

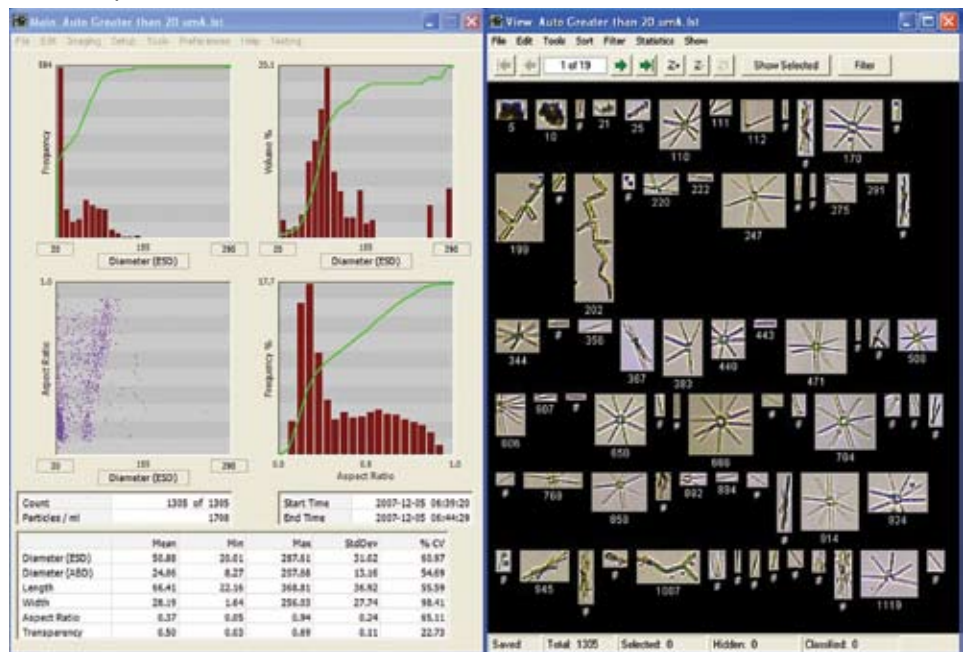


VisualSpreadsheet®: Intelligent Pattern Recognition for Particle Analysis and Automated Classification

FlowCAM® is an imaging-based particle analysis system, providing for rapid analysis of microscopic particles in a fluid. FlowCAM captures an image of each particle in a sample, providing up to 26 different measurements for each image. This is quite different than most other particle analysis instruments, which store only a measurement of Equivalent Spherical Diameter (ESD) for each particle. Having the particle images available, along with up to 26 measurements made for each particle, enables highly sophisticated pattern recognition operations to be made automatically. This process duplicates standard microscopy techniques without the need for a human operator, allowing for much larger quantities of sample to be processed in significantly less time. The greater number of data points analyzed yields a much higher degree of *statistical significance* for the results.

How it works:

1. FlowCAM acquires sample data
2. The user builds libraries of particles of the same type simply by clicking on images in the window (libraries can be stored for use on future samples)
3. The classification (pattern recognition) is invoked from the VisualSpreadsheet menu with the results displayed as images and summary statistics



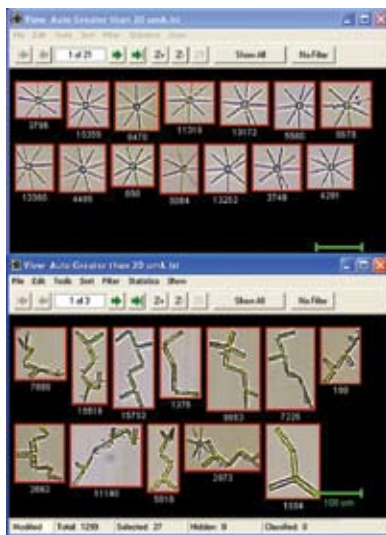
Screenshot of FlowCAM data acquired on reservoir sample

VisualSpreadsheet Pattern Recognition Benefits:

- High-speed automated classification of particles
- Intuitive *image-based* user interface
- Re-usable particle libraries
- Microscopy results in a fraction of the time
- Detailed, exportable statistical results
- Uses up to 26 different particle measurements for a high degree of discrimination
- Identify and count specific particles/cells

The image above shows the results of a FlowCAM run for a drinking water reservoir sample. In this particular sample, the object is to quantify the amount of two particular taste and odor causing algae, *Asterionella* and *Tabellaria* which may be found in the water supply. This is normally done manually through a microscope, which is time consuming, thereby not allowing for a large amount of sample to be analyzed. FlowCAM's integrated software, VisualSpreadsheet, can automate this process automatically using pattern recognition.

