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| Image Analysis Applications |

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|  | **Particle Detection and Analysis**   |  |  |  |  | | --- | --- | --- | --- | | |  |  |  | | --- | --- | --- | |  | |  | | --- | |  | | |   Image-Pro software provides advanced tools for automatically detecting and analyzing particles.   |  | | --- | | [Particle Detection and Analysis Overview](http://www.mediacy.com/index.aspx?page=ParticleAnalysis#Particle_Overview) | | [Particle Counting & Analysis App for Image-Pro Premier](http://www.mediacy.com/index.aspx?page=ParticleAnalysis#Apps) | | [Customer Stories](http://www.mediacy.com/index.aspx?page=ParticleAnalysis#Particle_Stories) | | [Published References](http://www.mediacy.com/index.aspx?page=ParticleAnalysis#PublishedReferences) | | [Recommended Software](http://www.mediacy.com/index.aspx?page=ParticleAnalysis#Particles_Software) |     **Particle Detection and Analysis with Image-Pro Software** Particle analysis represents an especially challenging problem for researchers analyzing the size, shape and conformation of particles in both static and dynamic environments. Attributes such as location, size and shape must be simultaneously considered, often in cluttered fields of view. An objective and quantifiable set of rules must be applied to properly evaluate each object in an image, necessitating the use of image analysis software.  **Acquire Images and Assign Calibrations** Image-Pro allows you to collect single images and image sequences from a variety of cameras. Calibration files can be assigned to images to properly reflect magnification and measurement units. Calibration options include spatial as well as intensity measurements.  **Create Manual Measurements** Several user-defined measurement options exist. Diameter, circumference, object location and class can all be manually indicated. Data are stored in tables, which can be saved, exported to Excel or embedded within standard reports.  *Automatic particle detection and quantification in*[*Image-Pro Premier*](http://www.mediacy.com/index.aspx?page=IP_Premier)*software*   **Automatically Detect, Measure and Save Objects** Image-Pro's long-standing Count/Size tools allow you to automatically detect and quantify particle attributes such as size, shape and intensity. Filters within the software let you precisely define ranges that represent objects of interest and exclude extraneous detail that can compromise data validity.  **Edit the Collected Data** Remove detected particles that do not meet measurement criteria. Artifacts, debris and other extraneous information can be removed from collected data in order to provide more statistically valid results.  *Display and report a sorted list of all identified particles in Image-Pro Premier software*   **Save Measurements as Overlays** Data can be saved for later analysis and verification, as well as shared with your colleagues who also use Image-Pro Premier. Stored data include object location and outlines, and can be recalled as overlays that directly correspond to the analyzed objects.  **Export and Report Findings** Data can be exported to Excel or other Spreadsheet applications through comma- and tab-delineated formats. PDF reports and PowerPoint presentations can be created from the stored images and data.  **Automate Data Collection and Simplify Your Life** Create macros to apply repetitive measurement tasks to multiple images. Macros can be saved for later use, modified for new applications and shared with your colleagues or the imaging community. |
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|  | **Physical Science**   |  |  |  |  | | --- | --- | --- | --- | | |  |  |  | | --- | --- | --- | |  | |  | | --- | |  | | |   Image-Pro software provides advanced tools physical science researchers need for image acquisition, stitching and tiling images together, automatically detecting objects based on intensity value or color, automatically measuring area, radius and more than 50 other measurement values, and reporting your work.  Whether you are involved in chemical engineering, geology, astronomy, or materials analysis, Image-Pro has the tools you need to streamline your research processes.   |  | | --- | | [Physical Science Overview](http://www.mediacy.com/index.aspx?page=PhysicalScience#Physical_Overview) | | [Customer Stories](http://www.mediacy.com/index.aspx?page=PhysicalScience#Physical_CustomerStory) | | [Published References](http://www.mediacy.com/index.aspx?page=PhysicalScience#Physical_References) | | [Recommended Software](http://www.mediacy.com/index.aspx?page=PhysicalScience#Physical_Software) |   **Physical Science Image Analysis with Image-Pro Software**  **Acquire Images and Assign Calibrations** Image-Pro allows you to collect single images and image sequences from a variety of cameras. Calibration files can be assigned to images to properly reflect magnification and measurement units. Calibration options include spatial as well as intensity measurements.  **Create Manual Measurements** Several user-defined measurement options exist. Diameter, circumference, object location and class can all be manually indicated. Data are stored in tables, which can be saved, exported to Excel or embedded within standard reports.  *Automatically count and measure objects in*[*Image-Pro Premier*](http://www.mediacy.com/index.aspx?page=IP_Premier)*software*   **Automatically Detect, Measure and Save Objects** Image-Pro's long-standing Count/Size tools allow you to automatically detect objects and extract attributes such as size, shape and intensity. Filters within the software let you precisely define ranges that represent objects of interest and exclude extraneous detail that can compromise data validity.  **Save Measurements as Overlays** Data can be saved for later analysis and verification, as well as shared with your colleagues who also use Image-Pro Premier. Stored data include object location and outlines, and can be recalled as overlays that directly correspond to the analyzed objects.  **Batch Process Multiple Images** Apply your image processing steps to all opened images or entire folders of images using Image-Pro Premier's easy-to- use batch processing tools.  This batch processing feature is only available in Image-Pro Premier.  **Record Your Frequently Used Steps with Macros** Rather than walking through the same steps over and over again, simplify your work and minimize the risk of error by recording commonly-used tasks. Simply press the Record Macro button to start recording your steps. Macros can be recalled later and shared with other Image-Pro users.  *Easily export images to PowerPoint with*[*Image-Pro Premier*](http://www.mediacy.com/index.aspx?page=IP_Premier)*software*   **Export and Report Findings** Data can be exported to Excel or other spreadsheet applications through comma- and tab-delineated formats. PDF reports and PowerPoint presentations can be created from the stored images and data. |
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|  | **Quality Assurance and Quality Control**   |  |  |  |  | | --- | --- | --- | --- | | |  |  |  | | --- | --- | --- | |  | |  | | --- | |  | | |   Image-Pro software provides Quality Assurance and Quality Control specialists with image analysis tools needed to automatically evaluate, analyze and report quality standards with a high level of precision.   |  | | --- | | [Quality Assurance/ Quality Control Analysis Overview](http://www.mediacy.com/index.aspx?page=QAQC#QA_Overview) | | [Customer Stories](http://www.mediacy.com/index.aspx?page=QAQC#QA_CustomerStory) | | [Published References](http://www.mediacy.com/index.aspx?page=QAQC#QA_References) | | [Recommended Software](http://www.mediacy.com/index.aspx?page=QAQC#QA_Software) |   **Quality Assurance and Quality Control using Image-Pro Software  Acquire images and  analyze in real-time** [Image-Pro](http://www.mediacy.com/index.aspx?page=Image_Pro_Software) software provides you the option of acquiring images directly from within the application, and then running automated analysis routines on the collected data. It is possible to evaluate a collection of images in real-time and then update data to a central location (the Data Collector) as it is collected from each image.  *Work with live image measurements and image comparison tools in Image-Pro Premier software*   **Select or create calibration files** Units of measure can be assigned to detected and measured objects. Typical calibrations take into account image magnification, but may also be user-defined to accommodate unique calibration requirements.  Calibrations can be stored for later use and assigned to images as part of the overall image metadata.  **Define and measure areas automatically with 'Smart Segmentation'** [Image-Pro Premier](http://www.mediacy.com/index.aspx?page=IP_Premier)has improved upon its well-known intensity segmenting tool with Smart Segmentation. You can now instruct the segmentation toolbox to take into account regions within the image that represent different intensity levels, yet represent pertinent detail. Smart segmentation contains over fifty object classifiers, and lets you split touching objects and apply size and intensity filters to refine results.  Smart Segmentation is only available in Image-Pro Premier software.  *Easily segment objects to analyze their area, density, intensity and other measurements in Image-Pro Premier.*   **Create manual measurements** Tracing tools in Image-Pro Premier let you manually define boundaries of corroded regions and determine measurements like percent area covered and average cross-section thickness. Much like their automatic measurement counterparts, manual measurement routines can be placed into macros and performed on either live or stored images.  **Store and recall measurement areas** Both user- and automatically-defined measurements can be archived for later use. You can overlay these files directly onto images and even share them with your colleagues or anyone else who use Image-Pro.  *Zoom in on objects and export measurement data in Image-Pro Premier.*   **Annotate areas of interest directly on the image** Regions of interest on the image can be highlighted with text and shapes. These annotations can be embedded directly within the image as a permanent record or exist in a separate layer to be recalled as necessary.  **Export measurements and create custom reports** Data can be exported to Excel or other spreadsheet packages. Data export options include tab- and comma-separated variable formats. Any data created within Image-Pro Premier can also be inserted into user-defined reports and created in PDF format to share with your colleagues.  **Multi-user Environment Support** Image-Pro Premier is designed to work in a multi-user environment. Network and multi-seat licenses are available. The software can be customized for each user registered on the license. The interface can be modified for each technician, providing scalable access to Image-Pro Premier's toolset. An audit trail creates a log of each step used to complete the analysis and ensures the accountability of each technician.    **QA/QC Customer Stories**   |  |  | | --- | --- | |  | **Acton Optics** [Image-Pro software is used for Optics Manufacturing Quality Assurance](http://www.mediacy.com/index.aspx?page=ActonOptics2) | |  | **Pixel Physics** [Image Chain Simulation Analysis using Image-Pro Plus software](http://www.mediacy.com/index.aspx?page=SS_ImageChainSimulationAnalysis) | |  | **LG Electronics** [Quality Assurance of Mo](http://www.mediacy.com/index.aspx?page=SS_QACellularPhonesProduction) | |

