# Object Classification using TI's TMS320C66x DSP

## User Guide

June 2017

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# 1 Read This First

## 1.1 About This Manual

This document describes how to install and work with Texas Instruments' (TI) Object Classification Module implemented on TI's TMS320C66x DSP. It also provides a detailed Application Programming Interface (API) reference and information on the sample application that accompanies this component.

TI's Object Classification Module implementations are based on IVISION interface. IVISION interface is an extension of the eXpressDSP Algorithm Interface Standard (XDAIS).

## 1.2 Intended Audience

This document is intended for system engineers who want to integrate TI's vision and imaging algorithms with other software to build a high level vision system based on C66x DSP.

This document assumes that you are fluent in the C language, and aware of vision and image processing applications. Good knowledge of eXpressDSP Algorithm Interface Standard (XDAIS) standard will be helpful.

## 1.3 How to Use This Manual

This document includes the following chapters:

**Chapter 2 - Introduction**, provides a brief introduction to the XDAIS standards. It also provides an overview of Object Classification and lists its supported features.

**Chapter 3 - Installation Overview**, describes how to install, build, and run the algorithm.

**Chapter 4 - Sample Usage**, describes the sample usage of the algorithm.

**Chapter 5 - API Reference**, describes the data structures and interface functions used in the algorithm.

**Chapter 6 - Frequently Asked Questions,** provides answers to frequently asked questions related to using Object Classification Module.

## 1.4 Related Documentation From Texas Instruments

This document frequently refers TI's DSP algorithm standards called XDAIS. To obtain a copy of document related to any of these standards, visit the Texas Instruments website at www.ti.com.

## 1.5 Abbreviations

The following abbreviations are used in this document.

**Table 1 List of Abbreviations**

| Abbreviation | Description |
|---|---|
| API | Application Programming Interface |
| CIF | Common Intermediate Format |
| CNN | Convolutional Neural Network |
| DMA | Direct Memory Access |
| DMAN3 | DMA Manager |
| DSP | Digital Signal Processing |
| EVM | Evaluation Module |
| IRES | Interface for Resources |
| OBJCLASS | Object Classification Module |
| QCIF | Quarter Common Intermediate Format |
| QVGA | Quarter Video Graphics Array |
| RMAN | Resource Manager |
| SQCIF | Sub Quarter Common Intermediate Format |
| VGA | Video Graphics Array |
| XDAIS | eXpressDSP Algorithm Interface Standard |

## 1.6 Text Conventions

The following conventions are used in this document:

Text inside back-quotes (‘‘) represents pseudo-code.

Program source code, function and macro names, parameters, and command line commands are shown in a `mono-spaced` font.

## 1.7 Product Support

When contacting TI for support on this product, quote the product name (Object Classification Module on TMS320C66x DSP) and version number. The version number of the Object Classification Module is included in the Title of the Release Notes that accompanies the product release.

## *1.8 Trademarks*

Code Composer Studio, eXpressDSP,  Object Classification Module are trademarks of Texas Instruments.

# 2 Introduction

This chapter provides a brief introduction to XDAIS. It also provides an overview of TI's implementation of Object Classification on the C66x DSP and its supported features.

## *2.1 Overview of XDAIS*

TI's vision analytics applications are based on IVISION interface. IVISION is an extension of the eXpressDSP Algorithm Interface Standard (XDAIS). Please refer documents related to XDAIS for further details.

### 2.1.1 XDAIS Overview

An eXpressDSP-compliant algorithm is a module that implements the abstract interface IALG. The IALG API takes the memory management function away from the algorithm and places it in the hosting framework. Thus, an interaction occurs between the algorithm and the framework. This interaction allows the client application to allocate memory for the algorithm and also share memory between algorithms. It also allows the memory to be moved around while an algorithm is operating in the system. In order to facilitate these functionalities, the IALG interface defines the following APIs:

- `algAlloc()`
- `algInit()`
- `algActivate()`
- `algDeactivate()`
- `algFree()`

The `algAlloc()` API allows the algorithm to communicate its memory requirements to the client application. The `algInit()` API allows the algorithm to initialize the memory allocated by the client application. The `algFree()` API allows the algorithm to communicate the memory to be freed when an instance is no longer required.

Once an algorithm instance object is created, it can be used to process data in real-time. The `algActivate()` API provides a notification to the algorithm instance that one or more algorithm processing methods is about to be run zero or more times in succession. After the processing methods have been run, the client application calls the `algDeactivate()` API prior to reusing any of the instance's scratch memory.

The IALG interface also defines three more optional APIs `algControl()`, `algNumAlloc()`, and `algMoved()`. For more details on these APIs, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

## 2.2 Overview of Object Classification

This version of object classification module, based on Convolutional Neural Network (CNN) can be used to classify up to 26 classes of German Traffic Signs. A pre-trained network is implemented on C66x DSP, optimized for performance. It requires image pyramid as an input along with a list (X, Y, scale) of traffic sign detections. It outputs an identical list as the input but with updated class id's.

Information regarding image pyramid generation and traffic sign detection is beyond the scope of this document.

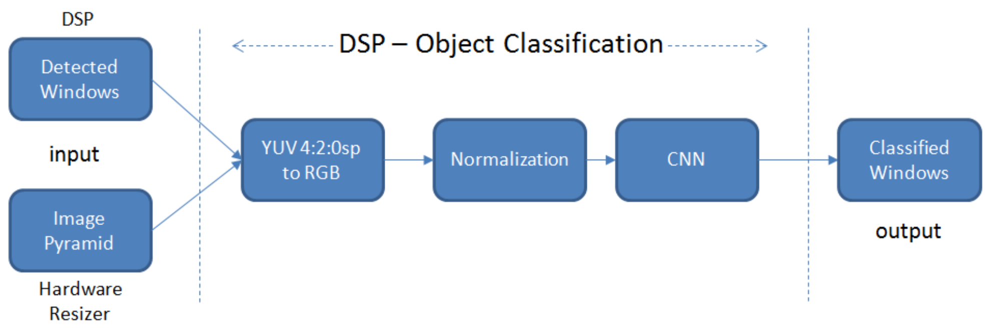


**Figure 1 Fundamental blocks of Object Classification**

## 2.3 Supported Services and Features

This user guide accompanies TI's implementation of Object Classification Algorithm on the TI's C66x DSP.

This version of the Object Classification has the following supported features of the standard:

- Supports Traffic sign recognition/classification.
- Independent of any operating system.
- This version of the Object Classification does not support following features:
- Traffic sign of any other country apart from Germany

# 3 Installation Overview

This chapter provides a brief description on the system requirements and instructions for installing Object Classification module. It also provides information on building and running the sample test application.

## *3.1 System Requirements*

This section describes the hardware and software requirements for the normal functioning of the algorithm component.

### 3.1.1 Hardware

This algorithm has been built and tested TI's C66x DSP on TDA2x platform. The algorithm shall work on any future TDA platforms hosting C66x DSP.

### 3.1.2 Software

The following are the software requirements for the stand alone functioning of the Object Classification module:

**Development Environment:** This project is developed using TI's Code Generation Tool 7.4.2. Other required tools used in development are mentioned in section 3.3

The project are built using g-make (GNU Make version 3.81). GNU tools comes along with CCS installation.

## *3.2 Installing the Component*

The algorithm component is released as install executable. Following sub sections provided details on installation along with directory structure.

### 3.2.1 Installing the compressed archive

The algorithm component is released as a compressed archive. To install the algorithm, extract the contents of the zip file onto your local hard disk. The zip file extraction creates a top-level directory called `200.V.OC.C66x.00.02`. Folder structure of this top level directory is shown Figure 2.

