

# imMix™ Micromixing Hyperspectral Analysis Software\*



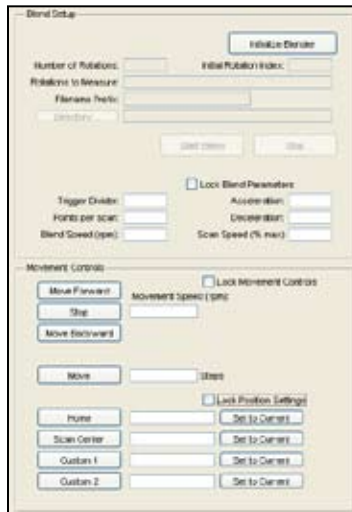
The imMix software allows the user to perform a complete micromixing project from start to finish. The software controls the measurement of a portion of the blend at selected rotations of the blender. Pure ingredients of the blend (analytes) can be measured and used to create a calibration for prediction, and analyze the predicted results with many different statistical and spatial uniformity measures.

The software allows the user the freedom to save the raw measurement data, calibrations to be used on future images, save prediction results to be viewed at a later time.

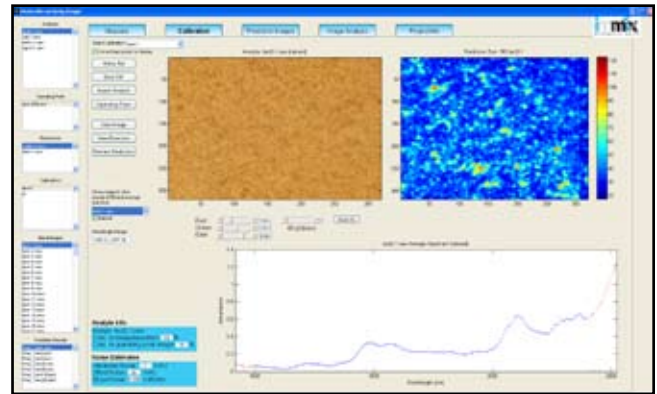
The lists on the left help the user keep track of the files associated with each calibration – which analytes and reference images are used, and which image files are predicted.

## Measure

The user specifies the number or rotations and which rotations to measure. This can be every rotation of the blender or selected ones. The user can also adjust hyperspectral camera settings (focusing, exposure time) and monitor scans. For an easy referencing, the white and dark background can be measured as well as any single image measurements to record the pure API and the pure excipients. These are done using the Small Sample Holder

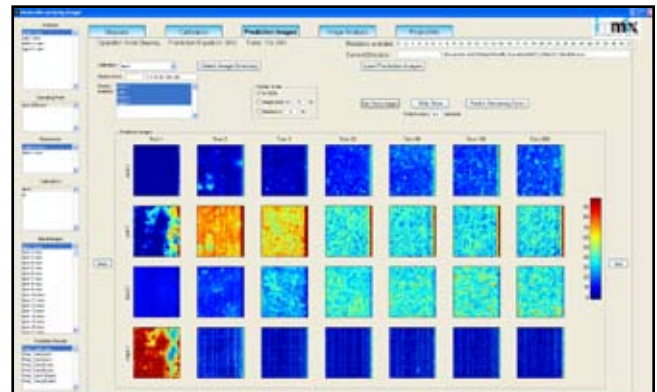


that allows the measurement of a small amount of material in the same location and through the same type and dimension window as the blend is measured.



## Calibration

The user creates a calibration by importing the appropriate analyte images or single-point spectra, references, operating point image/spectrum if desired, and setting noise level estimates. This calibration will then be used to predict the rotation images. The software allows the user to preview the prediction on a selected rotation image to assist in selecting appropriate calibration settings. The user may view additional information about the calibration, such as response spectra, b-vectors, and the cross-sensitivity that the calibration has between analytes. The user may create several calibrations within one project to determine the best parameters for their data.

