MI_S25Q7   s25q7Y;              /*Y coordinate*/
}MI_IVE_PointS25Q7_t;
```

Member

Member Code	Description
s25q7X	x coordinate of point, in SQ25.7 representation.
s25q7Y	y coordinate of point, in SQ25.7 representation.

Note

N/A.

Related Data Type and Interface

N/A.

2.21. MI_IVE_Rect_t

Description

Defines U16 rectangle information structure.

Defines

```
typedef struct MI_IVE_Rect_s
{
    MI_U16
    u16X;
    MI_U16
    u16Y;
    MI_U16
    u16Width;
    MI_U16
    u16Height;
}MI_IVE_Rect_t;
```

Member

Member Code	Description
u16X	X coordinate of the rectangle closest to the coordinate origin.
u16Y	Y coordinate of the rectangle closest to the coordinate origin.
u16Width	Width of rectangle.
u16Height	Height of rectangle.

Note

N/A.

Related Data Type and Interface

N/A.

2.22. MI_IVE_FilterCtrl_t

Description

Defines template filter control information.

Defines

```
typedef struct MI_IVE_FilterCtrl_s
{
    MI_S8 as8Mask[MI_IVE_MASK_SIZE_5X5];    /*Template parameter filter coefficient*/
    MI_U8 u8Norm;           /*Normalization parameter, by right shift*/
}MI_IVE_FilterCtrl_t;
```

Member

Member Code	Description
as8Mask[MI_IVE_MASK_SIZE_5X5]	5x5 template coefficient. Setting the peripheral coefficient to 0 can realize a 3x3 template filter.
u8Norm	Normalization parameter. Parameter range: [0, 13].

Note

By configuring different template coefficients, you can obtain different filter effects.

Related Data Type and Interface

N/A.

2.23. MI_IVE_CscMode_e

Description

Defines color space conversion mode.

Defines

```
typedef enum
{
/*CSC: YUV2RGB, video transfer mode, RGB value range [16, 235]*/
E_MI_IVE_CSC_MODE_VIDEO_BT601_YUV2RGB   = 0x0,
/*CSC: YUV2RGB, video transfer mode, RGB value range [16, 235]*/
E_MI_IVE_CSC_MODE_VIDEO_BT709_YUV2RGB   = 0x1,
/*CSC: YUV2RGB, picture transfer mode, RGB value range [0, 255]*/
E_MI_IVE_CSC_MODE_PIC_BT601_YUV2RGB     = 0x2,
/*CSC: YUV2RGB, picture transfer mode, RGB value range [0, 255]*/
E_MI_IVE_CSC_MODE_PIC_BT709_YUV2RGB             = 0x3,
/*CSC: YUV2HSV, picture transfer mode, HSV value range [0, 255]*/
E_MI_IVE_CSC_MODE_PIC_BT601_YUV2HSV     = 0x4,
/*CSC: YUV2HSV, picture transfer mode, HSV value range [0, 255]*/
E_MI_IVE_CSC_MODE_PIC_BT709_YUV2HSV     = 0x5,
/*CSC: YUV2LAB, picture transfer mode, Lab value range [0, 255]*/
E_MI_IVE_CSC_MODE_PIC_BT601_YUV2LAB= 0x6,
```

```
/*CSC: YUV2LAB, picture transfer mode, Lab value range [0, 255]*/
E_MI_IVE_CSC_MODE_PIC_BT709_YUV2LAB= 0x7,
/*CSC: RGB2YUV, video transfer mode, YUV value range [0, 255]*/
E_MI_IVE_CSC_MODE_VIDEO_BT601_RGB2YUV   = 0x8,
/*CSC: RGB2YUV, video transfer mode, YUV value range [0, 255]*/
E_MI_IVE_CSC_MODE_VIDEO_BT709_RGB2YUV   = 0x9,
/*CSC: RGB2YUV, picture transfer mode, Y:[16, 235],U\V:[16, 240]*/
E_MI_IVE_CSC_MODE_PIC_BT601_RGB2YUV      = 0xa,
/*CSC: RGB2YUV, picture transfer mode, Y:[16, 235],U\V:[16, 240]*/
E_MI_IVE_CSC_MODE_PIC_BT709_RGB2YUV      = 0xb,
E_MI_IVE_CSC_MODE_BUTT
}MI_IVE_CscMode_e;
```

Member

Member Code	Description
E_MI_IVE_CSC_MODE_VIDEO_BT601_YUV2RGB	BT601 YUV2RGB video conversion.
E_MI_IVE_CSC_MODE_VIDEO_BT709_YUV2RGB	BT709 YUV2RGB video conversion.
E_MI_IVE_CSC_MODE_PIC_BT601_YUV2RGB	BT601 YUV2RGB image conversion.
E_MI_IVE_CSC_MODE_PIC_BT709_YUV2RGB	BT709 YUV2RGB image conversion.
E_MI_IVE_CSC_MODE_PIC_BT601_YUV2HSV	BT601 YUV2HSV image conversion.
E_MI_IVE_CSC_MODE_PIC_BT709_YUV2HSV	BT709 YUV2HSV image conversion.
E_MI_IVE_CSC_MODE_PIC_BT601_YUV2LAB	BT601 YUV2LAB image conversion.
E_MI_IVE_CSC_MODE_PIC_BT709_YUV2LAB	BT709 YUV2LAB image conversion.
E_MI_IVE_CSC_MODE_VIDEO_BT601_RGB2YUV	BT601 RGB2YUV video conversion.
E_MI_IVE_CSC_MODE_VIDEO_BT709_RGB2YUV	BT709 RGB2YUV video conversion.
E_MI_IVE_CSC_MODE_PIC_BT601_RGB2YUV	BT601 RGB2YUV image conversion.
E_MI_IVE_CSC_MODE_PIC_BT709_RGB2YUV	BT709 RGB2YUV image conversion.

Note

- For E_MI_IVE_CSC_MODE_VIDEO_BT601_YUV2RGB and E_MI_IVE_CSC_MODE_VIDEO_BT709_YUV2RGB modes, the output must satisfy 16≤R, G, B≤235.
- For E_MI_IVE_CSC_MODE_PIC_BT601_YUV2RGB and E_MI_IVE_CSC_MODE_PIC_BT709_YUV2RGB modes, the output must satisfy 0≤R, G, B≤255.
- For E_MI_IVE_CSC_MODE_PIC_BT601_YUV2HSV and E_MI_IVE_CSC_MODE_PIC_BT709_YUV2HSV modes, the output must satisfy 0≤H, S, V≤255.

- For E_MI_IVE_CSC_MODE_PIC_BT601_YUV2LAB and E_MI_IVE_CSC_MODE_PIC_BT709_YUV2LAB modes, the output must satisfy 0≤L, A, B≤255.
- For E_MI_IVE_CSC_MODE_VIDEO_BT601_RGB2YUV and E_MI_IVE_CSC_MODE_VIDEO_BT709_RGB2YUV modes, the output must satisfy 0≤Y, U, V≤255.
- For E_MI_IVE_CSC_MODE_PIC_BT601_RGB2YUV and E_MI_IVE_CSC_MODE_PIC_BT709_RGB2YUV modes, the output must satisfy 0≤Y≤235, 0≤U, V≤240.

Related Data Type and Interface

MI_IVE_CscCtrl_t
MI_IVE_FilterAndCscCtrl_t

2.24. MI_IVE_CscCtrl_t

Description

Defines color space conversion control information.

Defines

```
typedef struct MI_IVE_CscCtrl_s
{
    MI_IVE_CscMode_e  enMode; /*Working mode*/
}MI_IVE_CscCtrl_t;
```

Member

Member Code	Description
enMode	Work mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_CscMode_e

2.25. MI_IVE_FilterAndCscCtrl_t

Description

Defines template filter plus color space conversion composite function control information.

Defines

```
typedef struct MI_IVE_FilterAndCscCtrl_s
{
    MI_IVE_CscMode_e  eMode; /*CSC working mode*/
    MI_S8  as8Mask[MI_IVE_MASK_SIZE_5X5];    /*Template parameter filter coefficient*/
    MI_U8  u8Norm;           /*Normalization parameter, by right shift*/
}MI_IVE_FilterAndCscCtrl_t;
```

Member

Member Code	Description
eMode	Work mode.
as8Mask[MI_IVE_MASK_SIZE_5X5]	5x5 template coefficient.
u8Norm	Normalization parameter. Parameter range: [0, 13].

Note

Only 4 modes of YUV2RGB are supported.

Related Data Type and Interface

MI_IVE_CscMode_e

2.26. MI_IVE_SobelOutCtrl_e

Description

Defines Sobel Output control information.

Defines

