



Improve Your Image with Autodesk Raster Design

Introduction

With every new project, mechanical engineers, cartographers, architects, and environmental specialists face new challenges and opportunities to incorporate raster data in their work. Many designs and maps are available only on paper, linen, Mylar, or microfilm. In addition, new sources for aerial photography and commercially available satellite imagery provide access to current conditions across the globe. Integrating these different data types with design, mapping, and infrastructure projects is no longer a novelty—it is a standard practice and a project requirement.

When design, mapping, and infrastructure professionals choose AutoCAD® software and AutoCAD-based products, they expect precision tools, improved productivity, and a complete set of features to accomplish their work. When incorporating raster images, they need specialized tools that are seamlessly integrated and intuitive so they can be productive without major retraining.

Virtually all organizations, large and small, working on design, mapping, and infrastructure projects need to use data from existing paper drawings, maps, or photographs. Although AutoCAD-based products support basic raster functionality, advanced users require specialized software. Autodesk® Raster Design offers a complete set of tools for working with raster images to get the most value from these crucial data sources.

This paper reviews the benefits of working with raster images for design, mapping, and infrastructure projects, provides an overview of raster data, dispels common myths about working with raster images, and discusses the functionality required to work on the most demanding projects.

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Benefits of Working with Raster Images

The benefits of working with raster images in design, mapping, and infrastructure projects fall into the following categories.

Presentation and Analysis

Incorporating scanned drawings, scanned maps, digital photos, and satellite imagery improves the appearance of design, mapping, and infrastructure presentations. The result is better communication of projects status and better decisions. In addition, incorporating such data helps provide a better understanding of project parameters, such as land use and topography, and can be integrated with other crucial project data for analysis.

Image Enhancement

For better understanding of project data, you can extract information from existing data sources to create image mosaics that cover large areas or bring out important details from the shadows. By improving readability of images and correcting image distortions, you extract more value from existing data and gain better control over your design projects.

Raster Editing

To facilitate reuse of existing documents, you can clean up and correct image data in raster format. To improve productivity and accuracy, working with existing documents in raster instead of attempting vector conversion is often desirable.

Vector Conversion

To get the most from your investment in existing documentation, and when you require a vector model for your design, you must be able to accurately and efficiently convert raster to vector. Interactive tools give you control to capture what you need to create a coherent design. Unfortunately, fully automatic tools cannot provide the level of accuracy demanded by most applications, and postprocessing cleanup can be cumbersome and time consuming.

Project Management

To improve collaboration on projects, project teams must be able to access and share data both inside and outside the firewall. Raster data from scanned drawings and maps, digital photographs, and satellite imagery is crucial for project collaboration on design, mapping, and infrastructure projects. With support for Internet protocols and security standards, the entire team can improve productivity and collaboration.

Raster Overview

A raster image, digital image, or bitmap is a data file representing a rectangular grid of pixels. The color of each pixel is individually defined.

When you use AutoCAD software to create vector graphics, you use geometry (lines, arcs, and circles) to create your design. However, when your design is displayed on screen, you see a raster image of the vector graphics.

You can create raster image files in several ways. You can scan existing documentation and save it to a file. Digital cameras and satellites capture images directly and save them to raster data files. Software applications offer features sometimes called “save bitmap” or “screen capture” to create raster files.

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However, all images are not created equal. You can choose from many raster image formats, discussed in the following sections. Image density, also called image resolution, defines the number of pixels per inch (PPI or DPI), which greatly influences image quality and file size. Various compression techniques are available to minimize file size, but image quality may be compromised.

Bitonal Images

Bitonal images, also called monochrome or binary images, represent only black-and-white data. This format is suitable for scanned drawings in relatively good condition. You can save bitonal images in numerous formats. Most common are TIFF and CALS, which both support Group 4 compression to minimize file size.

Grayscale Images

Grayscale images can contain up to 65,536 shades of gray, including black and white, but 8-bit images (256 gray shades) are most common. They are suitable for black-and-white photographs or paper drawings in poor condition.

