

ACQUISITION FEATURES	ImageWarp	ImageWarp LE
> Capture Devices:		
<i>TWAIN</i>	✓	✓
<i>VFW, WDM/Direct Show</i>	✓	✓
<i>GigE Vision</i>	✓	✓
<i>BitFlow Frame Grabbers</i>	✓	✓
<i>IEEE-1394(DCAM 1.31-compliant)</i>	✓	✓
> Perform frame averaging and integration while capturing	✓	✓
> Acquire, create, and playback image sequences with user-specified time lapse	✓	✓
> Capture video into AVI files with adjustable compression	✓	✓
> Support for 10-16 bit input devices	✓	✓
> Video format, frame rate and size selection	✓	✓
> Hardware-controlled exposure, gain, brightness, contrast, gamma, saturation, hue, white balance	✓	✓
> Real-time Bayer demosaicing for raw color devices	✓	✓
> Mapping of image memory to DMA buffer for performance boost	✓	
> Acquire images from multiple cameras and boards	✓	
> Trigger and encoder synchronization, exposure, clock and line rate adjustment for digital line scan cameras	✓	✓
> Simulation video-driver for prototyping real-time algorithms prior to buying hardware	✓	✓
> Simulate video input from AVI and TIFF sequences, generate standard patterns, apply several types of noise to a static image, add non-uniform background	✓	✓
> Read and store:		
BMP, GIF, TIFF, JPEG	✓	✓
<i>PCX, TGA, FITS, STK, User-Defined</i>	✓	
> ImageTypes:		
<i>1-bit binary, 8-bit gray, 16-bit gray</i>	✓	✓
<i>32-bit gray, 32-bit floating point, 64-bit complex</i>	✓	
<i>4 and 8-bit palletized</i>	✓	✓
<i>8-bit multiphase</i>	✓	✓
<i>24 and 48-bit color</i>	✓	✓
> Save sequences and animations in GIF, TIFF, AVI and IWD files	✓	✓
> Extended TIFF format for storing high depth images, look-up tables and sequences	✓	✓
> NASA-endorsed FITS format for astronomical and thermal imaging	✓	
> Metamorph STK format for 3D encoding with time and Z-position stamps	✓	
> Proprietary universal IWD format with lossless compression	✓	✓
> Preservation of geometrical and optical scales for:		
<i>IWD</i>	✓	✓
<i>JPEG and TIFF</i>	✓	
> Adjustable compression settings for:		
<i>AVI, JPEG and TIFF</i>	✓	✓

USER INTERFACE FEATURES	ImageWarp	ImageWarp LE
> Multiple document environment for viewing and manipulating images, data table and charts	✓	✓
> Open Image dialog with thumbnail preview and multiple image selections	✓	✓
> Real-time video window for live acquisition display		
> Up to 100 image frames with superimposed self-adjustable rulers	✓	✓
> Display-range selectors for high-depth images, sequences and live video	✓	✓
> Rendering of a high-depth luminance scale (1024 levels) using proprietary technique	✓	✓
> Correct rendering of images in 256-color display mode	✓	✓
> Built-in set of popular palettes for displaying monochrome images and video in pseudo-color	✓	✓
> Best-fit option to maximize image contrast without modifying pixel values	✓	✓
> Play/stop controls and frame counter for image sequences	✓	✓
> Intermittent and numerical zoom controls	✓	✓
> Context zoom that magnifies the area of interest pointed by the cursor	✓	✓
> Comprehensive functional dialogs with sliding previews	✓	✓
> Palette bar with foreground and background color selection	✓	✓
> Undo/redo stack of user-selected size	✓	✓
> Interactive multi-channel histogram associated with an active image	✓	✓
> Undo/redo stack of user-selected size	✓	✓
> Interactive multi-channel line profile with an extensive selection of shapes (vertical, horizontal, line, rectangle, ellipse, freehand)	✓	✓
> Digital Editor for viewing and editing the numeric content of an active image	✓	✓
> Script Editor for automatic and manual scripting, debugging, storing, and executing imaging algorithms	✓	✓
> Live update of interface elements (images, tables, charts and previews) while running real-time scripts	✓	✓
> Information box for viewing and changing general image parameters	✓	✓
> Print dialog with image position and size adjustment and integrated preview	✓	✓
> Context-sensitive help: position the cursor over any interface element and press F1	✓	✓

