# IPSDK 1.7- Main image processing algorithms

| Arithmetic image operations | Modules containing arithmetic operations on images, pixel by pixel | version |
|---|---|---|
| Addition | Addition of 2 images (or image and scalar) | 0-1-0-1 |
| Abs | Computation of the absolute value of an image, pixel by pixel algorithm | 0-1-0-1 |
| Blending | Blending of 2 images | 0-1-0-1 |
| Bounding | Algorithm allowing to bound image values to a given range algorithm | 0-1-0-1 |
| Cartesian to polar | cartesian to polar coordinates transformation | 1-5-0-0 |
| Divide | Division of 2 images | 0-1-0-1 |
| Formula | Generation of an image using a formula string | 1-5-0-0 |
| L1Norm | L1 norm of two or three images | 0-1-0-1 |
| L2Norm | L2 (euclidian) norm of two or three images | 0-1-0-1 |
| LinearCombination | Linear combination of 2 images | 0-1-0-4 |
| MaxAbs | Maximum of the absolute values of 2 images, pixel by pixel | 0-1-0-1 |
| Maximum | Maximum of 2 images, pixel by pixel algorithm | 0-1-0-1 |
| Minimum | Minimum of 2 images, pixel by pixel algorithm | 0-1-0-1 |
| Multiplication | Multiplication of 2 images (or image and scalar) | 0-1-0-1 |
| MultiplyAddScalar | Process an operation of type AX+B with X an input image | 1-0-0-0 |
| Polar to Cartesian | polar to cartesian coordinates transformation | 1-5-0-0 |
| Rounding | Round values of a floating point image algorithm | 0-1-0-1 |
| Square root | Computation of the square root of an image | 0-1-0-1 |
| Square | Computation of the square of an image | 0-1-0-1 |
| Subtraction | Subtraction of 2 images (or image and scalar) | 0-1-0-1 |

| Logical Image operations | Modules containing bitwise operations on images, pixel by pixel | |
|---|---|---|
| Bitwise and | Bitwise and operation on 2 input images | 0-1-0-1 |
| Bitwise nand | Bitwise nand operation on 2 input images | 0-1-0-1 |
| Bitwise nor | Bitwise nand operation on 2 input images | 0-1-0-1 |
| Bitwise not | Bitwise not operation on one input image | 0-1-0-1 |
| Bitwise nxor | Bitwise nxor operation on 2 input images | 0-1-0-1 |
| Bitwise or | Bitwise or operation on 2 input images | 0-1-0-1 |
| Bitwise exclusive or | Bitwise exclusive or operation on 2 input images | 0-1-0-1 |
| Logical not | Logical not on binary images | 0-1-0-5 |
| Mask filter (one input image) | Mask filter, computing an output image for which each pixel equals to either corresponding pixel in input image or 0, depending on whether corresponding input mask image pixel equals 1 or 0 algorithm | 0-1-0-1 |
| Mask filter (two input images) | Mask filter, computing an output image for which each pixel equals to corresponding pixel in either first or second input image, depending on whether corresponding input mask image pixel equals 1 or 0 algorithm | 0-1-0-1 |

| Utility image processing algorithms | Modules containing binarization operations on images | |
|---|---|---|
| Image comparison | Algorithm allowing to compare two images | 0-1-0-1 |
| Image conversion | Algorithm allowing to convert an image to a given type | 0-1-0-1 |
| Image copy | Algorithm allowing to copy an image | 0-1-0-1 |
| Image erasing | Algorithm allowing to erase values of an image | 0-1-0-1 |
| Image uniform random initialization | Algorithm filling an image with uniform random sampled values | 0-1-0-1 |
| Image normal random initialization | Algorithm filling an image with normal random sampled values | 1-0-0-0 |
| Image sequences append | Algorithm concatenating two images sequences | 1-3-0-0 |
| ROI insertion | Algorithm inserting a given ROI into an image | 1-3-0-0 |
| ROI extraction | Algorithm extracting a given ROI from an image | 1-3-0-0 |
| Extract image values | Extraction of values at specific coordinates into image | 1-4-0-0 |