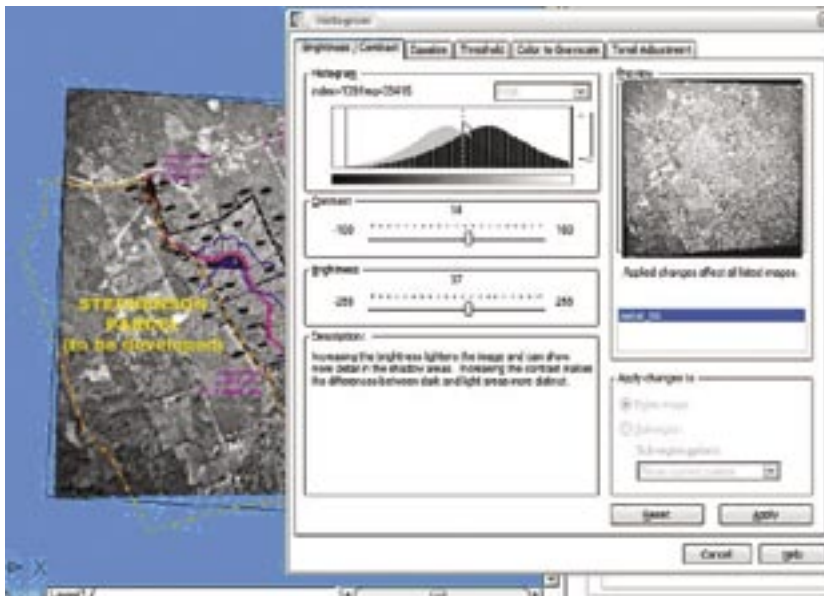


Figure 1: Enhance a grayscale image by adjusting brightness and contrast.

Color Images

Color images can contain 16 colors, 256 colors, or more than 16 million colors depending on the color depth. Capture, display, and analyze more detail by increasing the number of colors available.

Multispectral Images

Multispectral images contain data in two or more spectral bands, such as visible and infrared. Data from remote sensing devices (satellites) often use these formats. Use this data to interpret and analyze features revealed in this specialized format.

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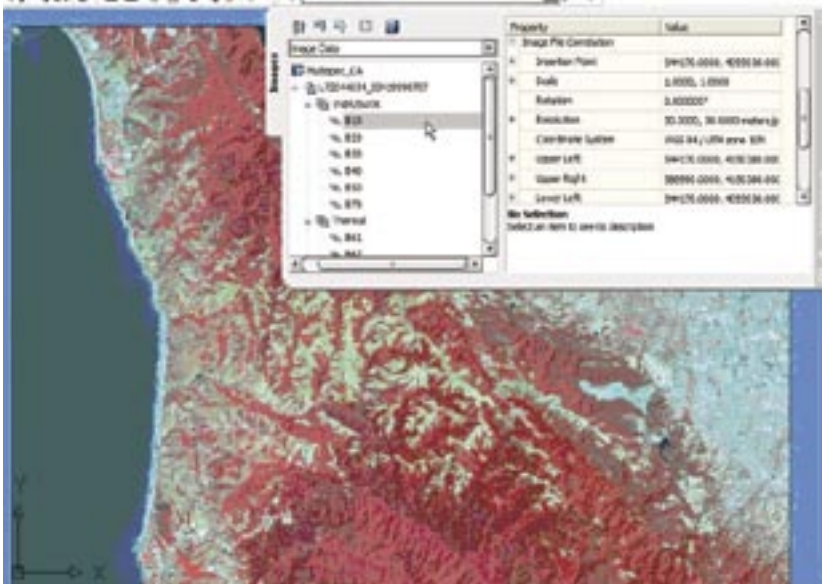


Figure 2: Work with multispectral data in Image Manager.

Digital Elevation Models

Digital elevation model (DEM) format files describe raster elevation scans of the earth's surface. Use this format to represent terrain relief using a palette of colors in which each color represents a range of values. The values can be surface elevation, slope, or aspect (slope direction).

