THE USE OF IMAGE PROCESSING IN THE CLASSROOM: M. M. Strait, Alma College, Alma, MI 48801

The computer has entered the classroom in many ways over the past decade. At Alma College the computer is an integral part of doing chemistry, from simple word processing and graphing to more complex molecular modelling and spectral interpretation. As early as a student's first course in chemistry, experiments are interfaced directly to a computer to collect data and then allow interactive processing of the data to produce the desired type of output for further calculations. The nature of the chemistry department at Alma College allows us to explore ways of using the computer in many new and different ways, such as the interpretation and analysis of images.

Image processing provides a powerful, interactive method of analyzing and interpreting imagery using a computer. It was recently introduced to Alma College through the auspices of a NASA/Joint Venture grant and has primarily been used in research applications. But, one of the components of the NASA/JOVE program involves educational applications of the technology. Over the past year, this technique has been introduced in three ways as an educational tool: to middle school children in a planetary science unit at a space science summer camp; to pre-college students as a component of a college orientation course in forensic science; and to upper level undergraduate students in courses in Environmental Chemistry and Instrumental Analysis.

Space Science Camp: As an outreach component of the NASA/JOVE grant, Alma College sponsored a Space Science Camp for middle school children (grades 6-8) in June, 1994. Eleven children spent four and one half days cycling through interactive lessons in three subject areas with space science ramifications: life science, astronomy and planetary geology. In the planetary geology component, students learned about dating, both absolute (radiometric) and relative (crater counting), the formation of planetary surfaces, in particular the formation of craters, the interpretation and creation of geologic maps, and the interpretation of spacecraft imagery. In this last section, we first looked at 2-D and 3-D photos of various circular formations and learned to differentiate between "up" (uplifts) and "down" (craters), as well as between volcanic and impact craters. The children were able to draw upon their experience in making craters in this part. Next, we moved to the computer and looked at digitized images using a MacIntosh based program from the NIH called IMAGE. Students learned to manipulate the image with various processing functions (brightness, contrast, sharpen, blur, false color, etc.) and then interpreted real planetary images containing circular features. (And also generally played with the program, exhibiting their lack of inhibitions in their approach to computers.)

College Orientation: The college orintation program for entering freshman at Alma College includes an academic component in which the students take a class for nine days and receive one college credit. Biology and Chemistry cooperated to offer a course in Forensic Science. We selected a limited set of forensic techniques which the students learned about, practiced, and then applied to a "crime" scene. Imagery was one of the techniques we worked with, both to document the crime scene, as well as the collection of photographic evidence present at the scene (photographs and video footage). In a manner similar to the space science camp, we introduced

the idea of image processing and experimented with the parameters of the program before providing photos from the "crime" scene for the students to process to reveal the clues to aid in solving their crime.

Upper level Coursework: A similar image interpretation exercise was used in the conclusion to the section on air pollution in an upper level Environmental Chemistry course. The students in this class were majors or minors in chemistry or biology. Again, the students learned about the technique, how the program worked, and then were asked to interpret images: volcanic action, smog, sand and dust storms, and mass burning. The students were asked to write a detailed description of criteria they would use to differentiate which of the various types of pollution were present in an unknown image with haze.

Image processing will be introduced in a different manner in the Instrumental Analysis course in Spring 1995. Rather than interpreting images, the process will be used as an analytical tool to measure the area under peaks from chart-recorded gas chromatographic data. Scanned chromatograms will have the peaks isolated and the area in the enclosed space measured by the program.

Conclusion: Except for the last usage, all of the imagery lessons were similar in content, even though the students were at different educational levels. However, none of them had ever seen or done anything like this before, so the exercise was as challenging for the senior college students as it was for the sixth grade middle school students. The middle school students tended to be bright and well-motivated, while the college students were intrigued by a new use for the computer, so they all performed the lesson with equal success. The middle school children did more "playing" with the program - randomly trying things to see what happened. Many of them discovered the text and graphic editors and created some very unique signed pictures of "Men on Mars". The older students tended to stick more to the confines of the written lesson and did less freelancing in other parts of the program, but did make some very sophisticated interpretations of the imagery they worked with.

In general, I feel all the students learned that a photograph is not a siple picture, but can allow much sophisticated information to be extracted by the astute observer. What with modern movies (and some very bad political ads in this year's election campaigns) most students are aware that imagery can be manipulated, but, through this exercise, they found out that the manipulations can be used to interpret good photos, as well as to improve marginal images for better interpretation. And, in the end, everyone was able to decide if the round feature was an impact crater or not, who wore the shirt that was worn by the suspect in the video at the crime scene, or whether the haze in the air was a natural or manmade phenomena.

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