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THE USE OF COMPUTER MODULATED DRAWING
IN THE TEACHING OF ART

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Abstract

A hardware-software process is described which automatically creates computer modulated drawings from an artist's own works. The process allows a drawing to act as a constant source of data for a series of renditions of it in widely varying styles. As a result a student of art can study the effects of line structure, line quality, and pen stroking style in rendering truly constant subject material.

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The figures shown in this paper are examples of "Computer Modulated Drawings". They were derived from a single source drawing and were produced by software developed by Williams [1] to allow artists to use a computer as a tool in rendering their own work. The process uses a Visicon Automatic Digitizer [2] to convert a hardcopy drawing into digits which are then manipulated by graphic collation software [3,4] into data structures which isolate and mathematically describe the geometry of the various lines which compose it. These data structures may be used as a direct source of commands for a digital plotter. Modulation occurs when the mathematical descriptions themselves are dynamically perturbed at the time of plot generation.

The simplest form of modulated art is no modulation at all, and the results are a faithful pen and ink reproduction of the original drawing. Heavier modulation, results in a work which retains the general holistic form of the original but which has been rendered in a completely different style. The process is totally automatic and rapid, requiring (for the figures shown) roughly two minutes for digitizing, four minutes for graphic collation (on an IBM 370/158) and twenty minutes for plotting. Graphic collation times are roughly linearly proportional to the amount of line data present, and plotting times vary with the complexity of modulation. The entire system is parameterized and does not require a knowledge of computer programming. Each type of modulation is coded by number, and the degree of perturbation is specified by such variables as amplitude and spatial frequency.

The value of computer modulated drawing to the teacher of art is derived from a capability for allowing a drawing to serve as a single and constant source of data for an indefinite number of variants to it. This permits the detailed
and parameterized study of the visual effects achieved by varying line structure, 
line texture, pen stroking style, etc. in rendering truly constant subject material. 
Such renditions are not possible by hand, for subtle localized changes in style 
will inevitably be introduced by the human while redrawing subjective material.

In essence the computer modulated drawing process provides the art teacher 
with the facilities of a computer darkroom with which to study the effects of 
different drawing styles on various subject matter. The source data for these 
studies may be carefully chosen archival works or they may be spontaneously 
selected drawings from the class itself. The speed of the computer based process 
insures that results will rapidly be forthcoming even in the case of the most 
complex and tediously structured design patterns.

The times required by computer modulation are currently largely a function of 
plotter speeds. Consequently the substitution of a display scope for a mechanical 
plotter can yield faster, though perhaps visually degraded, results. The plotter, 
of course, can manually be controlled in its employment of ink color and pen 
widths. The same data may be repeatedly plotted to yield high quality results on 
differing grades of paper.

The computer modulation process was expressly designed to give the artist the 
benefits of a computer while allowing him to perform much of his work in his 
acclimated environment unfettered by the mechanical and electronic constraints 
often associated with machines. He prepares his work at his leisure using 
standard art supplies of his choice. When he has finished he secures his drawing 
to the surface of a drum which is mechanically rotated past an optical sensing 
mechanism which records black and white decisions based on the amount of light 
reflected from the document. Placement of the drawing on the drum requires roughly 
one half minute and needs no special mechanical aptitude. Digitization proceeds 
atomatically and is completed in at most two minutes.
The digitizer output is fed to a computer which then creates the geometrically
descriptive data structures. Modulation begins when the modulation parameters
have been specified. The results are plotted mechanically on paper or electronically
on the face of a cathode ray tube.

A typical hardware configuration may include a digitizer, incremental plotter,
and display scope connected to a minicomputer which can communicate with a larger
general purpose computer. The current graphic collation and modulated drawing
software system resides in 160K bytes of IBM 370/158 memory but hopefully future
systems will totally be resident within the minicomputer itself. It is envisioned
that future systems will incorporate computer graphics facilities which will allow
an artist to manipulate and modify his drawing interactively.

The art teacher can employ such equipment throughout his domain of expertise
in attacking problems in drawing and, hence, in the photomechanical print (etching,
lithograph, and silk screen). Beginning students can study the effects of style
on rendering simple subjects, and advanced ones can selectively incorporate
widely varying modulation techniques in creating arbitrarily complex works. The
full power of computer graphics can be invoked to assure that pleasing localized
effects on a drawing are not destroyed while others are being developed elsewhere.

In short the computer modulated drawing process provides the teacher of art
with a new and exciting tool with which to work. The computer is involved in
its appropriate domain of tedium, and the artist retains his dominance in
creativity. Though the system is mechanical, the results need not have a mechanical
appearance.
Flower modulated by a "needlepoint" technique involving gridding on a coarse mesh
Flower modulated by a beaded pattern
created by a mosaic of small squares
Flower modulated by a Myers [5] box pattern consisting of overlapping deformed rectangles
Flower modulated by a "woodcut" technique using Myers box patterns of zero width
References


5. Myers, Eugene D., Computer Science Department, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061, U.S.A.