

cart lab bulletin board

THE PLACEMENT OF POINTS IN FREEHAND PATHS

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Illustrator 88 (Adobe Systems, Inc.) and FreeHand (Aldus Corp.) are powerful PostScript drawing packages that are widely used by graphic designers, including cartographers. Illustrator was introduced in 1987 for the Macintosh and has recently been ported to MS-DOS platforms. New versions for UNIX platforms (NeXT and Sun) have also been announced. FreeHand, a copy-cat program, is currently available for the Mac only. The packages are similar in functions and 'look and feel,' but important differences exist. This note will deal with what may be FreeHand's most important shortcoming and will suggest how users may minimize difficulties.

About 90 percent of the projects coming through the Deasy GeoGraphics Lab are dispatched with FreeHand 2.02. Our typical products are black and white information graphics printed by imagesetter for journal publications and color 35mm slides for professional and classroom presentations. We find FreeHand preferable to Illustrator because of its superior typographic functions, its avoidance of Illustrator's awkward separate drawing and preview modes, and its explicit layer control functions. FreeHand looks very bad in comparison, however, when it is asked to 'close' complex 'paths.' Some background information on PostScript seems in order here.

The problem of complex closed paths

A 'path' is an object in the PostScript language that consists of a

collection of points or curves. Paths may be 'stroked' (points connected with a line of definable weight, pattern and color) and 'filled' (interior areas washed with definable patterns or color), among other things. Only 'closed' paths (identical first and last points) may be filled. Several factors impose upper limits on the complexity of a closed path: the PostScript language itself, the operation of particular PostScript drawing programs, and the raster image processors (RIPs) that transform PostScript files into bitmap images that laser printers can print. The current implementation of PostScript allows a maximum of 1500 points in a path. The FreeHand program will not allow paths of greater than 1000 points. Our experience has shown, however, that FreeHand files often bomb with a PostScript 'limitcheck' error when we try to print closed paths of as few as 500 points. Illustrator 88 (we run version 1.8.3) solves this problem by automatically subdividing an excessively complex closed path into linked subpaths of manageable size.



Figure 1: The FreeHand toolbox with the freehand tool selected.

The problem that motivated this study confronted us the first time we used FreeHand. We were staging a 'John Henry test' in which one project was to be rendered by two cartographers: one using established photomechanical techniques (John Henry) and another using FreeHand on the Macintosh (the steam shovel).

That time, John Henry won. The FreeHand document was rendered long before the scribing and type stickup were complete, but we couldn't print it! We made several phone calls to Aldus' technical support department, and mailed them a copy of our file. We were informed that there are no plans to incorporate a path subdividing feature like Illustrator's into future versions of FreeHand. We considered switching to Illustrator, but decided that FreeHand's strengths outweigh (marginally) this weakness. Once this decision was

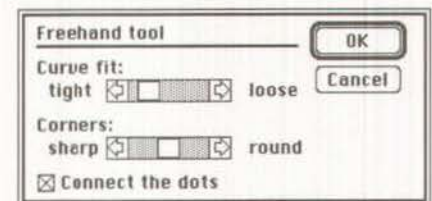


Figure 2: Freehand tool options dialog box. Curve fit option is set at position 2, corners option at position 3.

made, we initiated a small study designed to reveal what factors determine the number of points in a path. What we have learned has helped us avoid unnecessarily complex closed paths in routine production.

A few words on how paths are generated in FreeHand: Nine drawing tools are provided in Freehand's 'toolbox' (Figure 1). The four 'basic shape' tools allow the user to generate square- and round-cornered rectangles, ellipses and lines with a minimum number of points. The more powerful class of drawing tools is the five 'freeform tools.' Four of these — the combination, curve, corner and connector tools — require the user to perform a mouse click to place each point in a path. The 'freehand' tool allows the user to click the mouse button and drag the screen cursor, tracing a path in a continuous hand movement analogous to drafting or scribing (note that in the following 'Free-



Figure 3: Scanned drawing template used in the study (32 percent of original size)

Magnification Level	Curve Fit Setting				
	tight 1	2	3	4	5 loose
800%	8915	3783	1995	1376	1135
400%	2493	904	771	649	626
200%	1578	587	550	523	490
100%	930	324	300	281	283

Figure 4: Number of points placed in test drawing as a function of magnification level (view size) and curve fit setting.