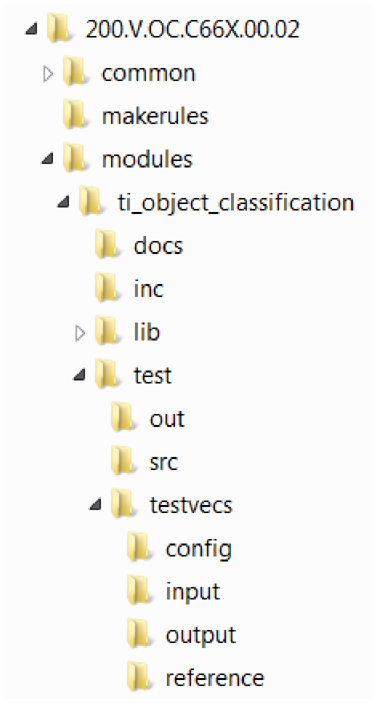


**Figure 2 Component Directory Structure In case of Object Release**

**Table 2 Component Directories in case of Object release**

| Sub-Directory | Description |
|---|---|
| `\modules` | `Top level folder containing different DSP app modules` |
| `\modules\common` | `Common files for building different DSP modules` |
| `\modules\makerules` | `Make rule files` |
| `\modules \ti_object_classification` | `Object classification module for C66x DSP` |
| `\modules \ti_object_classification \docs` | `User guide and Datasheet for Object classification module` |
| `\modules \ti_object_classification \inc` | `Contains iobjclass_ti.h interface file` |
| `\modules \ti_object_classification \lib` | `Contains Object classification algorithm library` |
| `\modules \ti_object_classification \test` | `Contains standalone test application source files` |

| Sub-Directory | Description |
|---|---|
| \modules \ti_object_classification \test\out | Contains test application .out executable |
| \modules \ti_object_classification \test\src | Contains test application source files |
| \modules \ti_object_classification \test\testvecs | Contains config, input, output, reference test vectors |
| \modules \ti_object_classification \test\testvecs\config | Contain config file to set various parameters exposed by Object classification module |
| \modules \ti_object_classification \test\testvecs\input | Contains sample input feature vector .bin file |
| \modules \ti_object_classification \test\testvecs\output | Contains output .txt file with a list of objects classified |
| \modules \ti_object_classification \test\testvecs\reference | Contains reference .txt file with a list of objects classified |

## 3.3 Building Sample Test Application

This Object classification library has been accompanied by a sample test application. To run the sample test application XDAIS tools are required.

This version of the Object Classification library has been validated with XDAIS tools containing IVISION interface version. Other required components (for test application building) version details are available in component release notes.

### 3.3.1 Installing XDAIS tools (XDAIS)

XDAIS can be downloaded from the following website:

http://downloads.ti.com/dsps/dsps_public_sw/sdo_sb/targetcontent/xdais/

Extract the XDAIS zip file and set a system environment variable named “`XDAIS_PATH`” pointing to <install directory>\<xdais_directory>

### 3.3.2 Installing Code Generation Tools

Install Code generation Tools from the link

https://www-a.ti.com/downloads/sds_support/TICodegenerationTools/download.htm

After installing the CG tools, set the environment variable to “`DSP_TOOLS`” to the installed directory like <install directory>\<cgtools_directory>

### 3.3.3 DMA Utils Library

Install DMA utility library from the link,

https://cdds.ext.ti.com/ematrix/common/emxNavigator.jsp?objectId=28670.42872.62652.37497

The DMA utility library is also available in processor SDK – Vision package. After installing DMA Utility Library, Set a system environment variable named “`DMAUTILS_PATH`” pointing to <install_directory>\dmautils

### 3.3.4 Installing C66x VLIB

Install C66x VLIB version from the link

http://software-dl.ti.com/libs/vlib/latest/index_FDS.html

After installing VLIB, set the environment variable to “`VLIB_PATH`” to the installed directory like <install directory>

### 3.3.5 Installing C66x MATHLIB

Install C66x MATHLIB version from the link

http://www.ti.com/tool/mathlib

After installing MATHLIB, set the environment variable to “`MATHLIB_PATH`” to the installed directory like <install directory>

### 3.3.6 Building the Test Application Executable through GMAKE

The sample test application that accompanies Object Classification module will run in TI's Code Composer Studio development environment. To build and run the sample test application through gmake, follow these steps:

1) Verify that you have installed code generation tools as mentioned.
2) Verify that you have installed XDAIS as mentioned
3) Verify that appropriate environment variables have been set as discussed in this above sections.
4) Build the sample test application project by gmake
    a. modules\ti_object_classification\test> gmake clean
    b. modules\ti_object_classification\test> gmake all
5) The above step creates an executable file, test_object_classification_algo.out in the modules\ti_object_classification\test\out sub-directory.
6) Open CCS with TDA2x platform selected configuration file. Select Target > Load Program on C66x DSP, browse to the modules\ti_object_classification\test\out sub-directory, select the executable created in step 5, and load it into Code Composer Studio in preparation for execution.
7) Select Target > Run on C66x DSP window to execute the sample test application.
8) Sample test application takes the input files stored in the \test\testvecs\input sub-directory, runs the module.
9) The reference files stored in the \test\testvecs\reference sub-directory can be used to verify that the object classification is functioning as expected.
10) On successful completion, the test application displays the information for each feature frame and writes the information regarding the classified objects in the \test\testvecs\output sub-directory.
11) User should compare with the reference provided in \test\testvecs\reference directory. Both the content should be same to conclude successful execution.

## 3.4 Configuration File

This algorithm is shipped along with:

- Algorithm configuration file (object_classification.cfg) – specifies the configuration parameters used by the test application to configure the Algorithm.

### 3.4.1 Test Application Configuration File

The algorithm configuration file, object_classification.cfg contains the configuration parameters required for the algorithm. The object_classification.cfg file is available in the \test\testvecs\config sub-directory.

A sample object_classification.cfg file is as shown.

```
#-------------------------------------------------------------------#
# Common Parameters                                                 #
#-------------------------------------------------------------------#

inFileName1      = "..\testvecs\input\
VIRB0008_0r_4p_PedSegments_1280x720_nv12_10fr_pyr.bin"

inFileName2      = "..\testvecs\input\
VIRB0008_0r_4p_PedSegments_1280x720_nv12_10fr_det.bin"

outFileName      = "..\testvecs\output\
VIRB0008_0r_4p_PedSegments_1280x720_nv12_10fr.log"

imgFileName      = "..\testvecs\output\VIRB0008"

maxImageWidth    = 1280
# Maximum width of the input image.

maxImageHeight   = 720
# Maximum height of the output image.

maxFrames        = 30
# Maximum number of input frames.

maxScales        = 20
# Maximum number of input scales to be checked. MAX_VALUE = 28

inputMode        = 0
# 0 - Accept Image Pyramid in YUV 4:2:0 SP and object list

classifierType   = 0
# 0 - TI CNN 101
```

If you specify additional fields in the object_classification.cfg file, ensure that you modify the test application appropriately to handle these fields.

## *3.5 Host emulation build for source package*

For source release the Object Classification module can be built in host emulation mode. This option speeds up development and validation time by running the platform code on x86/x64 PC.