GRAPHICAL EDITING FEATURES	ImageWarp	ImageWarp LE
> Rectangular, elliptical and freehand selections (ROI)	✓	✓
> Running marquee for outlining current selection	✓	✓
> Multiple selections automatically combined into one irregular ROI	✓	
> Add negative selections to set up an ROI with holes	✓	
> Use Magic Wand to select a connected area of similar pixels	✓	✓
> Create and manipulate animated selections on animated images	✓	✓
> Copy image or selection into Windows clipboard	✓	✓
> Paste image from clipboard as a new image or as a selection into an existing image (supports all image formats including the high-depth ones)	✓	✓
> Move selection over a current image or from one image onto another	✓	✓
> Move images from or into another program by using a drag-and-drop operation	✓	✓
> Extensive set of drawing tools for direct application to all* supported types of images: <i>Color picker, Pencil, Brush, Flood, Clone, Eraser, Stamp, Line, Rectangle, Ellipse, Text and Warp</i>	✓	✓
> Adjustable pen width	✓	✓
> Adjustable size, transparency, hardness, and spacing for brush family tools	✓	✓
> Constrain and straight line options for drawing tools	✓	✓
> Automatic image scrolling when a drawing tool touches the edge of the frame	✓	✓
> RGB/HLS interactive color editor for foreground and background color selection	✓	✓
> Comprehensive palette editor that allows the modification of indexed color palettes and changes to the appearance of 8-bit and 16-bit monochrome images by assigning colors to luminance values	✓	
> Automatic and interactive palette rotation	✓	
> Gray scale maps (look-up tables) for 8-bit and 16-bit monochrome images	✓	✓
> Edit image sequences by cutting off or inserting series of frames	✓	✓

PROCESSING FEATURES	ImageWarp	ImageWarp LE
> Intel SSE2/SIMD technology utilized for performance boost	✓	✓
> Multithreading engine allows for performing up to 16 parallel operations simultaneously	✓	✓
> Automatic parallelization distributes imaging functions among several CPUs on multiprocessor and multicore systems	✓	✓
> Distributed processing on several computers through Gigabit Ethernet	✓	✓
> Progress meters on the status bar (up to four in multiprocessing mode*) for following the execution progress of each function, execution time of the last called function displayed for benchmarking and prototyping purposes	✓	✓
> Hidden images for buffering intermediate results in scripts	✓	✓
> All operations performed on the current image selection	✓	✓
> Selectable coordinate system for processing color images (RGB, HLS, HSV, L-vector)	✓	✓
> Selectable overscan (invisible borders around the images) for speed-boost	✓	✓
> High-depth image support in all processing functions	✓	✓
> Processing applied to an entire sequence or current frame only	✓	✓
CONVERSION FEATURES	ImageWarp	ImageWarp LE
> Conversions between all types of supported image formats	✓	✓
> Select the output luminance range when converting into high-depth types	✓	✓
> Three modes of color reduction when converting into palletized types	✓	✓
> Extract or merge color channels:		
<i>RGB and HLS</i>	✓	✓
<i>HIS, RCH, YIQ and Lab</i>	✓	
> Convert a color filter array image into an RGB image (Bayer)	✓	
> Extract or merge component images from or to a complex image (Re, Im, Amp, Phase)	✓	
GEOMETRIC, ARITHMETIC AND LOGIC FEATURES	ImageWarp	ImageWarp LE
> Interactive or automatic resizing with selectable bilinear smoothing	✓	✓
> Translate, Rotate, Flip, Reflect and Warp spatial operations	✓	✓
> Affine and projective image transformation	✓	
> Conversion between Cartesian and Polar coordinate planes	✓	
> Arithmetic operations: Invert, Offset, Factor, Average, Add, Subtract, Multiply, Divide	✓	✓
> Automatic application of component operations to complex images	✓	
> Logical operations:		
<i>Not, And, Or, Xor and Mask</i>	✓	✓
<i>Nor, Nand, Xnor, Swap, L-Shift and R-Shift</i>	✓	
> And function that identifies overlapping features on two images	✓	
> Image Stitching	✓	
INTERACTIVE ADJUSTMENT AND SEGMENTATION FEATURES	ImageWarp	ImageWarp LE
> Real-time full screen preview during the adjustments	✓	✓
> Brightness/Contrast/Gamma adjustment in RGB and HLS space	✓	✓
> Hue/Saturation, Levels, Color balance correction	✓	✓
> Interactive binary and multiphase thresholding with sampling feature	✓	✓
> Color multiphase thresholding in RGB and HLS space	✓	✓
> Several methods of automatic thresholding based on histogram analysis	✓	
> Adaptive segmentation based on local distribution analysis	✓	