```
typedef enum
{
    E_MI_IVE_SOBEL_OUT_CTRL_BOTH = 0x0, /*Output horizontal and vertical*/
    E_MI_IVE_SOBEL_OUT_CTRL_HOR = 0x1, /*Output horizontal*/
    E_MI_IVE_SOBEL_OUT_CTRL_VER = 0x2, /*Output vertical*/
    E_MI_IVE_SOBEL_OUT_CTRL_BUTT
}MI_IVE_SobelOutCtrl_e;
```

Member

Member Code	Description
E_MI_IVE_SOBEL_OUT_CTRL_BOTH	Output results of both template filtering and transposed template filtering.
E_MI_IVE_SOBEL_OUT_CTRL_HOR	Output template filtering results only.
E_MI_IVE_SOBEL_OUT_CTRL_VER	Output transposed template filtering results only.

Note

N/A.

Related Data Type and Interface

MI_IVE_SobelCtrl_t

2.27. MI_IVE_SobelCtrl_t

Description

Defines Sobel-like gradient calculation control information.

Defines

```
typedef struct MI_IVE_SobelCtrl_s
{
    MI_IVE_SobelOutCtrl_e eOutCtrl; /*Output format*/
    MI_S8 as8Mask[MI_IVE_MASK_SIZE_5X5]; /*Template
    parameter*/
}MI_IVE_SobelCtrl_t;
```

Member

Member Code	Description
eOutCtrl	Output control enumeration parameter.
as8Mask[MI_IVE_MASK_SIZE_5X5]	5x5 template coefficient.

Note

N/A.

Related Data Type and Interface

MI_IVE_SobelOutCtrl_e

2.28. MI_IVE_MagAndAngOutCtrl_e

Description

Defines gradient magnitude and angle calculation output format.

Defines

```
typedef enum
{
    E_MI_IVE_MAG_AND_ANG_OUT_CTRL_MAG
        =                                   0x0,
    E_MI_IVE_MAG_AND_ANG_OUT_CTRL_MAG_AND_A
    NG  =                                   0x1,
    E_MI_IVE_MAG_AND_ANG_OUT_CTRL_BUTT
}MI_IVE_MagAndAngOutCtrl_e;
```

Member

Member Code	Description
E_MI_IVE_MAG_AND_ANG_OUT_CTRL_MAG	Output magnitude only.
E_MI_IVE_MAG_AND_ANG_OUT_CTRL_MAG_AND_ANG	Output both magnitude and angle.

Note

N/A.

Related Data Type and Interface

IVE_MAG_AND_ANG_CTRL_S

2.29. MI_IVE_MagAndAngCtrl_t

Description

Defines gradient magnitude and angle calculation control information.

Defines

```
typedef struct MI_IVE_MagAndAngCtrl_s
{
    MI_IVE_MagAndAngOutCtrl_e eOutCtrl;
    MI_U16 u16Thr;
    MI_S8 as8Mask[MI_IVE_MASK_SIZE_5X5];/*Template parameter.*/
}MI_IVE_MagAndAngCtrl_t;
```

Member

Member Code	Description
eOutCtrl	Output format.
u16Thr	Threshold value for magnitude thresholding.
as8Mask[MI_IVE_MASK_SIZE_5X5]	5x5 template coefficient.

Note

N/A.

Related Data Type and Interface

MI_IVE_MagAndAngOutCtrl_e

2.30. MI_IVE_DilateCtrl_t

Description

Defines Dilate control information.

Defines

```
typedef struct MI_IVE_DilateCtrl_s
{
    MI_U8 au8Mask[MI_IVE_MASK_SIZE_5X5]; /*The template parameter value must be
    0 or 255.*/
}MI_IVE_DilateCtrl_t;
```

Member

Member Code	Description
au8Mask[MI_IVE_MASK_SIZE_5X5]	5x5 template coefficient. Range: 0 or 255.

Note

N/A.

Related Data Type and Interface

N/A.

2.31. MI_IVE_ErodeCtrl_t

Description

Defines Erode control information.

Defines

```
typedef struct MI_IVE_ErodeCtrl_s
{
    MI_U8 au8Mask[MI_IVE_MASK_SIZE_5X5]; /*The template parameter value must be
    0 or 255.*/
}MI_IVE_ErodeCtrl_t;
```

Member

Member Code	Description
au8Mask[MI_IVE_MASK_SIZE_5X5]	5x5 template coefficient. Range: 0 or 255.

Note

N/A.

Related Data Type and Interface

N/A.

2.32. MI_IVE_ThreshMode_e

Description

Defines image binarization output format.

Defines

```
typedef enum
{
    E_MI_IVE_THRESH_MODE_BINARY = 0x0,      /*srcVal <= lowThr, dstVal = minVal;
                                              srcVal > lowThr, dstVal = maxVal.*/
    E_MI_IVE_THRESH_MODE_TRUNC = 0x1,       /*srcVal <= lowThr, dstVal = srcVal;
                                              srcVal > lowThr, dstVal = maxVal.*/
    E_MI_IVE_THRESH_MODE_TO_MINVAL =        /*srcVal <= lowThr, dstVal = minVal;
    0x2,                                      srcVal > lowThr, dstVal = srcVal.*/
    E_MI_IVE_THRESH_MODE_MIN_MID_MAX        /*srcVal <= lowThr, dstVal = minVal;
    = 0x3,                                    lowThr < srcVal <= highThr, dstVal =
                                              midVal; srcVal > highThr, dstVal =
                                              maxVal.*/
    E_MI_IVE_THRESH_MODE_ORI_MID_MAX        /*srcVal <= lowThr, dstVal = srcVal;
    = 0x4,                                    lowThr < srcVal <= highThr, dstVal =
                                              midVal; srcVal > highThr, dstVal =
                                              maxVal.*/
    E_MI_IVE_THRESH_MODE_MIN_MID_ORI        /*srcVal <= lowThr, dstVal = minVal;
    = 0x5,                                    lowThr < srcVal <= highThr, dstVal =
                                              midVal; srcVal > highThr, dstVal =
                                              srcVal.*/
    E_MI_IVE_THRESH_MODE_MIN_ORI_MAX        /*srcVal <= lowThr, dstVal = minVal;
    = 0x6,                                    lowThr < srcVal <= highThr, dstVal =
                                              srcVal; srcVal > highThr, dstVal =
                                              maxVal.*/
    E_MI_IVE_THRESH_MODE_ORI_MID_ORI        /*srcVal <= lowThr, dstVal = srcVal;
    = 0x7,                                    lowThr < srcVal <= highThr, dstVal =
                                              midVal; srcVal > highThr, dstVal =
                                              srcVal.*/
    E_MI_IVE_THRESH_MODE_BUTT
}MI_IVE_ThreshMode_e;
```

Member

Member Code	Description
E_MI_IVE_THRESH_MODE_BINARY	srcVal ≤ lowThr, dstVal = minVal; srcVal > lowThr, dstVal = maxVal.
E_MI_IVE_THRESH_MODE_TRUNC	srcVal ≤ lowThr, dstVal = srcVal; srcVal > lowThr, dstVal = maxVal.
E_MI_IVE_THRESH_MODE_TO_MINVAL	srcVal ≤lowThr, dstVal = minVal; srcVal > lowThr, dstVal = srcVal.
E_MI_IVE_THRESH_MODE_MIN_MID_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤ highThr, dstVal = midVal; srcVal > highThr, dstVal = maxVal.

Member Code	Description
E_MI_IVE_THRESH_MODE_ORI_MID_MAX	srcVal ≤lowThr, dstVal = srcVal; lowThr < srcVal ≤ highThr, dstVal = midVal; srcVal > highThr, dstVal = maxVal.
E_MI_IVE_THRESH_MODE_MIN_MID_ORI	srcVal ≤lowThr, dstVal = minVal; lowThr < srcVal ≤highThr,dstVal = midVal; srcVal > highThr, dstVal = srcVal.
E_MI_IVE_THRESH_MODE_MIN_ORI_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤ highThr,dstVal = srcVal; srcVal > highThr, dstVal = maxVal.
E_MI_IVE_THRESH_MODE_ORI_MID_ORI	srcVal≤ lowThr, dstVal = srcVal; lowThr < srcVal ≤ highThr, dstVal = midVal; srcVal > highThr, dstVal = srcVal.

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_Thresh.

Related Data Type and Interface

MI_IVE_ThreshCtrl_t

2.33. MI_IVE_ThreshCtrl_t

Description

Defines image binarization control information.

Defines