### 3.5.1 Installing Visual Studio

Building host emulation for Object Classification requires Microsoft Visual Studio 11.0 (2012) which can be downloaded from below link.

http://www.microsoft.com/en-in/download/details.aspx?id=34673

### 3.5.2 Installing VLIB package for host emulation

Object Classification source package relies on VLIB source package to build the target in host emulation mode. Install VLIB package and link the pre-built host emulation VLIB libraries against Object Classification module.

After installing VLIB, set the environment variable to "`VLIB_HOST_INSTALL_DIR`" to the installed directory like <install directory>\packages

### 3.5.3 Building source in host emulation

After installing the required components, navigate to Object Classification install path and run `vcvarsall.bat` to setup the required environment variables

```
{install_path} > {…\Microsoft Visual Studio 11.0\VC\vcvarsall.bat}
```

Once the environment variables are setup build the Object Classification source in host emulation mode

```
{install_path} > gmake all TARGET_BUILD=debug TARGET_PLATFORM=PC
```

This will build the host emulation executable under the path

```
{install_path}\test\out\ test_object_classification_algo.out.exe
```

To build the example in host emulation mode for c6x DSP  you will need to install the c6xsim which is available at
http://processors.wiki.ti.com/index.php/Run_Intrinsics_Code_Anywhere

Install this package in the common folder.

### 3.5.4 Running host emulation executable

Launch Microsoft Visual Studio 11.0 and open file
`test_object_classification_algo.out.exe`

This will load the host emulation program which can be used for development and validation purpose.

## *3.6 Uninstalling the Component*

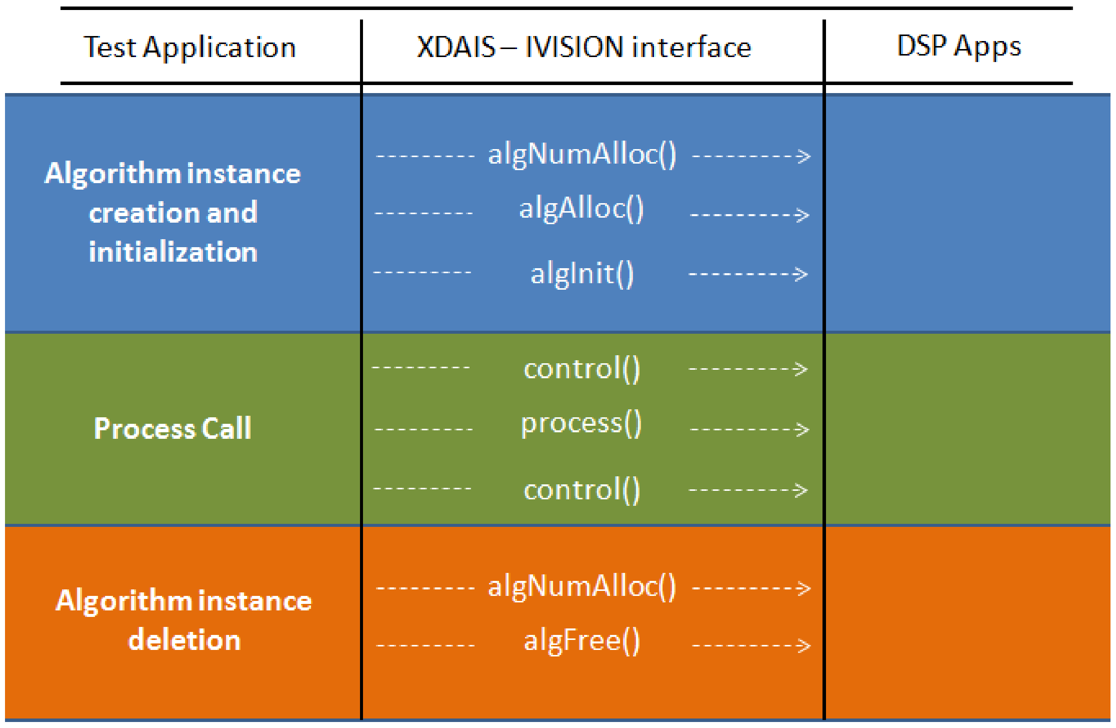
To uninstall the component, delete the algorithm directory from your hard disk.

# 4 Sample Usage

This chapter provides a detailed description of the sample test application that accompanies this Object Classification component.

## 4.1 Overview of the Test Application

The test application exercises the `IVISION` and extended class of the Object Classification library. The source files for this application are available in the \test\src sub-directories.



| Test Application | XDAIS – IVISION interface | DSP Apps |
|---|---|---|
| **Algorithm instance creation and initialization** | --------- algNumAlloc() ---------> | |
| | --------- algAlloc() ---------> | |
| | --------- algInit() ---------> | |
| **Process Call** | --------- control() ---------> | |
| | --------- process() ---------> | |
| | --------- control() ---------> | |
| **Algorithm instance deletion** | --------- algNumAlloc() ---------> | |
| | --------- algFree() ---------> | |

**Table 3 Test Application Sample Implementation**

The test application is divided into four logical blocks:

- Parameter setup
- Algorithm instance creation and initialization
- Process call
- Algorithm instance deletion

## *4.2 Parameter Setup*

Each algorithm component requires various configuration parameters to be set at initialization. For example, object classification requires parameters such as maximum image height, maximum image width, and so on. The test application obtains the required parameters from the Algorithm configuration files.

In this logical block, the test application does the following:

1) Opens the configuration file, listed in `object_classification.cfg` and reads the various configuration parameters required for the algorithm. For more details on the configuration files, see Section 3.4.
2) Sets the `TI_OC_CreateParams` structure based on the values it reads from the configuration file.
3) Does the algorithm instance creation and other handshake via. control methods
4) For each frame reads the feature planes into the application input buffer and makes a process call
5) For each frame dumps out the detected points along with meta data to specified output file.

## *4.3 Algorithm Instance Creation and Initialization*

In this logical block, the test application accepts the various initialization parameters and returns an algorithm instance pointer. The following APIs implemented by the algorithm are called in sequence by `ALG_create()`:

1) `algNumAlloc()` - To query the algorithm about the number of memory records it requires.
2) `algAlloc()` - To query the algorithm about the memory requirement to be filled in the memory records.
3) `algInit()` - To initialize the algorithm with the memory structures provided by the application.

A sample implementation of the create function that calls `algNumAlloc()`, `algAlloc()`, and `algInit()` in sequence is provided in the `ALG_create()` function implemented in the `alg_create.c` file.

**IMPORTANT!** In this release, the algorithm assumes a fixed number of EDMA channels and does not rely on any IRES resource allocator to allocate the physical EDMA channels.

**IMPORTANT!** In this release, the algorithm requests two types of internal memory via `IALG_DARAM0` and `IALG_DARAM1` enums. The performance of the algorithm is validated by allocating DARAM0 to L1D SRAM and DARAM1 to L2 SRAM. Refer datasheet for more information regarding data and program memory sizes.

## *4.4 Process Call*

After algorithm instance creation and initialization, the test application does the following:

1) Sets the dynamic parameters (if they change during run-time) by calling the `control()` function with the `IALG_SETPARAMS` command.
2) Sets the input and output buffer descriptors required for the `process()` function call. The input and output buffer descriptors are obtained by calling the `control()` function with the `IALG_GETBUFINFO` command.
3) Calls the `process()` function to detect objects in the provided feature plane. The inputs to the process function are input and output buffer descriptors, pointer to the `IVISION_InArgs` and `IVISION_OutArgs` structures.
4) When the `process()` function is called, the software triggers the start of algorithm.