**Spray Droplet Spectrum Analysis System Using Image-Pro Plus**  
  
[Previous Note](http://www.mediacy.com/index.aspx?page=AS_101) | [All Notes](http://www.mediacy.com/index.aspx?page=ArchivedCustomerStories) | [Next Note](http://www.mediacy.com/index.aspx?page=AS_103) 

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The spray droplet spectrum analysis system is aimed at providing easy, fast, and accurate analysis of spread droplets from agricultural spraying appliances (such as nozzles). The agricultural spraying appliances used for applying liquid pesticides do not atomize the liquid into droplets of identical size, but into a range of droplets of various sizes. The atomization of spray liquid into the various droplet sizes is known as the droplet spectrum. It is important to measure the droplet spectrum to determine the amount of pesticide to be used and to check the uniformity and efficiency of the spraying device.   
  
Image-Pro Plus, image processing software, provides in-depth and precise measurement analysis of the spread droplet. This eliminates human error and maintains the highest qualtiy standard possible. The system is able to determine:

* Spread droplet size and number in unit area
* Spread factor - spreading of droplet on paper due to the characteristics of paper and liquid mixture
* Actual droplet size and number
* Droplet density - number of droplet per unit are
* Volume of a droplet

Reports can be saved in text format using text (\*.txt) files and can be used in any Windows application. The application provides graphs for NMD and VMD. This graphical information is easy to understand and analyze and printouts of the graphs can be generated and saved.   
  
To analyze the spray droplet spectrum produced by a particular nozzle or sprayer, the sprayer is operated at fixed parameters. The water and color dye mixture is sprayed keeping kromocote paper on target, i.e. leaves of a plant. The spray droplets are deposited on papers after settlement and after drying, these papers are removed from the target. The images of these papers are grabbed using a microscope and camera. The images are analyzed in seconds by Image-Pro Plus, providing the spread droplet size and number of droples in the unit area.   
  
Next, the actual droplet size is calculated by dividing spread droplet size by spread factor. For analysis purposes, these droplets are arranged into different ranges, e.g. 0-5 micron. The droplets are sized so that the number of droplets within a given diameter range can be expressed as percentage volume of droplets multiplied by number of droplets. The percentage of the spray volume in each range and its cumulative percentage are then calculated.