| Color image operations | Utility image processing algorithm modules | |
|---|---|---|
| lightness | Lightness computation for an input RGB color image | 0-1-0-1 |
| RGB to YUV | Convert a RGB color image to a YUV color image algorithm | 0-1-0-1 |
| YUV to RGB | Convert a YUV color image to a RGB color image algorithm | 0-1-0-1 |

| Binarization algorithms | Image binarizarization algorithm modules | |
|---|---|---|
| Simple Threshold | Algorithm allowing to convert an image to a binary image using a range of greylevel | 0-1-0-1 |
| TopHat | TopHat binary threshold | 0-1-0-3 |
| Adaptative Threshold 2d | Binarize an input image according an adaptative threshold based on the pixel's neighbourhood | 1-1-0-0 |
| Kapur Threshold | Kapur binary threshold on one image | 1-1-0-0 |
| Kittler Threshold | Kittler binary threshold on one image | 1-1-0-0 |
| IsoDataThreshold | Isodata binary threshold on one image | 1-6-0-0 |
| Hysteresis Threshold | Hysteresis threshold on one image | 1-6-0-0 |
| Adaptative Threshold 3d | Binarize an input 3d image according an adaptative threshold based on the voxel's neighbourhood | 1-6-0-0 |
| Otsu Threshold | Algorithm allowing to convert an image to a binary image using a range automaticaly computed by the otsu method | 0-1-0-1 |

| Greyscale transform algorithms | Image greyscale transform algorithm modules | |
|---|---|---|
| Histogram equalization | Computes an output image associated to histogram equalization of an input image | 0-1-0-1 |
| Equalization LUT computation | Computes look up table used to equalize an histogram | 0-1-0-1 |
| LUT Transformation | Application of a look-up table on an input image algorithm | 0-1-0-1 |
| Normalization | Normalizes the intensity of an image from an optional given input range to a given output range | 0-1-0-1 |
| Smart paraboloid shading correction | Corrects an input image for shading, and normalize output image so that it fits an expected dynamic range | 1-4-0-0 |
| Smart Shading correction | Corrects an input image for shading, and normalize output image so that it fits an expected dynamic range | 0-1-0-2 |
| MatchHistogram | Adjust an image histogram using a reference histogram (or image) | 1-0-0-0 |
| MatchStats | Adjust image statistics using reference statistics (or image) | 1-0-0-0 |
| InvertImg | Algorithm allowing to invert 2d or 3d image intensity | 1-2-0-0 |
| Paraboloid shading correction | Computes a shading-corrected image, taking a paraboloid as the white image | 1-4-0-0 |
| Shading correction | Computes a shading-corrected image | 0-1-0-2 |
| Forward Discrete Fourier Transform | forward Discrete Fourier Transform for an input image | 1-5-0-0 |
| Backward Discrete Fourier Transform | backward Discrete Fourier Transform for an input image | 1-5-0-0 |
| Color mapping | Generates an output color image by applying a color map on a grey level input image | 1-6-0-0 |
| Index Compacting | Re-indexes the labels (or class indices) in order to use a minimum range of values | **1-7-0-0** |
| Image standardization | Standardizes an image | 1-5-0-0 |

| Morphological algorithms | | |
|---|---|---|
| Erosion | Generic algorithm for image erosion | 0-1-0-3 |
| Boundary | Algorithm allowing to extract boundary of a binary image | 0-1-0-1 |
| RemoveBorder | Removal of connected components in contact with image borders in binary images | 1-1-0-0 |
| FillHole | hole filling algorithm for binary images | 1-1-0-0 |
| Closing | Algorithm for image closing | 0-1-0-3 |
| Opening | Algorithm for image opening | 0-1-0-3 |
| Morphological Gradient | Gradient computation on an image using morphological operations | 0-1-0-3 |
| Dilatation | Generic algorithm for image dilatation | 0-1-0-3 |
| Distance map | Exact distance map transform of binary image | 0-1-0-4 |
| ConnectedComponent | Connected component image labeling algorithm | 0-1-0-5 |
| BinaryReconstruction | Binary reconstruction of an input image with a marker image | 0-1-0-5 |
| GreyReconstruction | Grey reconstruction of an input image with a marker image | 1-2-0-0 |