The `control()` and `process()` functions should be called only within the scope of the `algActivate()` and `algDeactivate()` XDAIS functions, which activate and deactivate the algorithm instance respectively. If the same algorithm is in-use between two process/control function calls, calling these functions can be avoided. Once an algorithm is activated, there can be any ordering of `control()` and `process()` functions. The following APIs are called in sequence:

5) `algActivate()` – To activate the algorithm instance.
6) `control()` (optional) - To algorithm on status or setting of dynamic parameters and so on, using the eight control commands.
7) `process()` - To call the Algorithm with appropriate input/output buffer and arguments information.
8) `control()` (optional) - To query the algorithm on status or setting of dynamic parameters and so on, using the eight available control commands.
9) `algDeactivate()` - To deactivate the algorithm instance.

The do-while loop encapsulates frame level `process()` call and updates the input buffer pointer every time before the next call. The do-while loop breaks off either when an error condition occurs or when the input buffer exhausts.

If the algorithm uses any resources through RMAN, then user must activate the resource after the algorithm is activated and deactivate the resource before algorithm deactivation.

## 4.5 Algorithm Instance Deletion

Once `process` is complete, the test application must release the resources granted by the IRES resource Manager interface if any and delete the current algorithm instance. The following APIs are called in sequence:

10) `algNumAlloc()` - To query the algorithm about the number of memory records it used.

11) `algFree()` - To query the algorithm to get the memory record information.

A sample implementation of the delete function that calls `algNumAlloc()` and `algFree()` in sequence is provided in the `ALG_delete()` function implemented in the `alg_create.c` file.

## 4.6 Frame Buffer Management

### 4.6.1 Input and Output Frame Buffer

The algorithm has input buffers that stores frames until they are processed. These buffers at the input level are associated with a `bufferId` mentioned in input buffer descriptor. The output buffers are similarly associated with `bufferId` mentioned in the output buffer descriptor. The IDs are required to track the buffers that have been processed or locked. The algorithm uses this ID, at the end of the process call, to inform back to application whether it is a free buffer or not. Any buffer given to the algorithm should be considered locked by the algorithm, unless the buffer is returned to the application through `IVISION_OutArgs->inFreeBufID[]` and `IVISION_OutArgs->outFreeBufID[]`.

For example,

| | | | | | |
|---|---|---|---|---|---|
| Process Call # | 1 | 2 | 3 | 4 | 5 |
| bufferID (input) | 1 | 2 | 3 | 4 | 5 |
| bufferID (output) | 1 | 2 | 3 | 4 | 5 |
| inFreeBufID | 1 | 2 | 3 | 4 | 5 |
| outFreeBufID | 1 | 2 | 3 | 4 | 5 |

The input buffer and output buffer is freed immediately once process call returns.

### 4.6.2 Input Buffer Format

The algorithm expects image pyramid data as input data and a list of detections containing the [X, Y, Scale] locations of the detected object.

The image pyramid data is YUV 4:2:0sp data of type, `IVISION_OutBufs`. An array of such `IVISION_OutBufs` is defined at `TI_OC_imgPyrData` structure.

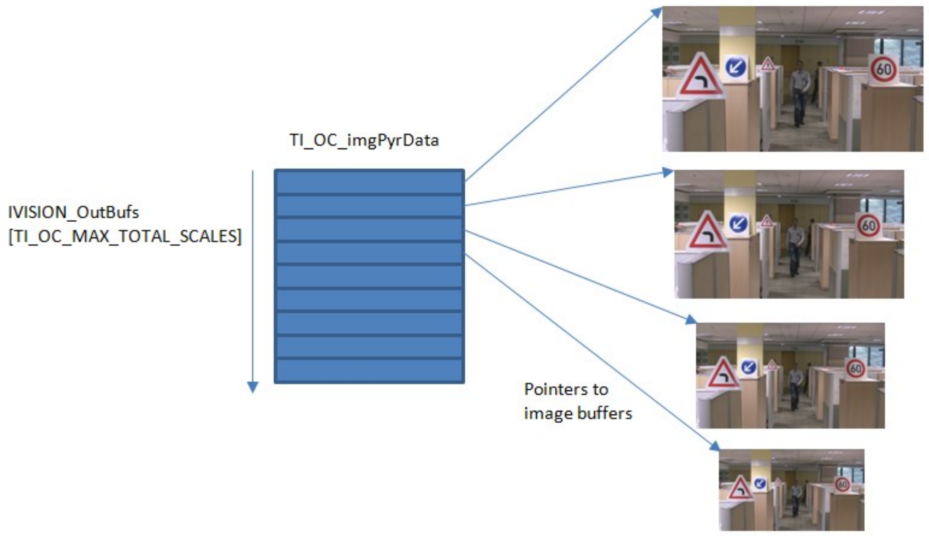


**Figure 3 Image Pyramid format**

A list of detections comprising of the location of detections [X, Y, and Scale] is required by the algorithm to fetch the detected window from image pyramid. The list of detections is of type `TI_OC_inputList` which contains a list of `TI_OC_objectDescriptor`.

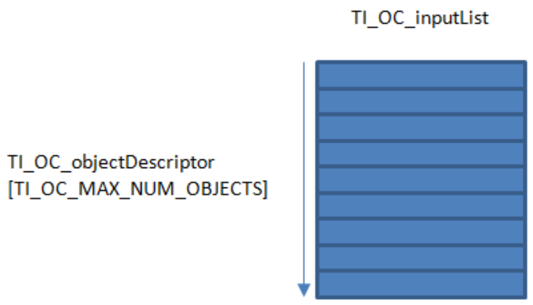


**Figure 4 Detection input format**

### 4.6.3 Output Buffer Format

The output buffer, `TI_OC_outputList` is same as `TI_OC_inputList` but the algorithm updates the `subTypeID` field with the appropriate class.

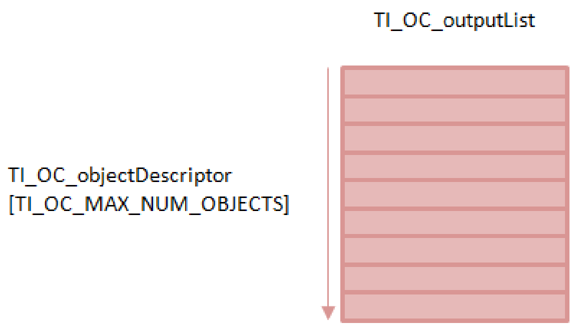


**Figure 5 Output list format format**

# 5 API Reference

This chapter provides a detailed description of the data structures and interfaces functions used by Object Classification.

### 5.1.1 IVISION_Params

**Description**

This structure defines the basic creation parameters for all vision applications.