```
typedef struct MI_IVE_ThreshCtrl_s
{
    MI_IVE_ThreshMode_e eMode;
    MI_U8 u8LowThr; /*user-defined threshold, 0<=u8LowThr<=255 */
    MI_U8 u8HighThr; /*user-defined threshold, if
    eMode<E_MI_IVE_THRESH_MODE_MIN_MID_MAX, u8HighThr is not used, else
    0<=u8LowThr<=u8HighThr<=255;*/
    MI_U8 u8MinVal; /*Minimum value when tri-level thresholding*/
    MI_U8 u8MidVal; /*Middle value when tri-level thresholding, if eMode<2, u32MidVal
    is not used; */
    MI_U8 u8MaxVal; /*Maxmum value when tri-level thresholding*/
}MI_IVE_ThreshCtrl_t;
```

Member

Member Code	Description
eMode	Thresholding operation mode.
u8LowThresh	Low threshold. Parameter range: [0,255].
u8HighThresh	High threshold. 0≤u8LowThresh≤u8HighThresh≤255.
u8MinVal	Min. value. Parameter range: [0,255].
u8MidVal	Median value. Parameter range: [0,255].
u8MaxVal	Max. value. Parameter range: [0,255].

Note

N/A.

Related Data Type and Interface

MI_IVE_ThreshMode_e

2.34. MI_IVE_SubMode_e

Description

Defines image subtraction output format.

Defines

```
typedef enum
{
    E_MI_IVE_SUB_MODE_ABS = 0x0,        /*Absolute value of the
    difference*/
    E_MI_IVE_SUB_MODE_SHIFT = 0x1, /*The output result is obtained by
    shifting the result one digit right to reserve the signed bit.*/
    E_MI_IVE_SUB_MODE_BUTT
}MI_IVE_SubMode_e;
```

Member

Member Code	Description
E_MI_IVE_SUB_MODE_ABS	Absolute value of the difference.
E_MI_IVE_SUB_MODE_SHIFT	Output the result by right-shifting one bit, sign bit reserved.

Note

N/A.

Related Data Type and Interface

MI_IVE_SubCtrl_t

2.35. MI_IVE_SubCtrl_t

Description

Defines image subtraction control parameter.

Defines

```
typedef struct MI_IVE_SubCtrl_s
{
    MI_IVE_SubMode_e eMode;
}MI_IVE_SubCtrl_t;
```

Member

Member Code	Description
eMode	Image subtraction mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_SubMode_e

2.36. MI_IVE_IntegOutCtrl_e

Description

Defines integral map output control parameter.

Defines

```
typedef enum
{
    E_MI_IVE_INTEG_OUT_CTRL_COMBINE    = 0x0,
    E_MI_IVE_INTEG_OUT_CTRL_SUM
        = 0x1,
    E_MI_IVE_INTEG_OUT_CTRL_SQSUM
            = 0x2,
    E_MI_IVE_INTEG_OUT_CTRL_BUTT
}MI_IVE_IntegOutCtrl_e;
```

Member

Member Code	Description
E_MI_IVE_INTEG_OUT_CTRL_COMBINE	Output integral map sum and sum of square.
E_MI_IVE_INTEG_OUT_CTRL_SUM	Output integral map sum only.
E_MI_IVE_INTEG_OUT_CTRL_SQSUM	Output integral map sum of square only.

Note

N/A.

Related Data Type and Interface

MI_IVE_IntegCtrl_t

2.37. MI_IVE_IntegCtrl_t

Description

Defines integral map calculation control parameter.

Defines

```
typedef struct MI_IVE_IntegCtrl_s
{
        MI_IVE_IntegOutCtrl_e eOutCtrl;
  }MI_IVE_IntegCtrl_t;
```

Member

Member Code	Description
eOutCtrl	Integral map output control parameter.

Note

N/A.

Related Data Type and Interface

E_MI_IVE_INTEG_OUT_CTRL_E

2.38. MI_IVE_ThreshS16Mode_e

Description

Defines 16-bit signed image thresholding mode.

Defines

```
typedef enum
{
    E_MI_IVE_THRESH_S16_MODE_S16_TO_S8_MIN_ =   0x0,
    MID_MAX

    E_MI_IVE_THRESH_S16_MODE_S16_TO_S8_MIN_ =   0x1,
    ORI_MAX

    E_MI_IVE_THRESH_S16_MODE_S16_TO_U8_MIN_ =   0x2,
    MID_MAX

    E_MI_IVE_THRESH_S16_MODE_S16_TO_U8_MIN_ =   0x3,
    ORI_MAX

    E_MI_IVE_THRESH_S16_MODE_BUTT
}MI_IVE_ThreshS16Mode_e;
```

Member

Member Code	Description
E_MI_IVE_THRESH_S16_MODE_S16_ TO_S8_MIN_MID_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤highThr, dstVal = idVal; srcVal > highThr, dstVal = maxVal;
E_MI_IVE_THRESH_S16_MODE_S16_ TO_S8_MIN_ORI_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤highThr, dstVal = rcVal; srcVal > highThr, dstVal = maxVal;
E_MI_IVE_THRESH_S16_MODE_S16_ TO_U8_MIN_MID_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤highThr, dstVal = idVal; srcVal > highThr, dstVal = maxVal;
E_MI_IVE_THRESH_S16_MODE_S16_ TO_U8_MIN_ORI_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤highThr, dstVal = rcVal; srcVal > highThr, dstVal = maxVal;

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_ThreshS16.

Related Data Type and Interface

MI_IVE_ThreshS16Ctrl_t

2.39. MI_IVE_ThreshS16Ctrl_t

Description

Defines 16-bit signed image thresholding control parameter.

Defines

```
typedef struct MI_IVE_ThreshS16Ctrl_s
{
    MI_IVE_ThreshS16Mode_e eMode;
    MI_S16 s16LowThr;        /*user-defined threshold*/
    MI_S16 s16HighThr;       /*user-defined threshold*/
    MI_IVE_Length8bit_u un8MinVal;     /*Minimum value when tri-level
    thresholding*/
    MI_IVE_Length8bit_u un8MidVal;     /*Middle value when tri-level thresholding*/
    MI_IVE_Length8bit_u un8MaxVal;     /*Maxmum value when tri-level
    thresholding*/
}MI_IVE_ThreshS16Ctrl_t;
```

Member

Member Code	Description
eMode	Thresholding operation mode.
s16LowThr	Low threshold.
s16HighThr	High threshold.
un8MinVal	Min. value.
un8MidVal	Median value.
un8MaxVal	Max. value.

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_ThreshS16.

Related Data Type and Interface

MI_IVE_ThreshS16Mode_e

2.40. MI_IVE_ThreshU16Mode_e

Description

Defines 16-bit unsigned image thresholding mode.

Defines

```
typedef enum
{
    E_MI_IVE_THRESH_U16_MODE_U16_TO_U8_MIN_MID_
    MAX                    =                    0x0,
    E_MI_IVE_THRESH_U16_MODE_U16_TO_U8_MIN_ORI_
    MAX = 0x1, E_MI_IVE_THRESH_U16_MODE_BUTT
}MI_IVE_ThreshU16Mode_e;
```

Member

Member Code	Description
E_MI_IVE_THRESH_U16_MODE_U16_ TO_U8_MIN_MID_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤highThr, dstVal = midVal; srcVal > highThr, dstVal = maxVal;
E_MI_IVE_THRESH_U16_MODE_U16_ TO_U8_MIN_ORI_MAX	srcVal ≤ lowThr, dstVal = minVal; lowThr < srcVal ≤highThr, dstVal = srcVal; srcVal > highThr, dstVal = maxVal;

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_ThreshU16.

Related Data Type and Interface

MI_IVE_ThreshU16Ctrl_t

2.41. MI_IVE_ThreshU16Ctrl_t

Description

Defines 16-bit unsigned image thresholding control parameter.

Defines