| Generic Seeded Distance Map | generic version of seeded distance map algorithm | 1-1-0-0 |
|---|---|---|
| Seeded Distance Map | automatic version of seeded distance map algorithm | 1-1-0-0 |
| LocalExtrema | extraction of local extrema from an image | 1-2-0-0 |
| DilateLocalExtrema | extraction of dilated local extrema from an image | 1-2-0-0 |
| RemoveSmallShape | removal of small connected component in binary or label 2d/3d image | 1-1-0-0 |
| KeepBigShape | keep only the big connected components in binary or label 2d image | 1-6-0-0 |
| SeededWatershed | seeded watershed algorithm | 1-2-0-0 |
| WatersheBinarySeparation | Binary separation algorithm based on watershed transformation | 1-2-0-0 |
| WatersheGreySeparation | Greyscale separation algorithm based on watershed transformation | 1-2-0-0 |
| MaxPropagation | Propagation of maxima | 0-1-0-5 |
| MinPropagation | Propagation of minima | 0-1-0-5 |

| Filtering algorithms | | |
|---|---|---|
| high-pass filter | high-pass filter algorithm | 0-1-0-4 |
| mean filter | Smooth an input image computing local mean of pixels | 0-1-0-1 |
| gaussian filter | Smooth an input image convolving it with a Gaussian kernel | 0-1-0-1 |
| gaussian gradient | Compute gradients of an input image convolving it with Gaussian kernels | 0-1-0-1 |
| convolution | Compute convolution of an input image with a kernel | 0-1-0-1 |
| anisotropic Diffusion | Anisotropic diffusion smoothing filter algorithm for 2d/3d images | 1-3-0-0 |
| median | Median filter algorithm | 0-1-0-4 |
| unsharp mask | Unsharp mask image filter algorithm | 0-1-0-4 |
| Bilateral smoothing | Bilateral filter algorithm | 0-1-0-4 |
| Separated Bilateral smoothing | Fast approximated version of bilateral filter algorithm | 1-0-0-0 |
| LaplacianDog | Laplacian difference of gaussian approximation | 0-1-0-4 |
| Laplacian DoG deblur | 2d image deblur algorithm using Laplacian kernels based on a difference of Gaussian approximation | 1-0-0-0 |
| Patch-based bilateral smoothing | Denoises image using patch-based bilateral filter algorithm | 1-4-0-0 |
| Pearson colocalization mapping | builds the Pearson's colocalization map computing the Pearson correlation coefficient on each pixel | 1-6-0-0 |
| Richardson-Lucy deblur | 2d image deblur algorithm using Laplacian kernels based on the Richardson-Lucy algorithm | 1-0-0-0 |
| Normalized Cross-Correlation | Computes the Normalized Cross Correlation between an image and a kernel | 1-0-0-0 |
| Despeckle Filtering | Smoothes the input image replacing aberrant values by the neighbourhood's mean intensity | 1-5-0-0 |
| Band-pass frequency filtering | Filters an image in Fourier domain by selecting a frequency range | 1-6-0-0 |
| Multiscale vessel enhancement | Multiscale vessel enhancement using Frangi's approach | **1-7-0-0** |
| Sobel gradient | Compute gradients of an input image using a Sobel kernel | 1-4-0-0 |

| Statistic algorithms | | |
|---|---|---|
| kurtosis | Local image kurtosis computation | 0-1-0-3 |
| skewness | Local image skewness computation | 0-1-0-3 |
| variance | Local image variance computation | 0-1-0-3 |
| local entropy | local entropy | 0-1-0-4 |
| local energy | local energy | 1-5-0-0 |
| local histogram module | local histogram module | 1-5-0-0 |
| Law's texture energy measures | Law's texture energy measures | 1-5-0-0 |