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `algParams` | `IALG_Params` | Input | IALG Params |
| `cacheWriteBack` | `ivisionCacheWriteBack` | Input | Function pointer for cache write back for cached based system. If the system is not using cache for data memory then the pointer can be filled with NULL. If the algorithm receive a input buffer with `IVISION_AccessMode` as `IVISION_ACCESSMODE_CPU` and the `ivisionCacheWriteBack` as `NULL` then the algorithm will return with error |

### 5.1.2 IVISION_Point

**Description**

This structure defines a 2-dimensional point

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `X` | `XDAS_Int32` | Input | X (horizontal direction offset) |
| `Y` | `XDAS_Int32` | Input | Y (vertical direction offset) |

### 5.1.3 IVISION_Rect

**Description**

This structure defines a rectangle

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `topLeft` | `XDAS_Int32` | Input | Top left co-ordinate of rectangle |
| `Width` | `XDAS_Int32` | Input | Width of the rectangle |
| `Height` | `XDAS_Int32` | Input | Height of the rectangle |

### 5.1.4 IVISION_Polygon

**Description**

This structure defines a poylgon

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `numPoints` | `XDAS_Int32` | Input | Number of points in the polygon |
| `Points` | `IVISION_Point*` | Input | Points of polygon |

### 5.1.5 IVISION_BufPlanes

**Description**

This structure defines a generic plane descriptor

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `Buf` | `void*` | Input | Number of points in the polygon |
| `Width` | `XDAS_UInt32` | Input | Width of the buffer (in bytes), This field can be viewed as pitch while processing a ROI in the buffer |
| `Height` | `XDAS_UInt32` | Input | Height of the buffer (in lines) |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| frameROI | IVISION_Rect | Input | Region of the intererst for the current frame to be processed in the buffer. Dimensions need to be a multiple of internal block dimenstions. Refer application specific details for block dimensions supported for the algorithm. This needs to be filled even if bit-0 of IVISION_InArgs::subFrameInfo is set to 1 |
| subFrameROI | IVISION_Rect | Input | Region of the intererst for the current sub frame to be processed in the buffer. Dimensions need to be a multiple of internal block dimenstions. Refer application specific details for block dimensions supported for the application. This needs to be filled only if bit-0 of IVISION_InArgs::subFrameInfo is set to 1 |
| freeSubFrameROI | IVISION_Rect | Input | This ROI is portion of subFrameROI that can be freed after current slice process call. This field will be filled by the algorithm at end of each slice processing for all the input buffers (for all the output buffers this field needs to be ignored). This will be filled only if bit-0 of IVISION_InArgs::subFrameInfois set to 1 |
| planeType | XDAS_Int32 | Input | Content of the buffer - for example Y component of NV12 |
| accessMask | XDAS_Int32 | Input | Indicates how the buffer was filled by the producer, It is IVISION_ACCESSMODE_HWA or IVISION_ACCESSMODE_CPU |

### 5.1.6 IVISION_BufDesc

**Description**

This structure defines the iVISION buffer descriptor

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| numPlanes | void* | Input | Number of points in the polygon |
| bufPlanes[IVISION_MAX_NUM_PLANES] | IVISION_BufPlanes | Input | Description of each plane |
| formatType | XDAS_UInt32 | Input | Height of the buffer (in lines) |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `bufferId` | `XDAS_Int32` | Input | Identifier to be attached with the input frames to be processed. It is useful when algorithm requires buffering for input buffers. Zero is not supported buffer id and a reserved value |
| `Reserved[2]` | `XDAS_UInt32` | Input | Reserved for later use |

### 5.1.7 IVISION_BufDescList

**Description**

This structure defines the iVISION buffer descriptor list. IVISION_InBufs and IVISION_OutBufs is of the same type

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `size` | `XDAS_UInt32` | Input | Size of the structure |
| `numBufs` | `XDAS_UInt32` | Input | Number of elements of type IVISION_BufDesc in the list |
| `bufDesc` | `IVISION_BufDesc **` | Input | Pointer to the list of buffer descriptor |

### 5.1.8 IVISION_InArgs

**Description**

This structure defines the iVISION input arugments

**Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `size` | `XDAS_UInt32` | Input | Size of the structure |
| `subFrameInfo` | `XDAS_UInt32` | Input | bit0 - Sub frame processing enable (1) or disabled (0)<br>bit1 - First subframe of the picture (0/1)<br>bit 2 - Last subframe of the picture (0/1)<br>bit 3 to 31 – reserved |

### 5.1.9 IVISION_OutArgs

**Description**

This structure defines the `IVISION` output arguments

**Fields**

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `size` | `XDAS_UInt32` | Input | Size of the structure |
| `inFreeBufIDs[IVISION_MAX_NUM_FREE_BUFFERS]` | `XDAS_UInt32` | Input | Array of bufferId's corresponding to the input buffers that have been unlocked in the Current process call. The input buffers released by the algorithm are indicated by their non-zero ID (previously provided via IVISION_BufDesc#bufferId A value of zero (0) indicates an invalid ID. The first zero entry in array will indicate end of valid inFreeBufIDs within the array hence the application can stop searching the array when it encounters the first zero entry. If no input buffer was unlocked in the process call, inFreeBufIDs[0] will have a value of zero. |
| `outFreeBufIDs [IVISION_MAX_NUM_FREE_BUFFERS]` | `XDAS_UInt32` | Input | Array of bufferId's corresponding to the Output buffers that have been unlocked in the Current process call. The output buffers released by the algorithm are indicated by their non-zero ID (previously provided via IVISION_BufDesc#bufferId A value of zero (0) indicates an invalid ID. The first zero entry in array will indicate end of valid inFreeBufIDs within the array hence the application can stop searching the array when it encounters the first zero entry. If no output buffer was unlocked in the process call, inFreeBufIDs[0] will have a value of zero. |
| `reserved[2]` | `XDAS_UInt32` | | Reserved for future usage |

### 5.1.10 Object Classification Enumeration

This section includes the following Object Classification specific enumerations:

- `TI_OC_ObjectType`
- `TI_OC_ObjectSubType`
- `TI_OC_InBufOrder`
- `TI_OC_OutBufOrder`

#### *5.1.10.1 TI_OC_ObjectType*

**Description**

Enum to indicate type of object detected. This is used to populate objType in TI_OC_objectDescriptor structure

**Fields**

| Field | Value | Description |
|---|---|---|
| `TI_OC_PEDESTRIAN` | 0 | Indicates that the detected object type is Pedestrian |
| `TI_OC_TRAFFIC_SIGN` | 1 | Indicates that the detected object type is Traffic sign |
| `TI_OC_VEHICLE` | 2 | Indicates that the detected object type is Vehicle |
| `TI_OC_MAX_OBJECTS` | 3 | Maximum number of objects supported |

#### *5.1.10.2 TI_OC_ObjectSubType*

**Description**

Enum to indicate sub type of object detected. This field will be set with appropriate class value by the algorithm.

**Fields**

| Field | Value | Description |
|---|---|---|
| `TI_CLASS_NEGATIVE` | 0 | Object is a false positive |
| `TI_TSR_SPEED_LIMIT_20` | 1 | Traffic sign - speed limit 20 km/h |
| `TI_TSR_SPEED_LIMIT_30` | 2 | Traffic sign - speed limit 30 km/h |
| `TI_TSR_SPEED_LIMIT_50` | 3 | Traffic sign - speed limit 50 km/h |