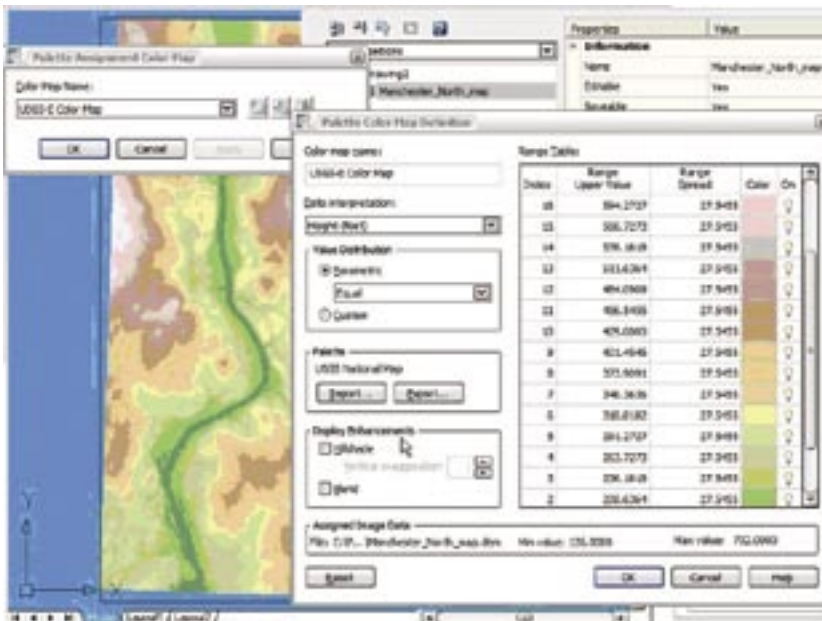


Figure 3: Assign a color map to a digital elevation model.

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Common Raster File Formats

You can save raster files in numerous formats depending on factors such as type of compression (lossy versus lossless) and color depth. BMP, TIF, and JPG are common image formats, but many variables can affect the size and quality of images in these formats. For example, TIF images can be grayscale, color, or bitonal (commonly used for fax and text recognition software). TIF images can be saved with various levels and types of compression to reduce file size. JPG images, commonly used on web pages, can be highly compressed and work nicely for sharing digital photographs. However, they may not be suitable for working with high-resolution technical images because the compression techniques may sacrifice some detail. Some raster file formats, including SID, ECW, and JPG2000, support multiresolution, wavelet, and lossless compression to greatly reduce file size while preserving image quality and improving display speed. These formats are beneficial when working with large data sets, such as high-resolution aerial photographs. However, creating and editing SID, ECW, and other file types might require specialized or proprietary software. JPG2000 is an open, industry-standard format that is gaining in popularity.

Raster Myths

Raster and vector data are clearly different, but is one better than the other? This section attempts to clarify some longstanding myths about raster data.

File Size

You may have heard that raster files are huge. However, this is not always the case. Raster image file size depends on the image format, size, and density. Modern compression techniques can dramatically reduce file size while maintaining excellent image quality. You can save a large, complex CAD design as a raster file that is significantly smaller than the original DWG file.

Automatic Conversion

You may have heard that automatic raster-to-vector conversion is faster than interactive methods of conversion. Although you can run automatic processes in batch mode, you must verify each entity and all text that result from automatic conversion. Interactive conversion yields accurate results without manual postprocessing. Many users try automatic conversion, are dissatisfied with the results, and return to interactive methods.

Intelligence

You may have heard that raster files have no intelligence and can't be used in AutoCAD software. By digitizing (scanning) paper drawings, maps, or photographs and storing them as raster files, you increase their value by making them easy to index, access, and share. That information can now be viewed, edited, enhanced, or converted in AutoCAD. Although a photograph might not have the attribute intelligence of a CAD drawing, a picture is still worth a thousand lines, arcs, or circles.

Some raster files can be manipulated for analysis and interpretation of features.

- DEM files use a palette color map in which each color can represent an equal range of values, or the ranges can be calculated using a formula for quantile or standard deviation distribution. This is useful to display surface elevation, slope, or aspect (slope direction).
- Multispectral files use a band assignment color map, which simply assigns data bands to color channels. By assigning multiple bands to different color channels, you can create "false color" images to study vegetation, land cover, water depth, and other terrain features.

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Tools of the Trade

Like professionals in any field, design and mapping professionals must have the right tool for the job. Autodesk Raster Design has a complete set of tools for working with all types of raster data. Some tools are designed for working on scanned paper drawings or maps, and some for color photos, maps, and satellite imagery.

Scanned Paper Drawings

Paper drawings are typically scanned into a bitonal raster format, since they contain linework. The tools in Autodesk Raster Design for working with bitonal images enable you to create, edit, and convert raster data interactively, giving you complete control over the results. If a drawing needs to be updated, use the powerful raster editing tools on the area to be modified and leave the remaining raster unchanged. When your design requires a vector model, use the vector conversion tools with your AutoCAD applications to get CAD-level accuracy.