```
typedef struct MI_IVE_ThreshU16Ctrl_s
{
    MI_IVE_ThreshU16Mode_e eMode;
    MI_U16 u16LowThr;
    MI_U16 u16HighThr;
    MI_U8 u8MinVal;
    MI_U8 u8MidVal;
    MI_U8 u8MaxVal;
}MI_IVE_ThreshU16Ctrl_t;
```

Member

Member Code	Description
eMode	Thresholding operation mode.
u16LowThr	Low threshold.
u16HighThr	High threshold.
u8MinVal	Min. value. Parameter range: [0,255].
u8MidVal	Median value. Parameter range: [0,255].
u8MaxVal	Max. value. Parameter range: [0,255].

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_ThreshU16.

Related Data Type and Interface

MI_IVE_ThreshU16Mode_e

2.42. MI_IVE_16BitTo8BitMode_e

Description

Defines 16-bit image data to 8-bit image data conversion mode.

Defines

```
typedef enum
{
    E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_S8 =  0x0,
    E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_U8_ABS =  0x1,
    E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_U8_BIAS =  0x2,
    E_MI_IVE_16BIT_TO_8BIT_MODE_U16_TO_U8 =  0x3,
    E_MI_IVE_16BIT_TO_8BIT_MODE_BUTT
}MI_IVE_16BitTo8BitMode_e;
```

Member

Member Code	Description
E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_S8	S16 data to S8 data linear conversion.
E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_U8_ABS	Linearly convert S16 data to S8 data and takes the absolute value to get U8 data.
E_MI_IVE_16BIT_TO_8BIT_MODE_S16_TO_U8_BIAS	Linearly convert S16 data to S8 data and truncate to U8 data after translation.
E_MI_IVE_16BIT_TO_8BIT_MODE_U16_TO_U8	S16 data to U8 data linear conversion.

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_16BitTo8Bit.

Related Data Type and Interface

MI_IVE_16bitTo8BitCtrl_t

2.43. MI_IVE_16bitTo8BitCtrl_t

Description

Defines 16-bit image data to 8-bit image data conversion control parameter.

Defines

```
typedef struct MI_IVE_16bitTo8BitCtrl_s
{
    MI_IVE_16BitTo8BitMode_e eMode;
    MI_U16 u16Denominator;
    MI_U8 u8Numerator;
    MI_S8 s8Bias;
}MI_IVE_16bitTo8BitCtrl_t;
```

Member

Member Code	Description
eMode	16-bit data to 8-bit data conversion mode.
u16Denominator	Denominator of linear conversion. Parameter range: [max{1,u8Numerator}, 65535]
u8Numerator	Numerator of linear conversion. Parameter range: [0,255].
s8Bias	Translated item of linear conversion. Parameter range: [-128,127].

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_ThreshU16.
Note: u8Numerator ≤u16Denominator, and u16Denominator≠0

Related Data Type and Interface

MI_IVE_16BitTo8BitMode_e

2.44. MI_IVE_OrdStatFilterMode_e

Description

Defines sequential statistic filtering mode.

Defines

```
typedef enum
{
    E_MI_IVE_ORD_STAT_FILTER_MODE_MEDIAN = 0x0,
    E_MI_IVE_ORD_STAT_FILTER_MODE_MAX = 0x1,
    E_MI_IVE_ORD_STAT_FILTER_MODE_MIN = 0x2,
    E_MI_IVE_ORD_STAT_FILTER_MODE_BUTT
}MI_IVE_OrdStatFilterMode_e;
```

Member

Member Code	Description
E_MI_IVE_ORD_STAT_FILTER_MODE_MEDIAN	Median filter.
E_MI_IVE_ORD_STAT_FILTER_MODE_MAX	Max. filter value, equivalent to the dilation of grayscale.
E_MI_IVE_ORD_STAT_FILTER_MODE_MIN	Min. filter value, equivalent to the erosion of grayscale.

Note

N/A.

Related Data Type and Interface

IVE_ORD_STAT_FILTER_CTRL_S

2.45. MI_IVE_OrdStatFilter_t

Description

Defines sequential statistic filtering control parameter.

Defines

```
typedef struct MI_IVE_OrdStatFilter_s
{
    MI_IVE_OrdStatFilterMode_e eMode;
}MI_IVE_OrdStatFilter_t;
```

Member

Member Code	Description
eMode	Sequential statistic filtering mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_OrdStatFilterMode_e

2.46. MI_IVE_MapLutMem_t

Description

Defines map operator lookup table memory information.

Defines

```
typedef struct MI_IVE_MapLutMem_s
{
    MI_U8 au8Map[MI_IVE_MAP_NUM];
}MI_IVE_MapLutMem_t;
```

Member

Member Code	Description
au8Map[MI_IVE_MAP_NUM]	Map lookup table array.

Note

N/A.

Related Data Type and Interface

N/A.

2.47. MI_IVE_EqualizeHistCtrlMem_t

Description

Defines histogram equalization auxiliary memory.

Defines

```
typedef struct MI_IVE_EqualizeHistCtrlMem_s
{
    MI_U32
    au32Hist[MI_IVE_HIST_NUM];
    MI_U8
    au8Map[MI_IVE_MAP_NUM];
}MI_IVE_EqualizeHistCtrlMem_t;
```

Member

Member Code	Description
au32Hist[MI_IVE_HIST_NUM]	Histogram statistics output.
au8Map[MI_IVE_MAP_NUM]	Map lookup table gained by statistical histogram calculation.

Note

N/A.

Related Data Type and Interface

MI_IVE_EqualizeHistCtrl_t

2.48. MI_IVE_EqualizeHistCtrl_t

Description

Defines histogram equalization control parameter.

Defines

```
typedef struct MI_IVE_EqualizeHistCtrl_s
{
    MI_IVE_MemInfo_t stMem;
}MI_IVE_EqualizeHistCtrl_t;
```

Member

Member Code	Description
stMem	The memory should at least have the size of (MI_IVE_EqualizeHistCtrlMem_t).

Note

N/A.

Related Data Type and Interface

MI_IVE_EqualizeHistCtrlMem_t

2.49. MI_IVE_AddMode_e

Description

Define the add calculation mode.

Defines

```
typedef enum
{
    E_MI_IVE_ADD_MODE_ROUNDING      =   0x0,
    E_MI_IVE_ADD_MOD_CLIPPING       =   0x1,

    E_MI_IVE_ADD_MODE_MAX
}MI_IVE_AddMode_e;
```

Member

Member Code	Description
E_MI_IVE_ADD_MODE_ROUNDING	Rounding mode
E_MI_IVE_ADD_MOD_CLIPPING	Clipping mode

Note

N/A.

Related Data Type and Interface

MI_IVE_AddCtrl_t

2.50. MI_IVE_AddCtrl_t

Description

Defines image weighted addition control parameter.

Defines

```
typedef struct MI_IVE_AddCtrl_s
{
        MI_IVE_AddMode_e eMode;
        MI_U0Q16 u0q16X;        /*x of "xA+yB"*/
        MI_U0Q16 u0q16Y;        /*y of "xA+yB"*/
}MI_IVE_AddCtrl_t;
```

Member

Member Code	Description
eMode	Calculation mode.
u0q16X	Weighted addition by the weight "x" in "xA+yB." Parameter range: [1, 65535].
u0q16Y	Weighted addition by the weight "y" in "xA+yB." Parameter range: {65536 - u0q16X}.

Note

MI_IVE_AddMode_e

Related Data Type and Interface

N/A.

2.51. MI_IVE_NccDstMem_t

Description

Defines NCC output memory information.

Defines

```
typedef struct MI_IVE_NccDstMem_s
{
    MI_U64
    u64Numerator;
    MI_U64
    u64QuadSum1;
    MI_U64
    u64QuadSum2;
}MI_IVE_NccDstMem_t;
```

Member

Member Code	Description
u64Numerator	Numerator of NCC calculation formula: $\sum_{i=1}^{w}\sum_{j=1}^{h}(I_{src1}(i,j)*I_{src2}(i,j))$
u64QuadSum1	Denominator, the inner part of the root number, of NCC calculation formula: $\sum_{i=1}^{w}\sum_{j=1}^{h}(I^{2}_{src1}(i,j))$
u64QuadSum2	Denominator, the inner part of the root number, of NCC calculation formula: $\sum_{i=1}^{w}\sum_{j=1}^{h}(I^{2}_{src2}(i,j))$

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_Ncc.

Related Data Type and Interface

N/A.

2.52. MI_IVE_Region_t

Description

Defines connected region information.

Defines