| Field | Value | Description |
|---|---|---|
| `TI_TSR_SPEED_LIMIT_60` | 4 | Traffic sign - speed limit 60 km/h |
| `TI_TSR_SPEED_LIMIT_70` | 5 | Traffic sign - speed limit 70 km/h |
| `TI_TSR_SPEED_LIMIT_80` | 6 | Traffic sign - speed limit 80 km/h |
| `TI_TSR_SPEED_LIMIT_100` | 7 | Traffic sign - speed limit 100 km/h |
| `TI_TSR_SPEED_LIMIT_120` | 8 | Traffic sign - speed limit 120 km/h |
| `TI_TSR_END_OF_SPEED_LIMIT_80` | 9 | Traffic sign – end of speed limit 80 km/h |
| `TI_TSR_PRIORITY_ROAD` | 10 | Traffic sign – priority road |
| `TI_TSR_GIVE_WAY` | 11 | Traffic sign – give way |
| `TI_TSR_NO_ENTRY` | 12 | Traffic sign – no entry |
| `TI_TSR_TURN_RIGHT` | 13 | Traffic sign – turn right |
| `TI_TSR_TURN_LEFT` | 14 | Traffic sign – turn left |
| `TI_TSR_AHEAD_ONLY` | 15 | Traffic sign – ahead only |
| `TI_TSR_GO_STRAIGHT_OR_RIGHT` | 16 | Traffic sign – go straight or right |
| `TI_TSR_GO_STRAIGHT_OR_LEFT` | 17 | Traffic sign – go straight or left |
| `TI_TSR_KEEP_RIGHT` | 18 | Traffic sign – keep right |
| `TI_TSR_KEEP_LEFT` | 19 | Traffic sign – keep left |
| `TI_TSR_ROUNDABOUT` | 20 | Traffic sign – roundabout |
| `TI_TSR_SPEED_LIMIT_END` | 21 | Traffic sign – End of all speed and passing limits |
| `TI_TSR_NO_STOPPING` | 22 | Traffic sign – no stopping |
| `TI_TSR_NO_VEHICLES` | 23 | Traffic sign – no vehicles |
| `TI_TSR_BICYCLE_LANE` | 24 | Traffic sign – bicycle lane |
| `TI_TSR_CAUTION` | 25 | Traffic sign – general caution |
| `TI_TSR_STOP_AND_GIVEWAY` | 26 | Traffic sign – stop and give way |
| `TI_CLASS_OTHER` | 27 | Other class |
| `TI_CLASS_PEDESTRIAN` | 28 | Pedestrian class |
| `TI_CLASS_BICYCLIST` | 29 | Bicyclist class |
| `TI_CLASS_VEHICLE` | 30 | Vehicle class |

| Field | Value | Description |
|---|---|---|
| `TI_CLASS_IGNORED` | 31 | Ignored class |
| `TI_MAX_SUB_TYPES` | 32 | Maximum number of sub type classes |

#### *5.1.10.3 TI_OC_InBufOrder*

**Description**

User provides most of the infomration through buffer descriptor during process call. Below enums define the purpose of input buffer.There are two input buffer descriptors

**Fields**

| Field | Value | Description |
|---|---|---|
| `TI_OC_IN_BUFDESC_IMAGE_PYRAMID` | 0 | This buffer descriptor provides the 8bit YUV 4:2:0sp image pyramid |
| `TI_OC_IN_BUFDESC_DETECTION_LIST` | 1 | This buffer descriptor provides the list of detections containing [X, Y and Scale] values |
| `TI_OC_IN_BUFDESC_TOTAL` | 2 | Total number of input buffer descriptor |

#### *5.1.10.4 TI_OC_OutBufOrder*

**Description**

User provides most of the infomration through buffer descriptor during process call. Below enums define the purpose of output buffer.There are 2 output buffer descriptors

**Fields**

| Field | Value | Description |
|---|---|---|
| `TI_OC_OUT_BUFDESC_OBJECT_LIST` | 0 | List of classified objects. |
| `TI_OC_OUT_BUFDESC_IMAGE_LIST` | 1 | Buffer comprises of 8bit RGB detected windows which are fed to the classifier. For debugging purpose only. |
| `TI_OC_OUT_BUFDESC_TOTAL` | 2 | Total number of output buffer descriptor |

### 5.1.11 Object Classification Data Structures

This section includes the following Object Classification specific extended data structures:

- `TI_OC_CreateParams`
- `TI_OC_InArgs`
- `TI_OC_Stats`
- `TI_OC_OutArgs`
- `TI_OC_imgPyrData`
- `TI_OC_objectDescriptor`
- `TI_OC_inputList`
- `TI_OC_outputList`

#### *5.1.11.1 TI_OC_CreateParams*

**‖ Description**

This structure defines the create-time input arguments for Object Classification instance.

**‖ Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `visionParams` | `IVISION_Params` | Input | See `IVISION_Params` data structure for details |
| `edma3RmLldHandle` | void * | Input | Pointer to edma3-lld resource manager |
| `maxImageWidth` | uint16_t | Input | Max input width of image |
| `maxImageHeight` | uint16_t | Input | Max input height of image |
| `maxScales` | uint16_t | Input | Max number of supported scales |

#### 5.1.11.2 TI_OC_InArgs

**|| Description**

This structure contains all the parameters which are given as input to OC algorithm every frame

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| iVisionInArgs | IVISION_InArgs | Input | See IVISION_InArgs data structure for details. |
| inputMode | uint8_t | Input | Type of input supplied to OC module. When,<br><br>0 – 8bit YUV 4:2:0sp image pyramid<br>1 – reserved |
| classifierType | uint8_t | Input | Type of classifier<br>When,<br><br>0 – TI CNN<br>1 – reserved |
| reserved0 | uint32_t | Input | Reserved 32-bit field. Must be set to 0 for normal operation |
| reserved1 | uint32_t | Input | Reserved 32-bit field. Must be set to 0 for normal operation |
| reserved2 | uint32_t | Input | Reserved 32-bit field. Must be set to 0 for normal operation |
| reserved3 | uint32_t | Input | Reserved 32-bit field. Must be set to 0 for normal operation |

#### 5.1.11.3 TI_OC_Stats

**|| Description**

This structure reports OC statistics, to be used only for debugging.

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| numCycles[TI_OC_MAX_LAYERS] | uint32_t | Output | Number of cycles taken by each layer (CNN) |
| numLayers | uint32_t | Output | Number of CNN layers |

#### 5.1.11.4 TI_OC_OutArgs

‖ **Description**

This structure contains all the parameters which are given as output by the algorithm.

‖ **Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `iVisionOutArgs` | `IVISION_OutArgs` | Output | See `IVISION_OutArgs` data structure for details. |
| `ocStats` | `TI_OC_Stats` | Output | See `TI_OC_Stats` data structure for details. |
| `errorCode` | `uint32_t` | Output | Error code returned by the algorithm |

#### 5.1.11.5 TI_OC_objectDescriptor

‖ **Description**

This structure contains the object properties such as location-(x, y,scale), size-(height, width), confidence (score) type - (objTag), string messages etc.

‖ **Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `objTag` | `uint32_t` | Input/ Output | Unique ID associated with an object. |
| `objType` | `uint8_t` | Input/ Output | See `TI_OC_ObjectType` enum for details. |
| `objSubType` | `uint8_t` | Input/ Output | See `TI_OC_ObjectSubType` enum for details. |
| `xPos` | `uint16_t` | Input/ Output | Location of the detected object in the image along X direction |
| `yPos` | `uint16_t` | Input/ Output | Location of the detected object in the image along Y direction |
| `objWidth` | `uint16_t` | Input/ Output | Width of the located object in pixels. Does not indicate actual width of the object. |
| `objHeight` | `uint16_t` | Input/ Output | Width of the located object in pixels. Does not indicate actual height of the object. |
| `objScore` | `Float` | Input/ Output | Confidence measure of detected object |
| `objScale` | `Float` | Input/ Output | Scale at which the object was detected |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `reserved0` | `Float` | Input/ Output | Reserved field set to 0 |
| `reserved1` | `Float` | Input/ Output | Reserved field set to 0 |
| `reserved2` | `Float` | Input/ Output | Reserved field set to 0 |
| `reserved3` | `Float` | Input/ Output | Reserved field set to 0 |

### 5.1.11.6 TI_OC_inputList

**|| Description**

This is the output structure given to object classification module. It contains the number of objects detected and `TI_OC_objectDescriptor` instances of `TI_OC_objectDescriptor` structure. The number of valid descriptors is governed by numObjects variable.