Cleanup

For designs to look their best, paper drawings need to be cleaned up after they have been scanned. Drawings may not be square on the paper or may be misaligned during the scanning process. Dirt, stains, wrinkles, fold lines, fading, and stretching are easily corrected with the Autodesk Raster Design cleanup tools. In addition to the standard Deskew and Despeckle features, you can edit bitonal images at the pixel level with Touch Up tools. Use filters to smooth, thin, thicken, and skeletonize bitonal images to prepare them for display, raster editing, or vector conversion.

Raster Entity Manipulation

To keep it simple, you select raster data in Autodesk Raster Design the same way you select vector entities and use standard AutoCAD commands. When you want to edit a raster primitive (line, arc, or circle), use powerful raster entity manipulation (REM) tools to select and modify the raster data. If you need to increase the radius of a circle or remove a symbol, use REM with SmartPick and Enhanced Bitonal Regions to greatly reduce the steps required to accomplish these tasks, while cleaning up the remaining raster data. REM tools bring AutoCAD functionality to raster data to trim, extend, fillet, and offset raster linework.

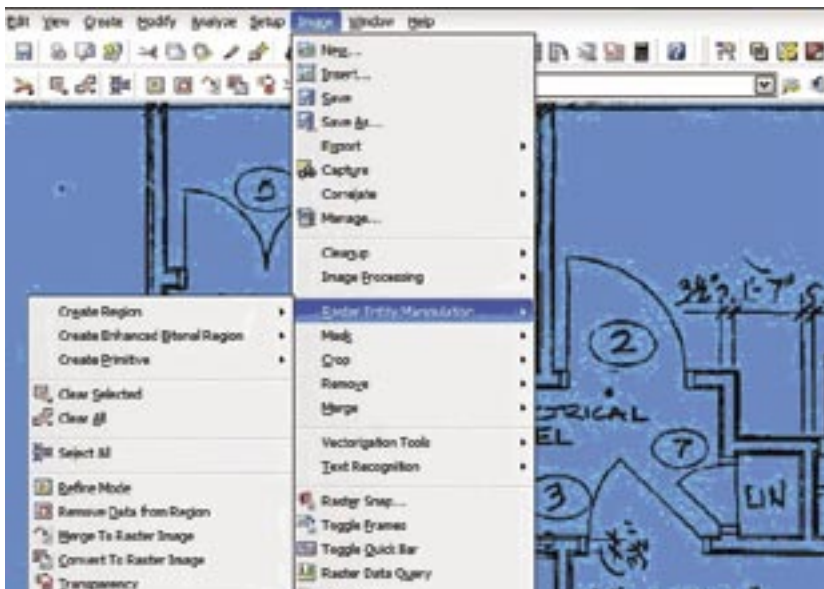


Figure 4: Operate on raster primitives with REM operations, including familiar tools like Fillet.

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Hybrid Editing

When you need to modify only a small area of a drawing, use Autodesk Raster Design with your AutoCAD product to create hybrid drawings—and improve productivity. Use raster editing features to erase selected raster entities or areas of raster data. Then simply use standard AutoCAD tools to add new vector objects or linework on top of the scanned drawing. Easily plot or publish data with standard AutoCAD output commands. Keep both raster and vector files for future editing sessions, or simply merge the vector data back into the raster image. Hybrid editing is the most productive way to use existing drawings, saving hours of work when full vector conversion is not required.

Vectorization

To get completely accurate results when your design requires a vector model, Autodesk Raster Design VTools help convert geometry and text in a bitonal raster image. Use the one-pick SmartCorrect method to accurately trace raster entities you select and respect the AutoCAD drafting settings. Use a follower method to create complex geometry, such as contours in Autodesk® Land Desktop. For the highest degree of precision, combine Raster Snap with VTools to verify and adjust a vector entity's dimensions as you draw it.

Vectorizing Text

To get fast and accurate results, text recognition tools in Autodesk Raster Design that work with bitonal raster images recognize both machine-printed and hand-printed text and text in tables and convert it to AutoCAD text or mtext (multiline text). The results are displayed in an Edit pane, which highlights words or characters that may not have been recognized accurately. The system compares results against an internal dictionary as well as your AutoCAD dictionary. To get the best results a single configuration screen lets you set all the required options easily.