```
typedef struct MI_IVE_Region_s
{
    MI_U32 u32Area;          /*Represented by the pixel number*/
    MI_U16 u16Left;          /*Circumscribed rectangle left border*/
    MI_U16 u16Right;         /*Circumscribed rectangle right border*/
    MI_U16 u16Top;           /*Circumscribed rectangle top border*/
    MI_U16 u16Bottom;        /*Circumscribed rectangle bottom border*/
}MI_IVE_Region_t;
```

Member

Member Code	Description
u32Area	Area size of connected region, represented by number of pixels of the connected region.
u16Left	Leftmost coordinate of the circumscribed rectangle of connected region.
u16Right	Rightmost coordinate of the circumscribed rectangle of connected region.
u16Top	Uppermost coordinate of the circumscribed rectangle of connected region.
u16Bottom	Lowermost coordinate of the circumscribed rectangle of connected region.

Note

N/A.

Related Data Type and Interface

MI_IVE_CcBlob_t

2.53. MI_IVE_CcBlob_t

Description

Defines connected region label output information.

Defines

```
typedef struct MI_IVE_CcBlob_s
{
    MI_U16 u16CurAreaThr; /*Threshold of the result regions' area*/
    MI_S8 s8LabelStatus; /*-1: Labeled failed ; 0: Labeled successfully*/
    MI_U8 u8RegionNum; /*Number of valid region, non-continuous stored*/
    MI_IVE_Region_t astRegion[MI_IVE_MAX_REGION_NUM]; /*Valid regions with
    'u32Area>0' and 'label = ArrayIndex+1'*/
}MI_IVE_CcBlob_t;
```

Member

Member Code	Description
u16CurAreaThr	Valid area size threshold of connected region. astRegion regions with area size smaller than this threshold will be set to 0.
s8LabelStatus	Connected region labelled successfully or not. -1: Labelling failed; 0: Labelling successful.
u8RegionNum	Effective number of connected regions.
astRegion[MI_IVE_MAX_REGION_NUM]	Connected region information: effective connected region with area size greater than 0. The reference label is the array subscript +1. Index 254 records the total area size of connected regions excluded in the process of pstCclCtrl→u16InitAreaThr.

Note

N/A.

Note

MI_IVE_Region_t

2.54. MI_IVE_CclMode_e

Description

Defines connected region mode.

Defines

```
typedef enum
{
    E_MI_IVE_CCL_MODE_4C    =    0x0,
        /*4-connectivity*/
    E_MI_IVE_CCL_MODE_8C    =    0x1,
        /*8-connectivity*/
    E_MI_IVE_CCL_MODE_BUTT
}MI_IVE_CclMode_e;
```

Member

Member Code	Description
E_MI_IVE_CCL_MODE_4C	4-connectivity.
E_MI_IVE_CCL_MODE_8C	8-connectivity.

Note

N/A.

Related Data Type and Interface

N/A.

2.55. MI_IVE_CclCtrl_t

Description

Defines connected region label control parameter.

Defines

```
typedef struct MI_IVE_CclCtrl_s
{
    MI_U16 u16InitAreaThr;    /*Init threshold of region area*/
    MI_U16 u16Step;           /*Increase area step for once*/
}MI_IVE_CclCtrl_t;
```

Member

Member Code	Description
u16InitAreaThr	Initial area threshold. Parameter range: [0, 65535]. Reference value: 4.
u16Step	Area threshold growth step. Parameter range: [1,65535]. Reference value: 2.

Note

N/A.

Related Data Type and Interface

MI_IVE_CcBlob_t

2.56. MI_IVE_GmmCtrl_t

Description

Defines GMM background modelling control parameter.

Defines

```
typedef struct MI_IVE_GmmCtrl_s
{
    MI_U22Q10 u22q10NoiseVar;     /*Initial noise Variance*/
    MI_U22Q10 u22q10MaxVar;       /*Max Variance*/
    MI_U22Q10 u22q10MinVar;       /*Min Variance*/
    MI_U0Q16  u0q16LearnRate;     /*Learning rate*/
```

```
    MI_U0Q16   u0q16BgRatio;          /*Background ratio*/
    MI_U8Q8    u8q8VarThr;            /*Variance Threshold*/
    MI_U0Q16   u0q16InitWeight;       /*Initial Weight*/
    MI_U8      u8ModelNum;            /*Model number: 3 or 5*/
}MI_IVE_GmmCtrl_t;
```

Member

Member Code	Description
u22q10NoiseVar	Initial noise variance. Parameter range: [0x1, 0xFFFFFF]. For grayscale GMM, please refer to noiseSigma * noiseSigma of OpenCV MOG grayscale model. Reference value: 15*15*(1<<10). For RGB GMM, please refer to noiseSigma * noiseSigma of OpenCV MOG RGB model 3 *. Reference value: 3*15*15*(1<<10).
u22q10MaxVar	Maximum value of model variance. Parameter range; [0x1, 0xFFFFFF]. Please refer to fVarMax of OpenCV MOG2. Reference value: 3*4000<<10 (RGB), 2000<<10 (grayscale).
u22q10MinVar	Minimum value of model variance. Parameter range: [0x1, 22q10MaxVar]. Please refer to fVarMin of OpenCV MOG2. Reference value: 600<<10 (RGB), 200<<10 (grayscale).
u0q16LearnRate	Learning rate. Parameter range: [1, 65535]. Please refer to learningRate of OpenCV MOG2. Reference value: if (frameNum<500) (1/frameNum)*((1<<16)-1); else ((1/500)*((1<<16)-1).
u0q16BgRatio	Background ratio threshold. Parameter range: [1, 65535]. Please refer to backgroundRatio of OpenCV MOG. Reference value: 0.8*((1<<16)-1).
u8q8VarThr	Variance threshold. Parameter range: [1, 65535]. Please refer to varThreshold of OpenCV MOG. This parameter is used to determine if a pixel hits the current model. Reference value: 6.25*(1<<8).
u0q16InitWeight	Initial weight. Parameter range: [1, 65535]. Please refer to defaultInitialWeight of OpenCV MOG. Reference value: 0.05*((1<<16)-1).

Member Code	Description
u8ModelNum	Model number. Parameter range: {3,5}. Please refer to nmixtures of OpenCV MOG.

Note

N/A.

Related Data Type and Interface

N/A.

2.57. MI_IVE_CannyStackSize_t

Description

Defines strong edge point stack size structure in the first half of Canny edge calculation.

Defines

```
typedef struct MI_IVE_CannyStackSize_s
{
    MI_U32 u32StackSize;                        /*Stack size for output*/
    MI_U8 u8Reserved[MI_IVE_CANNY_STACK_RESERVED_SIZE];    /*For 16 byte
    align*/
}MI_IVE_CannyStackSize_t;
```

Member

Member Code	Description
u32StackSize	Stack size (number of strong edge points).
u8Reserved[MI_IVE_CANNY_STACK_RESERVED_SIZE]	Reserved.

Note

N/A.

Related Data Type and Interface

N/A.

2.58. MI_IVE_CannyHysEdgeCtrl_t

Description

Defines control parameter in Canny edge first-half calculation task.

Defines

```
typedef struct MI_IVE_CannyHysEdgeCtrl_s
{
    MI_IVE_MemInfo_t
    stMem;
    MI_U16 u16LowThr;
    MI_U16 u16HighThr;
    MI_S8
    as8Mask[MI_IVE_MASK
    _SIZE_5X5];
} MI_IVE_CannyHysEdgeCtrl_t;
```

Member

Member Code	Description
stMem	Auxiliary memory. For details on the memory allocation and size, please refer to the Note provided with respect to MI_IVE_CannyHysEdge.
u16LowThr	Low threshold. Parameter range: [0,255].
u16HighThr	High threshold. Parameter range: [u16LowThr,255].
as8Mask[MI_IVE_MASK_SIZE_5X5]	Parameter template used for gradient calculation.

Note

N/A.

Related Data Type and Interface

N/A.

2.59. MI_IVE_LbpCmpMode_e

Description

Defines LBP calculation comparison mode.

Defines