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `numObjects` | `int32_t` | Input | Number of detected objects |
| `errorCode` | `int32_t` | Input | Error in the detected list, if any |
| `objDesc[TI_OC_MAX_NUM_OBJECTS]` | `TI_OC_objectDescriptor` |  | See `TI_OC_objectDescriptor` for more details |

### 5.1.11.7 TI_OC_outputList

**|| Description**

This is the output structure given by object classification module. It contains the number of objects classifier and `TI_OC_MAX_NUM_OBJECTS` instances of `TI_OC_objectDescriptor` structure. The number of valid descriptors is governed by numObjects variable.

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `numObjects` | `int32_t` | Input | Number of clasified objects |
| `errorCode` | `int32_t` | Input | Error in the detected list, if any |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `objDesc[TI_OC_MAX_NUM_OBJECTS]` | `TI_OC_objectDescriptor` | | See `TI_OC_objectDescriptor` for more details |

## 5.2 Default and Supported Values of Parameter

This version of Object Classification module provides a fixed functionality and does not support any configurability.

## 5.3 Interface Functions

This section describes the Application Programming Interfaces (APIs) used by Object classification. The APIs are logically grouped into the following categories:

- **Creation** – `algNumAlloc()`, `algAlloc()`
- **Initialization** – `algInit()`
- **Control** – `control()`
- **Data processing** – `algActivate()`, `process()`, `algDeactivate()`
- **Termination** – `algFree()`

You must call these APIs in the following sequence:

1) `algNumAlloc()`
2) `algAlloc()`
3) `algInit()`
4) `algActivate()`
5) `process()`
6) `algDeactivate()`
7) `algFree()`

`control()` can be called any time after calling the `algInit()` API.

`algNumAlloc()`, `algAlloc()`, `algInit()`, `algActivate()`, `algDeactivate()`, and `algFree()` are standard XDAIS APIs. This document includes only a brief description for the standard XDAIS APIs. For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

## 5.4 Creation APIs

Creation APIs are used to create an instance of the component. The term creation could mean allocating system resources, typically memory.

**|| Name**

`algNumAlloc()` – determine the number of buffers that an algorithm requires

**|| Synopsis**

```
XDAS_Int32 algNumAlloc(Void);
```

**|| Arguments**

```
void
```

**|| Return Value**

```
XDAS_Int32; /* number of buffers required */
```

**|| Description**

`algNumAlloc()` returns the number of buffers that the `algAlloc()` method requires. This operation allows you to allocate sufficient space to call the `algAlloc()` method.

`algNumAlloc()` may be called at any time and can be called repeatedly without any side effects. It always returns the same result. The `algNumAlloc()` API is optional.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

**|| See Also**

```
algAlloc()
```

**|| Name**

`algAlloc()` – determine the attributes of all buffers that an algorithm requires

**|| Synopsis**

```
XDAS_Int32 algAlloc(const IALG_Params *params, IALG_Fxns **parentFxns, IALG_MemRec
memTab[]);
```

**|| Arguments**

```
IALG_Params *params; /* algorithm specific attributes */

IALG_Fxns **parentFxns;/* output parent algorithm functions */

IALG_MemRec memTab[]; /* output array of memory records */
```

**|| Return Value**

```
XDAS_Int32 /* number of buffers required */
```

**|| Description**

`algAlloc()` returns a table of memory records that describe the size, alignment, type, and memory space of all buffers required by an algorithm. If successful, this function returns a positive non-zero value indicating the number of records initialized.

The first argument to `algAlloc()` is a pointer to a structure that defines the creation parameters. This pointer may be `NULL` however, in this case, `algAlloc()` must assume default creation parameters and must not fail.

The second argument to `algAlloc()` is an output parameter. `algAlloc()` may return a pointer to its parent's IALG functions. If an algorithm does not require a parent object to be created, this pointer must be set to `NULL`.

The third argument is a pointer to a memory space of size `nbufs * sizeof(IALG_MemRec)` where, `nbufs` is the number of buffers returned by `algNumAlloc()` and `IALG_MemRec` is the buffer-descriptor structure defined in ialg.h.

After calling this function, `memTab[]` is filled up with the memory requirements of an algorithm.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

**|| See Also**

algNumAlloc()

algFree()

## 5.5 Initialization API

Initialization API is used to initialize an instance of the algorithm. The initialization parameters are defined in the `IVISION_Params` structure (see section 5.1.1 for details).

**|| Name**

`algInit()` – initialize an algorithm instance

**|| Synopsis**

```
XDAS_Int32 algInit(IALG_Handle handle, IALG_MemRec memTab[], IALG_Handle parent,
IALG_Params *params);
```

**|| Arguments**

```
IALG_Handle handle; /* algorithm instance handle*/

IALG_memRec memTab[]; /* array of allocated buffers */

IALG_Handle parent; /* handle to the parent instance */

IALG_Params *params; /*algorithm init parameters */
```

**|| Return Value**

```
IALG_EOK; /* status indicating success */

IALG_EFAIL; /* status indicating failure */
```

**|| Description**

`algInit()` performs all initialization necessary to complete the run time creation of an algorithm instance object. After a successful return from `algInit()`, the instance object is ready to be used to process data.

The first argument to `algInit()` is a handle to an algorithm instance. This value is initialized to the base field of `memTab[0]`.

The second argument is a table of memory records that describe the base address, size, alignment, type, and memory space of all buffers allocated for an algorithm instance. The number of initialized records is identical to the number returned by a prior call to `algAlloc()`.

The third argument is a handle to the parent instance object. If there is no parent object, this parameter must be set to `NULL`.

The last argument is a pointer to a structure that defines the algorithm initialization parameters.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

Since there is no mechanism to return extended error code for unsupported parameters, this version of algorithm returns `IALG_EOK` even if some parameter unsupported is set. But subsequence control/process call it returns the detailed error code

**‖ See Also**

```
algAlloc(),
algMoved()
```

## 5.6 Control API

Control API is used for controlling the functioning of the algorithm instance during run-time. This is done by changing the status of the controllable parameters of the algorithm during run-time. These controllable parameters are defined in the `IALG_Cmd` data structure.

**‖ Name**

`control()` – change run time parameters and query the status

**‖ Synopsis**

```
XDAS_Int32 (*control) (IVISION_Handle handle, IALG_Cmd id, IALG_Params *inParams,
IALG_Params *outParams);
```

**‖ Arguments**

```
IVISION_Handle handle; /* algorithm instance handle */

IALG_Cmd id; /* algorithm specific control commands*/

IALG_Params *inParams /* algorithm input parameters */

IALG_Params *outParams /* algorithm output parameters */
```

**‖ Return Value**

```
IALG_EOK; /* status indicating success */

IALG_EFAIL; /* status indicating failure */
```

**‖ Description**

This function changes the run time parameters of an algorithm instance and queries the algorithm's `status`. `control()` must only be called after a successful call to `algInit()` and must never be called after a call to `algFree()`.

The first argument to `control()` is a handle to an algorithm instance.

The second argument is an algorithm specific control command. See `IALG_CmdId` enumeration for details.

**|| Preconditions**

The following conditions must be true prior to calling this function; otherwise, its operation is undefined.

- `control()` can only be called after a successful return from `algInit()` and `algActivate()`.
- If algorithm uses DMA resources, `control()` can only be called after a successful return from `DMAN3_init()`.
- `handle` must be a valid handle for the algorithm's instance object.
- params must not be NULL and must point to a valid `IALG_Params` structure.