FILTER FEATURES	ImageWarp	ImageWarp LE
> Emphasize contours with adjustable boost	✓	✓
> Sharpen and unsharpen masks	✓	✓
> Uniform, logarithmic, exponent, and bell equalization	✓	✓
> Brightness normalization with selectable strength	✓	✓
> Dark and white field background correction	✓	✓
> Several methods of background elimination	✓	
> Noise Suppression operators with adjustable window and strength: <i>Lowpass, Median, Gauss and Sigma</i>	✓	✓
<i>Salt & Pepper</i>	✓	
> Remove motion artifacts with Deinterlace function	✓	
> Edge detection operators: <i>Sobel, Prewitt and Laplace</i>	✓	✓
<i>Roberts, Range and Variance</i>	✓	
<i>HighPass</i>	✓	✓
<i>Gradient</i>	✓	
> Find direction of edges using the Phase mode	✓	✓
> Create graphic effects using Emboss, Pixelate, Floyd, and other miscellaneous filters	✓	✓
> Customized convolution with user-defined kernel images	✓	
FOURIER TRANSFORM FEATURES	ImageWarp	ImageWarp LE
> Perform discrete and fast transform in both directions	✓	
> Create a complex image as a spectral result of direct transform	✓	
> Switch between real, imaginary, amplitude and phase components of the spectrum	✓	
> Use graphical editing to modify the spectrum in a complex image	✓	
> Perform Fourier-based convolution and de-convolution with a user-defined kernel image	✓	
MORPHOLOGY FEATURES	ImageWarp	ImageWarp LE
> Basic set operators: <i>Erosion, Dilatation, Opening, Closing</i>	✓	✓
<i>Tophat and Contours</i>	✓	
> Iteration-independent high-speed algorithms for binary morphology	✓	✓
> Multiphase-aware algorithms keep objects of different class from merging	✓	✓
> Proprietary high-speed thinning, thickening and pruning	✓	
> Fast convex hull in the multiphase space	✓	
> Grayscale morphology with full support of 16-bit, 32-bit and floating point images	✓	✓
> Proprietary color morphology	✓	✓
> Proprietary color morphology with selectable color space	✓	
> Binary, gray and color operations with user-defined kernels	✓	
> Extensive set of geodesy functions: <i>Distance map, Direction Map, Local Min and Local Max</i>	✓	✓
<i>Ultimate erosion</i>	✓	
<i>Medial axis transform</i>	✓	
<i>End, Node and Saddle points</i>	✓	
> Several metrics for distance transform including Euclidian	✓	✓
> Accurate separation of touching convex objects	✓	
> Multiphase connectivity algorithms: <i>Labeling, Filling holes, Border kill and Scrap cleaning</i>	✓	✓
> Watershed operator extracts ridges and basins in the intensity relief	✓	
> Link operator for connecting broken lines	✓	
> Hit and miss transform for binary template search	✓	

SIGNAL/PATTERN GENERATION FEATURES	ImageWarp	ImageWarp LE
> Built-in set of standard signal and pattern generators for prototyping and testing:		
<i>Random noise with user-defined amplitude</i>	✓	
<i>Non-uniform light from point and line sources</i>	✓	
<i>Gray and color wedges</i>	✓	
<i>Gray and color grids</i>	✓	
<i>Sine wave of arbitrary amplitude, frequency, phase and orientation</i>	✓	
CALIBRATION FEATURES	ImageWarp	ImageWarp LE
> Spatial calibration:		
<i>Interactive</i>	✓	✓
<i>Automatic</i>	✓	
> Interactive choice of the coordinate system origin and Y-axis direction	✓	✓
> View image dimensions in calibrated units on superimposed rulers	✓	✓
> Set up default spatial scale for video capture device	✓	✓
> Optical calibration with Lagrange and polynomial approximation	✓	
> Name, store and load calibration scales	✓	✓
> Store calibration data along with images:		
<i>IWD</i>	✓	✓
<i>JPEG and TIFF</i>	✓	