```
typedef enum
{
    E_MI_IVE_LBP_CMP_MODE_NORMAL = 0x0, /* P(x)-P(center)>= un8BitThr.s8Val,
    s(x)=1; else s(x)=0; */
    E_MI_IVE_LBP_CMP_MODE_ABS = 0x1, /* abs(P(x)-P(center))>=un8BitThr.u8Val,
    s(x)=1; else s(x)=0;*/
    E_MI_IVE_LBP_CMP_MODE_ABS_MUL      = 0x2
    E_MI_IVE_LBP_CMP_MODE_MAX
}MI_IVE_LbpCmpMode_e;
```

Member

Member Code	Description
E_MI_IVE_LBP_CMP_MODE_NORMAL	LBP normal comparison mode.
E_MI_IVE_LBP_CMP_MODE_ABS	LBP absolute comparison mode.
E_MI_IVE_LBP_CMP_MODE_ABS_MUL	LBP absolute multiply comparison mode

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_Lbp.

Related Data Type and Interface

MI_IVE_LbpCtrrl_t

2.60. MI_IVE_LbpChalMode_e

Description

Defines LBP input channel mode.

Defines

```
typedef enum
{
    E_MI_IVE_LBP_CHAL_MODE_U8C1     = 0x0,
    E_MI_IVE_LBP_CHAL_MODE_U8C2     = 0x1,

    E_MI_IVE_LBP_CHAL_MODE_MAX
}MI_IVE_LbpChalMode_e;
```

Member

Member Code	Description
E_MI_IVE_LBP_CHAL_MODE_U8C1	Only one input
E_MI_IVE_LBP_CHAL_MODE_U8C2	Two input

Note

N/A.

Related Data Type and Interface

MI_IVE_LbpCtrrl_t

2.61. MI_IVE_LbpCtrrl_t

Description

Defines LBP texture calculation control parameter.

Defines

```
typedef struct MI_IVE_LbpCtrrl_s
{
    MI_IVE_LbpCmpMode_e eMode;
    MI_IVE_LbpChalMode_e chMode;
    MI_IVE_Length8bit_u un8BitThr;
}MI_IVE_LbpCtrrl_t;
```

Member

Member Code	Description
eMode	LBP comparison mode.
chMode	LBP channel mode
un8BitThr	LBP comparison threshold. Parameter range for E_MI_IVE_LBP_CMP_MODE_NORMAL: [-128,127]. Parameter range for E_MI_IVE_LBP_CMP_MODE_ABS: [0,255]. Parameter range for E_MI_IVE_LBP_CMP_MODE_ABS: [0,7].

Note

For calculation formula, please refer to the Note provided with respect to MI_IVE_Lbp.

Related Data Type and Interface

MI_IVE_LbpCmpMode_e
MI_IVE_LbpChalMode_e
MI_IVE_Length8bit_u

2.62. MI_IVE_NormGradOutCtrl_e

Description

Defines enumeration type of normalized gradient information calculation task output control.

Defines

```
typedef enum
{
    E_MI_IVE_NORM_GRAD_OUT_CTRL_HOR_AND_
    VER  = 0x0,
    E_MI_IVE_NORM_GRAD_OUT_CTRL_HOR
        = 0x1,
    E_MI_IVE_NORM_GRAD_OUT_CTRL_VER
        = 0x2,
    E_MI_IVE_NORM_GRAD_OUT_CTRL_COMBINE
        = 0x3,
    E_MI_IVE_NORM_GRAD_OUT_CTRL_BUTT
}MI_IVE_NormGradOutCtrl_e;
```

Member

Member Code	Description
E_MI_IVE_NORM_GRAD_OUT_CTRL_ HOR_AND_VER	Output H, V component map of gradient information. (For H, V definition, please refer to Parameter of MI_ IVE_NormGrad.)
E_MI_IVE_NORM_GRAD_OUT_CTRL_ HOR	Output H component map of gradient information.
E_MI_IVE_NORM_GRAD_OUT_CTRL_ VER	Output V component map of gradient information.
E_MI_IVE_NORM_GRAD_OUT_CTRL_ COMBINE	Output H, V component map in package format of gradient information.

Note

N/A.

Related Data Type and Interface

IVE_NORM_GRAD_CTRL_S

2.63. MI_IVE_NormGradCtrl_t

Description

Defines normalized gradient information calculation control parameter.

Defines

```
typedef struct MI_IVE_NormGradCtrl_s
{
    MI_IVE_NormGradOutCtrl_e eOutCtrl;
    MI_S8
    as8Mask[MI_IVE_MASK_SIZE_5X5];
    MI_U8 u8Norm;
}MI_IVE_NormGradCtrl_t;
```

Member

Member Code	Description
eOutCtrl	Gradient information output control mode.
as8Mask[MI_IVE_MASK_SIZE_5X5]	Template required of gradient calculation.
u8Norm	Normalization parameter. Parameter range: [1,13].

Note

N/A.

Related Data Type and Interface

E_MI_IVE_NORM_GRAD_OUT_CTRL_E

2.64. MI_IVE_MvS9Q7_t

Description

Defines LK optical flow displacement structure.

Description

```
typedef struct MI_IVE_MvS9Q7_s
{
    MI_S32   s32Status;   /*Result of tracking: 0-success; -1-failure*/
    MI_S9Q7  s9q7Dx;      /*X-direction component of the movement*/
    MI_S9Q7  s9q7Dy;      /*Y-direction component of the movement*/
}MI_IVE_MvS9Q7_t;
```

Member

Member Code	Description
s32Status	Feature point tracking result. 0: Successful. 1: Failed.
s9q7Dx	Displacement of X-direction component.
s9q7Dy	Displacement of Y-direction component.

Note N/A.

Related Data Type and Interface

N/A.

2.65. MI_IVE_LkOpticalFlowCtrl_t

Description

Defines LK optical flow calculation control parameter.

Defines

```
typedef struct MI_IVE_LkOpticalFlowCtrl_s
{
    MI_U16 u16CornerNum;   /*Number of the feature points,<200*/
    MI_U0Q8 u0q8MinEigThr;        /*Minimum eigenvalue threshold*/
    MI_U8 u8IterCount;        /*Maximum iteration times*/
    MI_U0Q8 u0q8Epsilon;    /*Threshold of iteration for dx^2 + dy^2 <
    u0q8Epsilon */
}MI_IVE_LkOpticalFlowCtrl_t;
```

Member

Member Code	Description
u16CornerNum	Number of input corner points / feature points. Parameter range: [1,200].
u0q8MinEigThr	Minimum Eigen value threshold. Parameter range: [1,255].
u8IterCount	Maximum number of iterations. Parameter range: [1,20].
u0q8Epsilon	Eteration convergence condition: dx^2 + dy^2 < u0q8Epsilon. Parameter range: [1,255]. Reference value: 2.

Note

N/A.

Related Data Type and Interface

N/A.

2.66. MI_IVE_SadMode_e

Description

Defines SAD calculation mode.

Defines

```
typedef enum
{
    E_MI_IVE_SAD_MODE_MB_4X4 = 0x0,
    /*4x4*/
    E_MI_IVE_SAD_MODE_MB_8X8 = 0x1,
    /*8x8*/
    E_MI_IVE_SAD_MODE_MB_16X16    = 0x2,
    /*16x16*/
    E_MI_IVE_SAD_MODE_BUTT
}MI_IVE_SadMode_e;
```

Member

Member Code	Description
E_MI_IVE_SAD_MODE_MB_4X4	Calculation of SAD by 4x4 pixel block.
E_MI_IVE_SAD_MODE_MB_8X8	Calculation of SAD by 8x8 pixel block.
E_MI_IVE_SAD_MODE_MB_16X16	Calculation of SAD by 16x16 pixel block.

Note

N/A.

Related Data Type and Interface

MI_IVE_SadCtrl_t

2.67. MI_IVE_SadOutCtrl_e

Description

Defines SAD output control mode.

Defines