**|| Postconditions**

The following conditions are true immediately after returning from this function.

- If the control operation is successful, the return value from this operation is equal to `IALG_EOK` otherwise it is equal to either `IALG_EFAIL` or an algorithm specific return value. If status or handle is NULL then Object Classification returns `IALG_EFAIL`
- If the control command is not recognized or some parameters to act upon are not supported, the return value from this operation is not equal to `IALG_EOK`.
- The algorithm should not modify the contents of params. That is, the data pointed to by this parameter must be treated as read-only.

**|| Example**

See test bench file, `object_classification_tb.c` available in the \test\src sub-directory.

**|| See Also**

algInit(), algActivate(), process()

## *5.7 Data Processing API*

Data processing API is used for processing the input data.

**|| Name**

`algActivate()` – initialize scratch memory buffers prior to processing.

**|| Synopsis**

```
void algActivate(IALG_Handle handle);
```

**|| Arguments**

```
IALG_Handle handle; /* algorithm instance handle */
```

**|| Return Value**

Void

**|| Description**

`algActivate()` initializes any of the instance's scratch buffers using the persistent memory that is part of the algorithm's instance object.

The first (and only) argument to `algActivate()` is an algorithm instance handle. This handle is used by the algorithm to identify various buffers that must be initialized prior to calling any of the algorithm's processing methods.

For more details, see *TMS320 DSP Algorithm Standard API Reference.* (literature number SPRU360).

**|| See Also**

`algDeactivate()`

**|| Name**

`process()` – basic encoding/decoding call

**|| Synopsis**

```
XDAS_Int32 (*process)(IVISION_Handle handle, IVISION_inBufs *inBufs, IVISION_outBufs
*outBufs, IVISION_InArgs *inargs, IVISION_OutArgs *outargs);
```

**|| Arguments**

```
IVISION_Handle handle; /* algorithm instance handle */

IVISION_inBufs *inBufs; /* algorithm input buffer descriptor */

IVISION_outBufs *outBufs; /* algorithm output buffer descriptor */

IVISION_InArgs *inargs /* algorithm runtime input arguments */

IVISION_OutArgs *outargs /* algorithm runtime output arguments */
```

**|| Return Value**

```
IALG_EOK; /* status indicating success */

IALG_EFAIL; /* status indicating failure */
```

**|| Description**

This function does the basic object classification. The first argument to `process()` is a handle to an algorithm instance.

The second and third arguments are pointers to the input and output buffer descriptor data structures respectively (see `IVISION_inBufs, IVISION_outBufs` data structure for details).

The fourth argument is a pointer to the `IVISION_InArgs` data structure that defines the run time input arguments for an algorithm instance object.

The last argument is a pointer to the `IVISION_OutArgs` data structure that defines the run time output arguments for an algorithm instance object.

Note:

If you are using extended data structures, the fourth and fifth arguments must be pointers to the extended `InArgs` and `OutArgs` data structures respectively. Also, ensure that the `size` field is set to the size of the extended data structure. Depending on the value set for the `size` field, the algorithm uses either basic or extended parameters.

## || Preconditions

The following conditions must be true prior to calling this function; otherwise, its operation is undefined.

- `process()` can only be called after a successful return from `algInit()`.
- If algorithm uses DMA resources, `process()` can only be called after a successful return from `DMAN3_init()`.
- `handle` must be a valid handle for the algorithm's instance object.
- Buffer descriptor for input and output buffers must be valid.
- Input buffers must have valid input data.
- `inBufs->numBufs` indicates the total number of input
- Buffers supplied for input frame, and conditionally, the algorithms meta data buffer.
- `inArgs` must not be NULL and must point to a valid `IVISION_InArgs` structure.
- `outArgs` must not be NULL and must point to a valid `IVISION_OutArgs` structure.
- `inBufs` must not be NULL and must point to a valid `IVISION_inBufs` structure.
- `inBufs->bufDesc[0].bufs` must not be NULL, and must point to a valid buffer of data that is at least `inBufs->bufDesc[0].bufSize` bytes in length.
- `outBufs` must not be NULL and must point to a valid `IVISION_outBufs` structure.
- `outBufs->buf[0]` must not be NULL and must point to a valid buffer of data that is at least `outBufs->bufSizes[0]` bytes in length.
- The buffers in `inBuf` and `outBuf` are physically contiguous and owned by the calling application.

## || Postconditions

The following conditions are true immediately after returning from this function.

- If the process operation is successful, the return value from this operation is equal to `IALG_EOK` otherwise it is equal to either `IALG_EFAIL` or an algorithm specific return value.
- The algorithm must not modify the contents of `inArgs`.
- The algorithm must not modify the contents of `inBufs`, with the exception of `inBufs.bufDesc[].accessMask`. That is, the data and buffers pointed to by these parameters must be treated as read-only.

- The algorithm must appropriately set/clear the `bufDesc[].accessMask` field in `inBufs` to indicate the mode in which each of the buffers in `inBufs` were read. For example, if the algorithm only read from `inBufs.bufDesc[0].buf` using the algorithm processor, it could utilize `#SETACCESSMODE_READ` to update the appropriate `accessMask` fields. The application may utilize these returned values to manage cache.
- The buffers in `inBufs` are owned by the calling application.

**|| Example**

See test application file, `object_classification_tb.c` available in the `\test\src` sub-directory.

**|| See Also**

algInit(), algDeactivate(), control()

> Note:
>
> The algorithm cannot be preempted by any other algorithm instance. That is, you cannot perform task switching while filtering of a particular frame is in progress. Pre-emption can happen only at frame boundaries and after `algDeactivate()` is called.

**|| Name**

`algDeactivate()` – save all persistent data to non-scratch memory

**|| Synopsis**

```
void algDeactivate(IALG_Handle handle);
```

**|| Arguments**

```
IALG_Handle handle; /* algorithm instance handle */
```

**|| Return Value**

```
void
```

**|| Description**

`algDeactivate()` saves any persistent information to non-scratch buffers using the persistent memory that is part of the algorithm's instance object.

The first (and only) argument to `algDeactivate()` is an algorithm instance handle. This handle is used by the algorithm to identify various buffers that must be saved prior to next cycle of `algActivate()` and processing.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

**|| See Also**

`algActivate()`

## 5.8 Termination API

Termination API is used to terminate the algorithm instance and free up the memory space that it uses.

**|| Name**

`algFree()` – determine the addresses of all memory buffers used by the algorithm

**‖ Synopsis**

```
XDAS_Int32 algFree(IALG_Handle handle, IALG_MemRec memTab[]);
```

**‖ Arguments**

```
IALG_Handle handle; /* handle to the algorithm instance */

IALG_MemRec memTab[]; /* output array of memory records */
```

**‖ Return Value**

```
XDAS_Int32; /* Number of buffers used by the algorithm */
```

**‖ Description**

`algFree()` determines the addresses of all memory buffers used by the algorithm. The primary aim of doing so is to free up these memory regions after closing an instance of the algorithm.

The first argument to `algFree()` is a handle to the algorithm instance.

The second argument is a table of memory records that describe the base address, size, alignment, type, and memory space of all buffers previously allocated for the algorithm instance.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

**‖ See Also**

`algAlloc()`

# 6 Frequently Asked Questions

This chapter provides answers to few frequently asked questions related to using this algorithm.

## *6.1 Code Build and Execution*

| **Question** | **Answer** |
|---|---|

### 6.1.1 Algorithm Related

| **Question** | **Answer** |
|---|---|