MEASUREMENT FEATURES	ImageWarp	ImageWarp LE
> Select from numerous parameters using comprehensible graphic representation:		
Object count, class, pixel count, equivalent diameter	✓	✓
Area, outline area, reference area	✓	✓
Phase area, box area, convex area	✓	
Perimeter, circular perimeter, elliptical perimeter	✓	✓
Convex perimeter	✓	
Best-fit radius	✓	
Circularity, ellipticity, rectangularity, convexity, roughness, aspect ratio	✓	✓
Starting and ending position, bounding box, box ratio, angle	✓	✓
Feret diameters (maximum, minimum, average), Feret angles, Feret ratio	✓	✓
Radii (maximum, minimum, average), radial angles, radial ratio	✓	
Diameters (maximum, minimum, average), diametric angles, elongation	✓	
Centroid, major and minor axes and angles	✓	✓
Center of gray	✓	
Raw and normalized binary moments, skewness and asymmetry	✓	
Chord length, vertical and horizontal intercept, anisotropy	✓	
Gray level, standard deviation	✓	✓
Transmission, optical density, roughness	✓	
Red, green and blue average levels and standard deviations	✓	
Number of holes, area of holes, perforation	✓	
> Parameter arrays of variable size:		
Histogram	✓	
Contour	✓	
Convex hull	✓	
Curvature	✓	
Radii	✓	
Diameters (maximum, minimum, average), diametric angles, elongation	✓	
> User-defined parameters programmed into scripting language syntax	✓	
> Manual count and classification	✓	✓
> Point, line, angle and area morphometry	✓	✓
> Multiphase field stereology	✓	
> Densitometry and position analysis	✓	
> Interactive object tracking by mouse or digitizer	✓	✓
> Automatic and interactive blob measurements	✓	✓
> Adjustable measurement settings: border processing, scanning precision, pixel connectivity	✓	✓
> Accumulation of results in interactive grids; clicking a line causes a correspondent in the image to blink	✓	✓
> Selection or removal of objects by using specified parameter limits	✓	
> Classification of objects by a specified parameter	✓	
> Interactive line profile	✓	✓



ANALYSIS FEATURES	ImageWarp	ImageWarp LE
> Load, view and edit measurement data in multilevel tables and spreadsheets:		
Select from three data formats: fixed, scientific and general	✓	✓
Choose between full list and selected class of objects	✓	✓
Calculate additional parameters using the built-in set of more than 200 spreadsheet functions including: Mathematical, Statistical, String, Logic, Date and Time and Miscellaneous	✓	
Switch to Statistics mode to view full statistic report for each parameter	✓	
Export data into text, HTML, dBase and MS Access format	✓	
Run-time DDE export to MS Excel	✓	✓
Switch to Graph mode to visualize the data in a form of multi-channel histogram, scattergram, line profile, pie and 3D plot	✓	
> High-performance global data grids:		
Display instantaneous measurement results in real time	✓	✓
Double-click a cell with a parameter array and it's elements are reported in a pop-up grid	✓	
Interactively connect grid cells to script variable	✓	
Open data charts linked to desired measurement parameters	✓	
> Analyze and edit the pixel values of an active in the interactive Digital Editor:		
Observe and edit pixel values separated into channels and formatted with regard to the type of an active image	✓	✓
Select between calibrated and raw pixel values	✓	
Scroll the pixel table to a new location and watch the marker on the image move accordingly	✓	✓
Drag the marker on the image to a new location and watch the table scroll accordingly (in development)	✓	✓
Change the active image selection using the Selection Tool and watch an instant change of values in the Digital	✓	✓
Apply any image processing function and watch an instant digital result	✓	✓
Click a table cell and use an emerged spin control to gradually change pixel values	✓	✓
Select a group of pixels on a table and fill it with a background color	✓	✓
Observe pixel values changing in real-time for live images and sequences	✓	✓
> Plot an intensity profile with the Line Profile tool:		
Choose among several profile shapes: vertical, horizontal, line, rectangle, ellipse, freehand	✓	✓
Switch between different channels of color images (R, G, B, H, L, S, Y, I, Q)	✓	✓
Select a desired intensity range for profile analysis	✓	✓
Switch between Table and Graph modes	✓	✓
View statistics collected along the profile line	✓	✓
Drag a profile line over the image and watch a synchronous update of the graph	✓	✓
Profile animation for live images and sequences	✓	✓
> Display comprehensive Excel-style data charts:		
Link a chart to a desired data table or global grid	✓	
Choose measurement parameters and channels for data series	✓	
Display the distribution of an object's population in the form of bar or line histograms	✓	
Select between regular, cummulative and weighed histogram with Gaussian curve overlay	✓	
Display the distribution of a parameter on a pie diagram	✓	
Analyze the correlation between two measurements using a scattergram with a polynomial fit	✓	
Plot several measurements against each other on a 3D multi-histogram	✓	
Adjust the appearance of titles, axes, tick marks and background	✓	
Live chart updates linked to real-time data	✓	