```
typedef enum
{
    E_MI_IVE_SAD_OUT_CTRL_16BIT_BOTH   = 0x0, /*Output 16 bit sad and thresh*/
    E_MI_IVE_SAD_OUT_CTRL_8BIT_BOTH    = 0x1, /*Output 8 bit sad and thresh*/
    E_MI_IVE_SAD_OUT_CTRL_16BIT_SAD    = 0x2, /*Output 16 bit sad*/
    E_MI_IVE_SAD_OUT_CTRL_8BIT_SAD     = 0x3, /*Output 8 bit sad*/
    E_MI_IVE_SAD_OUT_CTRL_THRESH  = 0x4, /*Output thresh,16 bits sad */
    E_MI_IVE_SAD_OUT_CTRL_BUTT
}MI_IVE_SadOutCtrl_e;
```

Member

Member Code	Description
E_MI_IVE_SAD_OUT_CTRL_16BIT_BOTH	16-bit SAD map and thresholding map output mode.
E_MI_IVE_SAD_OUT_CTRL_8BIT_BOTH	8-bit SAD map and thresholding map output mode.
E_MI_IVE_SAD_OUT_CTRL_16BIT_SAD	16-bit SAD map output mode.
E_MI_IVE_SAD_OUT_CTRL_8BIT_SAD	8-bit SAD map output mode.
E_MI_IVE_SAD_OUT_CTRL_THRESH	Thresholding map output mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_SadCtrl_t

2.68. MI_IVE_SadCtrl_t

Description

Defines SAD control parameter.

Defines

```
typedef struct MI_IVE_SadCtrl_s
{
    MI_IVE_SadMode_e eMode;
    MI_IVE_SadOutCtrl_e eOutCtrl;
    MI_U16 u16Thr; /*srcVal <= u16Thr, dstVal = minVal;srcVal > u16Thr, dstVal = maxVal.*/
    MI_U8 u8MinVal; /*Min value*/
    MI_U8 u8MaxVal; /*Max value*/
}MI_IVE_SadCtrl_t;
```

Member

Member Code	Description
eMode	SAD calculation mode.
eOutCtrl	SAD output control mode.
u16Thr	Value for thresholding against calculated SAD map.
u8MinVal	Value for thresholding lower than u16Thr.
u8MaxVal	Value for thresholding higher than u16Thr.

Note

N/A.

Related Data Type and Interface

MI_IVE_SadMode_e
MI_IVE_SadOutCtrl_e

2.69. MI_IVE_BernsenCtrl_t

Description

Defines Bernsen thresh control parameters.

Defines

```
typedef struct MVE_IVE_BernsenCtrl_s
{
    MI_IVE_BernsenMode_e enMode;
    MI_U8 u8WinSize;
    MI_U8 u8MaxVal;
} MVE_IVE_BernsenCtrl_t;
```

Member

Member Code	Description
eMode	Bernsen thresh mode.
u8WinSize	Window size for the local threshold calculation. Value range: {3, 5}
u8MaxVal	Thresh in MVE_BERNSEN_MODE_THRESH mode in which the global threshold is involved. Value range: [0, 255]

Note

N/A.

Related Data Type and Interface

MI_IVE_BernsenMode_e

2.70. MI_IVE_BernsenMode_e

Description

Defines the Bernsen thresh mode.

Defines

```
typedef enum
{
        E_MI_IVE_BERNSEN_MODE_NORMAL = 0x0,
        E_MI_IVE_BERNSEN_MODE_THRESH = 0x1,

        E_MI_IVE_BERNSEN_MODE_MAX
} MVE_IVE_BernsenMode_e;
```

Member

Member Code	Description
E_MI_IVE_BERNSEN_MODE_NORMAL	Simple Bernsen thresh
E_MI_IVE_BERNSEN_MODE_THRESH	Thresh based on the global threshold and local Bernsen threshold
E_MI_IVE_BERNSEN_MODE_MAX	Error mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_BernsenCtrl_t

2.71. MI_IVE_LineFilterHorCtrl_t

Description

Defines control parameters for filtering the horizontal density of binary images.

Defines

```
typedef struct MVE_IVE_LineFilterHorCtrl_s
{
    MI_U8 u8GapMinLen;
    MI_U8 u8DensityThr;
    MI_U8 u8HorThr;
} MVE_IVE_LineFilterHorCtrl_t;
```

Member

Member Code	Description
u8GapMinLen	Minimum black line length. For details, see thr1 in the note field of MI_IVE_LineFilterHor. Value range: [1, 20] Reference value: 10
u8DensityThr	Density threshold. For details, see thr2 in the Note field of MI_IVE_LineFilterHor. Value range: [1, 50] Reference value: 20
u8HorThr	Horizontal line length threshold. For details, see thr3 in the note field of MI_IVE_LineFilterHor. Value range: [1, 50] Reference value: 20

Note

N/A.

Related Data Type and Interface

N/A.

2.72. MI_IVE_LineFilterVerCtrl_t

Description

Defines control parameters for filtering the vertical density of binary images.

Defines

```
typedef struct MVE_IVE_LineFilterVerCtrl_s
{
    MI_U8 u8VerThr;
} MVE_IVE_LineFilterVerCtrl_t _t;
```

Member

Member Code	Description
u8VerThr	Vertical line length threshold. For details, see thr in the note field of MI_IVE_LineFilterVer. Value range: [1, 64] Reference value: 30

Note

N/A.

Related Data Type and Interface

N/A.

2.73. MI_IVE_NoiseRemoveHorCtrl_t

Description

Defines the horizontal noise removal control parameter for the binary image.

Defines

```
typedef struct MVE_IVE_NoiseRemoveHorCtrl_s
{
    MI_U8 u8HorThr;
    MI_U8 u8HorThrMax;
} MVE_IVE_NoiseRemoveHorCtrl_t;
```

Member

Member Code	Description
u8HorThr	Length threshold for determining horizontal noises, see thr1 in the note field of MI_IVE_NoiseRemoveHor. Value range: [1, 100] Reference value: 25
u8HorThrMax	Maximum length threshold for determining horizontal , see thr2 in the note field of MI_IVE_NoiseRemoveHor. Value range: [1, 100] Reference value: 79

Note

u8HorThrMax is always bigger than u8HorThr.

Related Data Type and Interface

N/A.

2.74. MI_IVE_NoiseRemoveVerCtrl_t

Description

Defines the vertical noise removal control parameter for the binary image.

Defines

```
typedef struct MVE_IVE_NoiseRemoveVerCtrl_s
{
    MI_U8 u8VerThr;
    MI_U8 u8VerThrMax;
} MVE_IVE_NoiseRemoveVerCtrl_t;
```

Member

Member Code	Description
u8VerThr	Length threshold for determining vertical noises, see thr1 in the note field of MI_IVE_NoiseRemoveVer. Value range: [1, 100] Reference value: 25
u8VerThrMax	Maximum Length threshold for determining vertical noises, see thr2 in the note field of MI_IVE_NoiseRemoveVer. Value range: [1, 100] Reference value: 79

Note

u8VerThrMax is always bigger than u8VerThr.

Related Data Type and Interface

N/A.

2.75. MI_IVE_AdpThreshCtrl_t

Description

Defines adaptive thresh control parameters.

Defines

```
typedef struct MVE_IVE_AdpThreshCtrl_s
{
    MI_U8 u8RateThr;
    MI_U8 u8HalfMaskx;
    MI_U8 u8HalfMasky;
    MI_U8 s16Offset;
    MI_U8 u8ValueThr;
} MVE_IVE_AdpThreshCtrl_t;
```

Member

Member Code	Description
u8RateThr	Threshold rate for determining adaptive thresh. For details, see RateThr in the formula of MI_IVE_AdpThresh. Value range: [1, 20] Default: 10
u8HalfMaskx	Half of Mask size width for determining adaptive thresh. For details, see w in the formula of MI_IVE_AdpThresh. Value range: [1,40] Default: 10
u8HalfMasky	Half of Mask size height for determining adaptive thresh. For details, see h in the formula of MI_IVE_AdpThresh. Value range: [1,40] Default: 35
s16Offset	Offset for determining adaptive thresh. For details, see Offset in the formula of MI_IVE_AdpThresh. Value range: [-128,127] Default: -100
u8ValueThr	Threshold pixel value for determining adaptive thresh. For details, see ValueThr in the formula of MI_IVE_AdpThresh. Value range: [1,255] Default: 100

Note

N/A..

Related Data Type and Interface

N/A.

2.76. MI_IVE_ResizeCtrl_t

Description

Defines the resize control parameters.

Defines

```
typedef struct _MVE_IVE_ResizeCtrl_s
{
    MVE_IVE_ResizeMode_e enMode;
} MVE_IVE_ResizeCtrl_t;
```

Member

Member Code	Description
enMode	Input image mode. For detail, see MVE_IVE_ResizeMode_e

Note

N/A.

Related Data Type and Interface

MI_IVE_ResizeMode_e

2.77. MI_IVE_ResizeMode_e

Description

Defines the resize control parameters.

Defines