Submitted by:  
Sarita Seth, Director

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| Customer Stories |

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|  | **Image-Pro Plus Used for Automated Insect Classification**   |  | | --- | |  | | Dr. Jeffrey T. Drake |   Dr. Jeffrey T. Drake, a researcher for the United States Department of Agriculture -APHIS Center for Plant Health, Science and Technology was tasked in 2003 with the Automated Insect Survey Using Image Analysis Project. The goal of this project is to develop tools to aid in the rapid screening of large samples of insects; such as those obtained from traps surveying for bark boring beetles, as well as from vacuum samples of row crops.  As a proof-of-concept, Drake in collaboration with entomologists from New Mexico State University tackled a tough problem: processing (identification to the genus level) vacuum samples obtained from cotton in support of biological control. Prior to this project, insects were counted and identified by hand, which was time consuming and often took several days to process just one field’s samples.  "This delay of several days has always made using sampling to assist in biological control decisions impractical as insect densities can change significantly in even a day's time," says Drake.     Slow, Hand Method of Counting  As part of the Automated Insect Survey project, Dr. Drake and his team developed macros in Image-Pro Plus that enable them to automatically count and classify insects.  To gather insects for their research, an Insecta-Vac (a four-wheel drive, hydraulically controlled, platform with a 4,200 cfm insect vacuum) is driven through the field, collecting samples which are placed in plastic bags with a killing agent. The samples are then transported back to the image processing lab at New Mexico State University for the counting process.     Collecting insects from rows of cotton  The insect samples are poured onto non-reflective glass and imaged from both above and below by 14 mega pixel digital cameras. The digital images are then automatically transferred to the image processing workstation for processing and ultimately determination of insect predator/prey ratios. .     Capturing digital images for the field samples  Three critical image processing functions are automated via Image-Pro Plus macros. All images have four registration points and known color swatches. The Image-Pro macros automatically locate the registration points on both top and bottom images and transform (flip left to right and scale) the bottom image to align with the top image. This way, the objects have both top and bottom measurements, which greatly improve classifier performance. Color correction is also automatically performed by locating the color swatches, measuring the swatch colors, and transforming the image colors to the known reference swatch colors. Accurate, robust image segmentation—the process of separating objects of interest from background and more difficult, separating objects that are touching from each other—is possibly the most crucial (and in this application difficult) image processing step automated with Image-Pro macros. Through an iterative process implemented with macros, images in which 80% of the insects are touching at least one other insect are acceptably segmented.     Automated Registration & Color Correction  After image segmentation, the top and bottom measurements are sent to an external classification algorithm. The classifier returns the estimated class for each object and well as a summary of the classification results to Image-Pro Plus. An Image-Pro macro creates a user dialog and labels each object with the estimated classification. Through this interface, the analyst can review the results, make changes to an objects classification, and update the classifier’s training set to improve performance.     First Classification View  A second view of the classification results has proven to be very useful in rapidly identifying and correcting classification errors. This view was implemented as a DLL using C++. This view sorts the objects by class, after classification, enabling the analyst to very quickly see misclassified objects. As the mouse is moved over an object the object is zoomed in separate windows, and its classification data displayed. To make a change, the analyst simply clicks in the object in the sorted view and a dialog opens. Any changes are then forwarded to the classification algorithm to improve the training data.     Second Classification View  "This automated system has clearly demonstrated the capability to significantly decrease, from several days to several hours for large samples, the time required to count and classify field samples," says Drake. "This quick turn-around in providing insect densities enables growers, for the first time to make biological control decisions based on real time (same day) predator/prey ratios. This in turn has huge potential economic and environment consequences. Through biological control practices, growers can reduce costs through reduced insecticide application."  The second phase of this project, which is expected to get underway in early 2005, will focus on other applications such as processing insects collected in traps for bark beetle surveys. This application will require classifying a select group of samples to the species level. Robotics technology, integrated with the identification system, will physically sort the identified samples, picking-up each sample and placing it in the appropriate container. This in turn will greatly reduce the number of samples sent to taxonomists for identification, allowing these specialists to focus there efforts on identifying the "unknown" specimens.  Collaborators at New Mexico State University include: Dr. Joe Ellington, Professor of Entomology Tracey Carrillo, Senior Technician Jill McCauley, Research Assistant |