| Global measures | | |
|---|---|---|
| histogram | Computes the histogram of an image | 0-1-0-1 |
| Masked histogram | Computes the histogram of the portion of an image (portion is defined by a mask image) | 1-5-0-0 |
| XProjection | Statistical information on x image data projection | 1-0-0-0 |
| YProjection | Statistical information on x image data projection | 1-0-0-0 |
| Seq Projection | measure of common statistics indicators in the image sequence | 1-0-0-0 |
| Similarity Measurement | Similarity measurement on a image (PSNR, SSD) | 1-0-0-0 |
| Gaussian Noise Measurement | Gaussian noise measurement on an image | 1-0-0-0 |
| ParaboloidImgFit2d | Fitting of a paraboloid with a 2d image seen as a 3d surface (with the pixel intensities as the heights) | 1-4-0-0 |
| Pearson Correlation Coefficient | computes the Pearson correlation coefficient in the image | 1-6-0-0 |
| Statistics (Min, max, mean stddev) | Measure of common statistics indicators in the image (mean, max, etc.) algorithm | 0-1-0-1 |
| Masked statistics (Min, max, mean stddev) | Masked version of measure of common statistics indicators in the image (mean, max, etc.) algorithm | 1-0-0-0 |
| Kernel density estimation | algorithm allowing to estimate probability density function of an image | 1-5-0-0 |

| Feature detection | | |
|---|---|---|
| Canny edges 2D detector | Extracts edges in a 2D image | 1-4-0-0 |
| Canny surfaces 3D detector | Extracts surfaces in a 3D image | 1-4-0-0 |
| Local Extrema Extraction | Finds the local extrema in an image | 1-0-0-0 |
| Harris Corners | Extracts the corners in an image | 1-4-0-0 |
| Hough Lines | Detects lines in image using Hough algorithm | **1-7-0-0** |
| Hough Circles | Detects circles in image using Hough algorithm | 1-0-0-0 |

| Shape Analysis | | |
|---|---|---|
| Shape Analysis 2d | Shape 2d analysis and measurement algorithm | 1-0-0-0 |
| Shape Analysis 3d | Shape 3d analysis and measurement algorithm | 1-2-0-0 |
| Label Analysis 2d | Connected component 2d analysis and measurement algorithm | **1-7-0-0** |
| Label Analysis 3d | Connected component 3d analysis and measurement algorithm | **1-7-0-0** |
| Shape Filtering 2d | Shape 2d filtering algorithm | 1-0-0-0 |
| Shape Filtering 3d | Shape 3d filtering algorithm | 1-2-0-0 |

| Shape Segmentation | | |
|---|---|---|
| Label Shape Extraction 2d | Shape extraction from label 2d image | 1-0-0-0 |
| Label Shape Extraction 3d | Shape extraction from label 3d image | 1-2-0-0 |
| Shape to Label image 2d | Creation of a label 2d image from a collection of shape | 1-4-0-0 |
| Shape to Label image 3d | Creation of a label3d image from a collection of shape | 1-4-0-0 |

| Registration | | |
|---|---|---|
| Extract grey signed features | Extraction of grey signed features from image | 1-4-0-0 |
| Registration from grey signed features | Compute motion transform linking two sets of grey signed features | 1-4-0-0 |
| Image grey signed features registration | Computation of motion transform linking two images based on a grey signed features algorithm | 1-4-0-0 |
| Tracking step | Tracking stage for intensity based registration 2d algorithm | 1-5-0-0 |
| Training step | Training stage for intensity based registration 2d algorithm | 1-5-0-0 |
| Registration tracker | Intensity based 2d registration tracker | 1-5-0-0 |

| Classification | | |
|---|---|---|
| PCA image reduction | reduces temporal dimensionality of an image using PCA | 1-6-0-0 |
| K-Means | classifies an image using k-means algorithm | 1-5-0-0 |

| Geometric transformation | | |
|---|---|---|
| Image zoom | Algorithm resizing an image using a given interpolation method | 1-3-0-0 |
| Image regular resampling along z-axis | Algorithm resampling along z-axis a 3d image with regularly spaced z-plans | 1-5-0-0 |
| Image custom resampling along z-axis | Algorithm resampling along z-axis a 3d image with unregularly spaced z-plans | 1-5-0-0 |
| Image flipping | Algorithm flipping input image along one of its axis | 1-5-0-0 |
| Image cylinder unrolling | Algorithm unfolding a cylinder contained in a 3D input image into a 2D output image | 1-5-0-0 |
| Image ring unrolling | Algorithm allowing ring surface unrolling | 1-6-0-0 |
| Image warping | Algorithm allowing to apply a motion transformation warping operation on an image | 1-6-0-0 |