This process does not occur without first having an operator “train” the system so that it knows what to look for. However, the process of training the system is a one-time occurrence; once the system has been trained, it can be used to look for the same set(s) of particles in *any* sample. To train the system, the user simply browses through the particle images and highlights target particles of the type one desires to find. These are then added to a “library” stored in the software. Multiple libraries can be built and applied against any given sample. The image above shows the two libraries defined for this example: *Asterionella* on top and *Tabellaria* below.



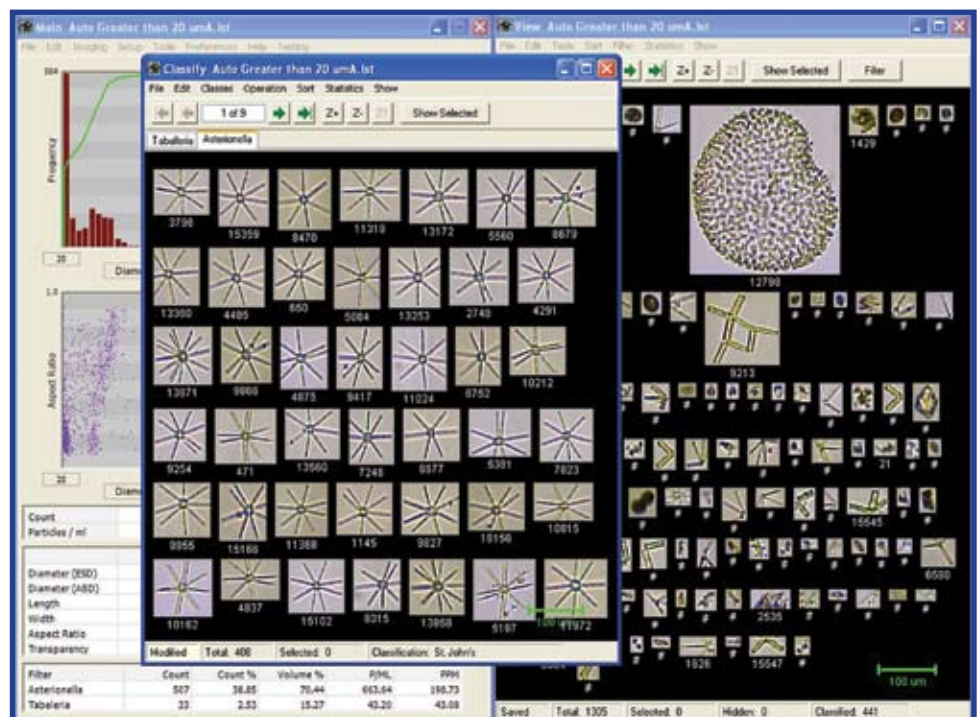
Libraries built by user

Although this example is a relatively simple one applied to algae in drinking water, the same technique is being successfully used on many other types of samples, including foods, beverages, chemicals, pharmaceuticals and many others. In all cases, VisualSpreadsheet is able to replace manual microscopy methods, analyzing far more statistically significant amounts of data in a fraction of the time it would take to accomplish manually.

For a more detailed explanation of how pattern recognition works in particle analysis, you may download our white paper, “*Particle Image Understanding - A Primer*”, available on the Fluid Imaging web site at www.fluidimaging.com. Or call us to discuss your potential application in detail at (207) 846-6100.

Once the libraries are built, the pattern recognition (classification) is invoked from the VisualSpreadsheet menu structure. Although the two classes shown above are relatively simple to distinguish by eye, this is computationally a fairly advanced discrimination to make mathematically.

After the classification is finished, each particle that has been assigned to a class appears in a separate image window for each class. All remaining particles which are “unclassified” remain in the original image window. Detailed statistics (total count, particles/ml, etc.) are generated for each class which are easily exported to be incorporated into reports.



Results of the automated statistical classification. The “Classify” window shows the particles identified as members of each class. Note there are two “tabs” in this window, one for each class. In this case the window shows the particles classified as *Asterionella*, but clicking on the “tab” labelled *Tabellaria* would show the particles classified as that type. Particles in the right hand window are the particles left over as “unclassified”. Note also in the lower part of the left hand window that exact statistics (including count and concentration) for each class are summarized.