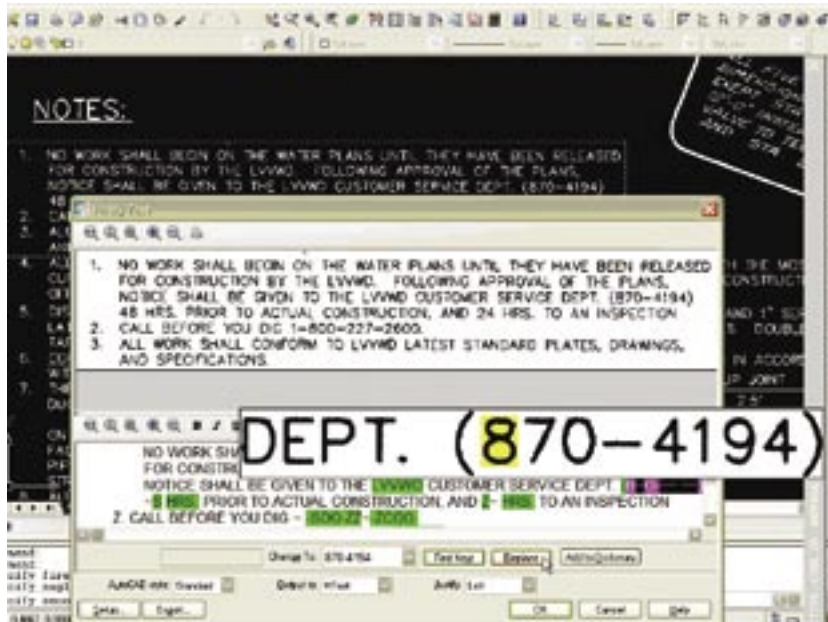


Figure 5: Get accurate results by verifying the results of text recognition.

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Digital Maps, Photos, and Satellite Imagery

Color maps, photos, and other imagery are typically stored as grayscale and color image files. Specialized formats increase the utility of these images in software applications. Autodesk Raster Design offers powerful tools for multispectral remote sensing data, digital elevation models, as well as color U.S. Geological Survey maps and digital aerial photos. Autodesk Map® 3D, Autodesk Land Desktop, or Autodesk® Civil 3D® users working with these data types will be concerned with correcting image distortion and enhancing images.

Correcting Image Distortion

Use the following techniques to correct image distortions and properly align images with existing geometry or physical features.

Correlation: To precisely position, scale, and rotate an image during insertion, Autodesk Raster Design wizards guide you and give you control. Some data files include correlation data in World files or in the image file. When working with an assigned coordinate system in Autodesk Map 3D, Autodesk Land Desktop, or Autodesk Civil 3D, you can insert images with correlation data quickly and accurately.

Rubbersheeting: To correct distortions of distance and shape in a map or photograph, Autodesk Raster Design rubbersheeting helps you align the image in your design or map. Using a set of matched control points or working with a grid and control points, you apply one of two algorithms to correct the image data. To avoid unexpected results, you can preview the correction before the change is applied. Because Autodesk Raster Design is integrated with your AutoCAD product, accuracy of the rubbersheeting process is easy to verify.

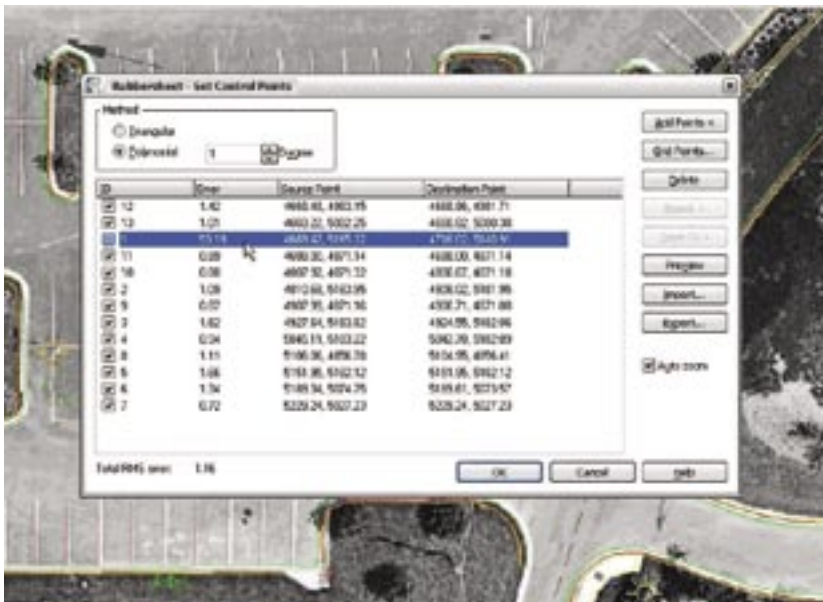


Figure 6: Reduce error when rubbersheeting by removing a control point.