```
typedef enum
{
    E_MI_IVE_RESIZE_TYPE_U8C1              = 0x0,
    E_MI_IVE_RESIZE_TYPE_U8C3_PLANAR       = 0x1,
    E_MI_IVE_RESIZE_TYPE_U8C3_PACKAGE      = 0x2,
    E_MI_IVE_RESIZE_TYPE_YUV420SP          = 0x3,

    E_MI_IVE_RESIZE_TYPE_MAX
} MVE_IVE_ResizeMode_e;
```

Member

Member Code	Description
E_MI_IVE_RESIZE_TYPE_U8C1	Single-channel image of which each pixel is expressed by an 8-bit unsigned data segment.
E_MI_IVE_RESIZE_TYPE_U8C3_PLANAR	Three-channel image (stored in planar format) of which each pixel is expressed by three 8-bit unsigned data segments.
E_MI_IVE_RESIZE_TYPE_U8C3_PACKAGE	Three-channel image (stored in package format) of which each pixel is expressed by three 8-bit unsigned data segments.
E_MI_IVE_RESIZE_TYPE_YUV420SP	YUV420 semi-planar image.
E_MI_IVE_RESIZE_TYPE_MAX	Error mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_ResizeCtrl_t

2.78. MI_IVE_BatCtrl_t

Description

Defines the bat control parameters.

Defines

```
typedef struct _MVE_IVE_BatCtrl_s
{
    MVE_IVE_BatMode_e enMode;
    MI_U16 _t u16HorTimes;
    MI_U16 _t u16VerTimes;
} MVE_IVE_BatCtrl_t;
```

Member

Member Code	Description
enMode	Input image mode. For detail, see MVE_IVE_BatMode_e
u16HorTimes	Threshold of horizontal direction.
u16VerTimes	Threshold of vertical direction.

Note

N/A.

Related Data Type and Interface

MI_IVE_BatMode_e

2.79. MI_IVE_BatMode_e

Description

Define the output control mode.

Defines

```
typedef enum
{
        E_MI_IVE_BAT_OUT_CTRL_BOTH = 0x0,
        E_MI_IVE_BAT_OUT_CTRL_HOR  = 0x1,
        E_MI_IVE_BAT_OUT_CTRL_VER  = 0x2,

        E_MI_IVE_BAT_OUT_CTRL_MAX
} MVE_IVE_BatMode_e
```

Member

Member Code	Description
E_MI_IVE_BAT_OUT_CTRL_BOTH	Horizontal and vertical mode.
E_MI_IVE_BAT_OUT_CTRL_HOR	Horizontal mode.
MVE_BAT_OUT_CTRL_VER	Vertical mode
MVE_BAT_OUT_CTRL_MAX	Error mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_BatCtrl_t

2.80. MI_IVE_AccCtrl_t

Description

Define the acc control parameter.

Defines

```
typedef struct MVE_IVE_AccCtrl_s
{
        MVE_IVE_AccMode_e enMode;
} MVE_IVE_AccCtrl_t;
```

Member

Member Code	Description
enMode	Input image mode. For detail, see MVE_IVE_AccMode_e

Note

N/A.

Related Data Type and Interface

MI_IVE_AccMode_e

2.81. MI_IVE_AccMode_e

Description

Define the acc input control mode.

Defines

```
typedef enum
{
        E_MI_IVE_ACC_MODE_INCREASE                = 0x0,
        E_MI_IVE_ACC_MODE_DECREASE                = 0x1,
        E_MI_IVE_ACC_MODE_INCREASE_MAP_255TO1     = 0x2,

        E_MI_IVE_ACC_MODE_MAX
} MVE_IVE_AccMode_e
```

Member

Member Code	Description
E_MI_IVE_ACC_MODE_INCREASE	Increase mode.
E_MI_IVE_ACC_MODE_DECREASE	Decrease mode.
E_MI_IVE_ACC_MODE_INCREASE_MAP_255TO1	Increase 255 to 1 mode.
E_MI_IVE_ACC_MODE_MAX	Error mode.

Note

N/A.

Related Data Type and Interface

MI_IVE_AccCtrl_t

2.82. MI_IVE_MatrTranfMode_e

Description

Define the input channel mode of matrix transform.

Defines

```
typedef enum
{
    E_MI_IVE_MATRIX_TRANSFORM_TYPE_C1       = 0x0,
    E_MI_IVE_MATRIX_TRANSFORM_TYPE_C2       = 0x1,
    E_MI_IVE_MATRIX_TRANSFORM_TYPE_C3       = 0x2,

    E_MI_IVE_MATRIX_TRANSFORM_TYPE_MAX
}MVE_IVE_MatrTranfMode_e;
```

Member

Member Code	Description
E_MI_IVE_MATRIX_TRANSFORM_TYPE_C1	Only use one input source.
E_MI_IVE_MATRIX_TRANSFORM_TYPE_C2	Two input sources.
E_MI_IVE_MATRIX_TRANSFORM_TYPE_C3	Thress input sources.

Note

N/A.

Related Data Type and Interface

MI_IVE_MatrTranfCtrl_t

2.83. MI_IVE_MatrTranfCtrl_t

Description

Define the control parameters of matrix transform.

Defines

```
typedef struct MI_IVE_MatrTranfCtrl_S
{
    MVE_IVE_MatrTranfMode_e enMode;      /*Input channel mode*/
    MI_S16 s16MatrixArray[9];   //Official
} MI_IVE_MatrTranfCtrl_t;
```

Member

Member Code	Description
enMode	Input image mode. For detail, see MI_IVE_MatrTranfMode_e
s16MatrixArray[9];	cofficients of matrix

Note

If the enMode = E_MI_IVE_MATRIX_TRANSFORM_TYPE_C1, only need to set vlaue s16MatrixArray[0]

If the enMode = E_MI_IVE_MATRIX_TRANSFORM_TYPE_C2, the value s16MatrixArray[0]~ s16MatrixArray[3] must be setted

If the enMode = E_MI_IVE_MATRIX_TRANSFORM_TYPE_C3, the all matrix value should be setted.

Related Data Type and Interface

MI_IVE_MatrTranfMode_e

3. IVE ERROR CODES

The following table lists the Intellegient Acceleration Engine API Error Codes.

Table 1: Intellegient Acceleration Engine API Error Codes

Error Code	Macro Definition	Description
0xA01D8001	MI_ERR_IVE_INVALID_DEVID	Invalid ID
0xA01D8002	MI_ERR_IVE_INVALID_CHNID	Invalid channel ID or area handle
0xA01D8003	MI_ERR_IVE_ILLEGAL_PARAM	Illegal parameter
0xA01D8004	MI_ERR_IVE_EXIST	Device, channel or resource already exists
0xA01D8005	MI_ERR_IVE_UNEXIST	Device, channel or resource to be used or destroyed does not exist
0xA01D8006	MI_ERR_IVE_NULL_PTR	Null pointer found in function parameter
0xA01D8007	MI_ERR_IVE_NOT_CONFIG	Module not configured
0xA01D8008	MI_ERR_IVE_NOT_SUPPORT	Parameter or function not supported
0xA01D8009	MI_ERR_IVE_NOT_PERM	Operation, e.g. attempt to modify static configuration parameter, not permitted
0xA01D800C	MI_ERR_IVE_NOMEM	Memory allocaton failed, e.g. system memory not enough
0xA01D800D	MI_ERR_IVE_NOBUF	Buffer allocation failed, e.g. image buffer area too broad
0xA01D800E	MI_ERR_IVE_BUF_EMPTY	No image in buffer area
0xA01D800F	MI_ERR_IVE_BUF_FULL	Image full in buffer area
0xA01D8010	MI_ERR_IVE_NOTREADY	System not initialized or corresponding module not loaded
0xA01D8011	MI_ERR_IVE_BADADDR	Invalid address
0xA01D8012	MI_ERR_IVE_BUSY	System busy
0xA01D8040	MI_ERR_IVE_SYS_TIMEOUT	System timeout
0xA01D8041	MI_ERR_IVE_QUERY_TIMEOUT	Query timeout
0xA01D8042	MI_ERR_IVE_OPEN_FILE	Failed to open Library
0xA01D8043	MI_ERR_IVE_READ_FILE	Library read failed
0xA01D8044	MI_ERR_IVE_WRITE_FILE	Library write failed