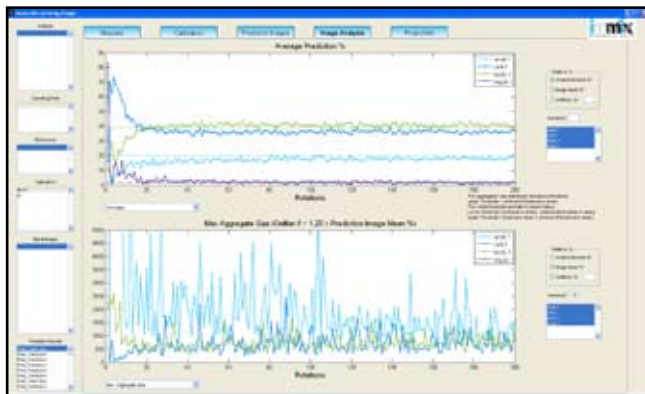


## Prediction Images

The user selects a calibration with which to predict rotation images. The software displays the first few rotations and allows the user to

\* Patent pending

flip through other rotations' prediction images, a chosen number of rotations and analytes at a time. In addition to visual examination of any composition image at any rotation, the user may also choose to watch a slide show of all selected consecutive rotation images of one or more selected analytes.



## Image Analysis

The user can choose from many types of analyses' plots and view two at a time for comparison. Images are automatically analyzed with the available algorithms and the results are displayed as a function of rotations. Smoothing may be done on the data to better view the trends of the micromixing process.

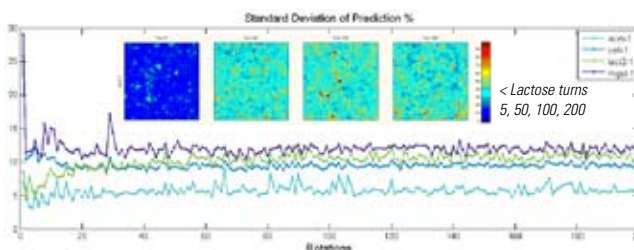
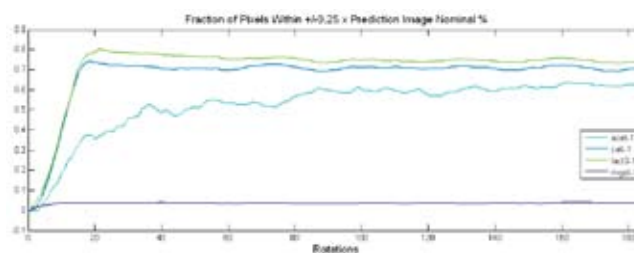
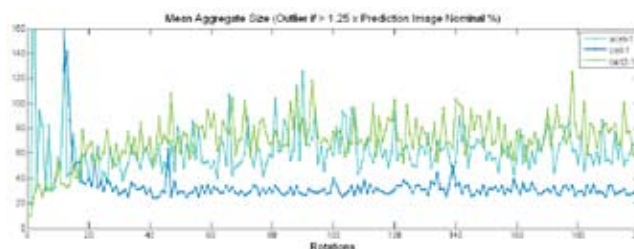
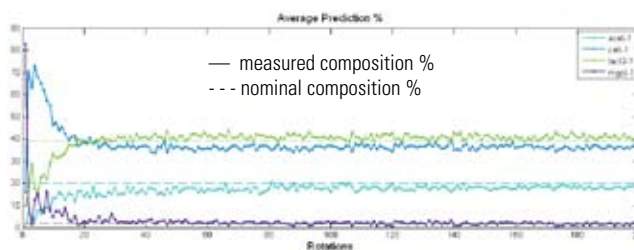
The currently implemented algorithms are:

- Averages (of the predicted values of all the measured points in the images, in concentration scale)
- Standard deviations of concentration values of the prediction images
- Within/Above Threshold
- Ratio: Peaks/Valleys: Concentration values exceeding the nominal, or average, plus a preset threshold are defined as "peaks," whereas values below the nominal, or image average, composition minus a threshold are defined as "valleys". The ratio of peaks/valleys is the ratio of the pixels which are classified as such. This factor describes how tight certain aggregates are relative to other ingredients and how this factor is changing during the blending.
- Mean/Median or Maximum values of the Aggregate Sizes
- Skew/Kurtosis of Aggregate Size distribution in each image

The user can explore the relationship between different types of analyses with an interactive vertical cursor. The user can change the display limits of the axes or zoom in on a certain area of the plot to view the micromixing process details.

## Saving Project Results

The user may save any of the graphical images or plots as \*.bmp image files to view outside this software for reports, presentations or archiving, and can also save any of the plots' data as a \*.csv file.



Middleton Research is committed to continually update the software with additional user-friendly controls and displays, chemometric and image analysis techniques.