Coordinate Transformation: Georeferenced images of maps, aerial photographs, multispectral data, and DEM data may be acquired with coordinate system information so it can be placed properly on a map. If you are working in Autodesk Map 3D, Autodesk Land Desktop, or Autodesk Civil 3D, your project may have an assigned coordinate system. If the coordinate systems of the image and the project are different, the image may be inserted

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in the wrong location or with unacceptable distortion. When you are inserting the image into your project, Autodesk Raster Design enables you to transform the coordinate system of an image to match the coordinate system in the drawing. A wizard prompts you to select the correct coordinate system information and preview the results. The software performs the necessary calculations for a true coordinate transformation of the image, point by point, to insert it properly into your project.

Density and Resampling: To control file size or make additional pixels available, Autodesk Raster Design enables you to increase or decrease image density by resampling the image. Select one of five resampling methods: bicubic, bilinear, Lanczos, Mitchell, or nearest neighbor to get the best image with the lowest distortion.

Enhancing Detail

Use the following techniques to enhance color and grayscale images.

Color and Contrast: To improve image quality for display, analysis, presentation, and hard-copy prints, Autodesk Raster Design includes powerful image processing features to adjust contrast, brightness, and color palette. Use the Histogram feature to change the image data definition, enabling you to maximize detail, convert color or grayscale images to bitonal, and convert color images to grayscale.

Filters and More: To improve the appearance of grayscale images, Autodesk Raster Design includes filters specifically designed for this raster data type. Use smoothing filters such as Lowpass and Median to reduce harshness, and sharpening filters such as Highpass and Edge Enhancement to make shading differences more distinct in grayscale raster data. Highpass filters can enhance the edges and sharpen details in a grayscale image. Matched Filter Edge Enhancements can look for features in noisy images. For all images, Equalize maximizes the detail in an image by performing a nonlinear contrast stretch.

Tempting Your Palette: To prepare an image for presentation and control the display of color values, use the Palette Manager to manipulate individual colors and entire palettes for indexed color (8-bit) images. Import and export color palettes, display and sort the palette by virtually any criteria, change or combine colors, compress the color palette, and set transparency. You have total control over the display of the color palette in simultaneous color table and list window views. Use standard Microsoft® Windows® controls to select individual colors or ranges of colors with cut, copy, and paste options.

Raster Analysis and Color Maps: To analyze, extract, and highlight geographic or terrain information from multispectral images and DEM data, Autodesk Raster Design includes color map functionality, enabling you to edit a DEM palette map or assign image bands to color channels on multispectral imagery. In a digital elevation model, each color in the palette color map represents a range of values, such as surface elevation or slope. Multispectral files use a band assignment color map, which simply assigns data bands to color channels. Configure these images for viewing, presentation, or analysis of vegetation, land cover, water depth, and other terrain features.

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Benefits of Autodesk Raster Design

Autodesk Raster Design helps you solve challenges when working with raster images. The business benefits include the following:

Interactivity Puts You in Control

Interactive functionality in Autodesk Raster Design gives you the power to make choices for the best results in your design, mapping, or infrastructure projects. This philosophy is pervasive in features where your input or guidance is crucial.

Automatic Is Problematic

Because you are working with scanned paper drawings and maps, the results of automatic processes may be far from perfect. You use an AutoCAD system because it offers the highest degree of precision and accuracy. Can you justify frustrating, less-than-perfect results?

Selectivity Means Facility

With Autodesk Raster Design, you select the image data before you begin to process it. Modify a single component from a drawing, or digitize only contours on the east slope of a project, or enhance only the area of interest on an aerial photograph. Complete these tasks with ease and precision, enhancing the value of your projects.

Autodesk Software Integration

Autodesk Raster Design is integrated with AutoCAD-based products. Compatibility with AutoCAD and AutoCAD-based applications like Autodesk® Mechanical Desktop® and Autodesk Architectural Desktop software helps to ensure the highest level of user satisfaction. With support and services from Autodesk and the worldwide reseller network, organizations of all sizes in every industry have access to a powerful, flexible solution.