PROGRAMMING FEATURES	ImageWarp	ImageWarp LE
> Built-in high-level scripting language with parallel processing engine:		
<i>Popular Visual Basic syntax</i>	✓	✓
<i>Automatic compilation for higher performance</i>	✓	✓
<i>Integer, floating point and string variables</i>	✓	✓
<i>Support of objects with dynamic memory allocation</i>	✓	✓
<i>Predefined frequently used constants</i>	✓	✓
<i>Nested arithmetic and logical expressions</i>	✓	✓
<i>IF/THEN/ELSE/END IF and GOTO branch operators</i>	✓	✓
<i>Cycle operators (FOR/TO/STEP/NEXT, WHILE/WEND, DO/LOOP)</i>	✓	✓
<i>Nested subroutines and functions (SUB/END SUB, FUNCTION/END FUNCTION)</i>	✓	✓
<i>THREAD operator for parallel processing</i>	✓	
<i>Terminal window for rapid data input/output (INPUT, PRINT)</i>	✓	✓
<i>Dialog window for interactive input/output (DIALOG)</i>	✓	✓
<i>Direct access to ImageWarp's global data tables for real-time data management</i>	✓	✓
<i>Set of serial communication commands (COM and Camera Link ports)</i>	✓	✓
> Comprehensive Script Editor with command line support:		
<i>Use Record button to log all the interface commands into the script</i>	✓	✓
<i>Use Play button to playback the recorded session</i>	✓	✓
<i>Use Step, Step Into and Step Over buttons to perform step-by-step execution</i>	✓	✓
<i>Insert breakpoints for halting the execution of the script at desired lines</i>	✓	✓
<i>Debug your script using variable watch and error window</i>	✓	✓
<i>Change the execution point by double-clicking on the desired line</i>	✓	✓
<i>Insert new operators and functions into the script by manual editing</i>	✓	✓
<i>Use keyword highlighting and popup tips for help on syntax</i>	✓	✓
<i>Enter a single command in the command line box and execute it outside the script</i>	✓	✓
<i>Save the current script and reload it later</i>	✓	✓
> Dynamic Data Exchange (DDE)		
<i>Take advantage of ImageWarp's functionality inside your own application</i>	✓	✓
<i>Have full control of ImageWarp by executing prerecorded scripts or issuing run-time image processing</i>	✓	✓
<i>Exchange images between your application and ImageWarp via Clipboard</i>	✓	✓
<i>Establish a hot link with ImageWarp and have it notify your application when an important event occurs</i>	✓	✓
<i>Retrieve the results of image analysis and process them further with your own algorithms</i>	✓	✓
<i>Run ImageWarp in an invisible mode providing a user interface through your application</i>	✓	✓
<i>REMOVE THIS LINE</i>		
> Automation (COM)		
<i>Integrate ImageWarp into your application by using it as a COM-server</i>	✓	
<i>Access hundreds of ImageWarp functions through the set of COM-methods and properties</i>	✓	
<i>Exchange data and images between ImageWarp and your application in real time</i>	✓	
<i>Synchronize your application and ImageWarp with a set of COM-events</i>	✓	
<i>Run ImageWarp in an invisible mode and provide a user with your own GUI</i>	✓	
> Send us your sample images and application requirements and we will create a demonstration script	✓	✓
> Customization services and interfacing to video devices available upon request	✓	✓