Exclusive Capabilities

Unique functionality is available when you use Autodesk Raster Design with Autodesk Map 3D, so you can align images correlated in one coordinate system with a project in a different coordinate system. When rubbersheeting images, Autodesk Land Desktop users can select coordinate geometry (COGO) points as control points.

Synchronous Releases

Autodesk's goal is to keep users up to date, ensuring that you can continue your work on the latest software, without interruption. With Autodesk® Subscription you get the latest releases of your Autodesk software, incremental product enhancements, personalized web support direct from Autodesk technical experts, and self-paced training to help extend your skills. And with access to a range of exclusive community resources and members-only privileges, you can use the power of your design tools to the fullest and make the most of your technology investment.

Continuous Product Improvements

Since 1988, Autodesk Raster Design (formerly Autodesk® CAD Overlay®) has had a steady stream of new features, enhancements, and improvements. The latest release has nine categories of new and enhanced features, including additional raster image format support, raster drafting capabilities, touch up, and image capture.

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Comparative Analysis

Autodesk Raster Design is the only comprehensive application for AutoCAD and AutoCAD-based products for working with all relevant raster data types. It works in all AutoCAD-based products and is fully compatible with the latest DWG data format. It includes complete feature sets for working with scanned paper drawings and digital photographs, satellite imagery, and digital elevation models. Raster editing tools work just like the familiar vector editing tools in AutoCAD software. Vector conversion tools provide accurate, verified geometry with no postprocessing required. Image enhancement tools provide control to improve the appearance of images.

WisImage Pro for AutoCAD

IDEAL Scanners & Systems, Inc. offers a software application developed by Consistent Software. WisImage Pro for AutoCAD has general raster capabilities, with a focus on automatic raster-to-vector conversion and raster editing functionality. A separate, stand-alone raster application for mapping and GIS projects is required. WisImage Pro Geo Edition does not work in AutoCAD software. The advertised price of WisImage Pro for AutoCAD is nearly twice the price of Autodesk Raster Design, but WisImage Pro for AutoCAD lacks many of the important features of Autodesk Raster Design.

WisImage Pro for AutoCAD has limited capability for working with coordinate systems, even when working in Autodesk Map 3D, Autodesk Land Desktop, or Autodesk Civil 3D. If images with correlation information reference a coordinate system different from the Autodesk Map 3D coordinate system, users must perform manual correlation. Autodesk Raster Design not only handles the coordinate system transformation, but also performs the required rubbersheeting of the image so it is positioned accurately, increasing productivity and saving time.

WisImage Pro for AutoCAD has no support to view, edit, or save DEM or multispectral data. Also lacking are tools for working with color-mapped imagery, so imagery cannot be displayed with multiple color bands assigned to color channels to display “false color” imagery.

In addition, despite automatic raster-to-vector conversion with extensive postprocessing requirements, the line following commands produce only vector polylines that approximate raster contours. The software cannot create Autodesk Land Desktop contour objects as part of the conversion process.

GTXRaster CAD

GTX Corporation offers GTXRaster CAD products, with applications available both for AutoCAD and stand-alone software. GTXRaster CAD focuses on raster editing and automatic raster-to-vector conversion. It does not offer specific functionality for mapping and infrastructure applications.

GTXRaster CAD product features work only with bitonal images. Color or grayscale images are reduced to bitonal by the system, and prepared for raster editing or automatic raster-to-vector conversion with extensive postprocessing requirements. There is no functionality for editing, enhancing, or otherwise working with color or grayscale data. DEM and multispectral data cannot be

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displayed. Correlation of images is limited to insertion point and scale, if saved. The software does not support coordinate system information of any type. As for WiselImage Pro for AutoCAD, the line following commands in the GTXRaster CAD products produce only vector polyline entities. The software cannot create Autodesk Land Desktop contour objects as part of the conversion process.

The latest version, GTXRaster CAD V8.6, adds support for AutoCAD software but includes only a few new features, mainly in the image cleanup category. Most large-format scanner software already performs these tasks adequately.

Conclusion

Autodesk customers in every industry have business challenges that require working with raster data from paper drawings, photographs, or other digital imagery. To streamline project workflow and produce the best design, mapping, and infrastructure projects, the technical solution to those business challenges must offer a comprehensive, purpose-built raster application that works in the primary design environment. Autodesk Raster Design integrated with the AutoCAD-based, industry-specific applications offers unique business value with extensive, proven technology to satisfy the most demanding projects.

For more information about Autodesk Raster Design, visit www.autodesk.com/rasterdesign.