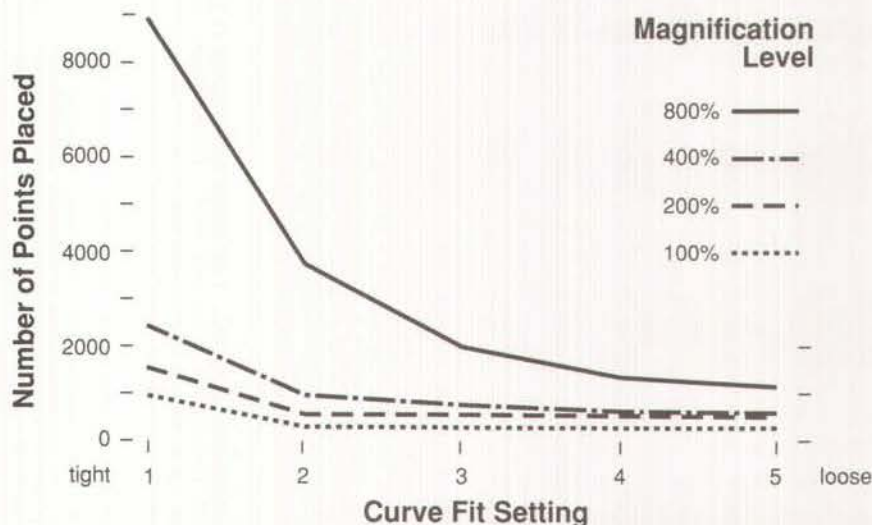


Figure 5: Observed effects of magnification level (view size) and curve fit setting on number of points placed in freehand paths.

Hand' refers to the entire drawing program, while 'freehand' refers to a particular kind of path). Points are placed along freehand paths by the program, not by the user. The number of points placed along freehand paths varies as a function of 1) the magnification level (view size) at which the path is created, and 2) tolerance levels set in the freehand tool options dialog box (Figure 2).

FreeHand provides seven view size options. A drawing may be viewed and edited at actual size (100 percent), or at 200, 400 or 800 percent magnifications, as well as reductions to 50, 25 and 12.5 percent. Since users are unlikely to edit drawings from a reduced view, we only evaluated the program's performance at 100, 200, 400 and 800 percent view sizes.

The freehand tool options dialog box appears when the user double-clicks on the freehand tool icon in the toolbox. Two parameters can be adjusted. The 'curve fit' parameter controls the sensitivity of the program to the user's movement of the mouse; a 'tighter' setting in the curve fit scroll bar sets a tighter tolerance value and causes the program to place more

points along a freehand path. The 'corners' scroll bar controls the program's angle detection sensitivity; the 'sharper' this option is set, the sharper an angle must be before a point is placed at its vertex. Although the scroll bars are continuously variable, we evaluated their influence on point placement by limiting their variability to five positions: far left (position 1), middle left (position 2), center (position 3), and so on.

Effect of view size and the curve fit parameter

The FreeHand manual suggests that the curve fit parameter affects the number of points placed along a freehand path, but we learned only by experience that view size is a second independent variable. To derive an approximation of the functional relationship between these variables, one operator drew a cartographic shape twenty times (four view sizes times five curve fit settings; corners option held constant at position 3) and observed the number of points placed in each case (provided in FreeHand's 'element info' dialog box). We used the same shape that crashed FreeHand in the John Henry test: the highly articulated Island of Newfoundland. The shape was compiled at 1: 2,980,000 scale onto drafting film with a .012" technical pen and scanned at 600 dpi resolution using an HP ScanJet desktop scanner. The scanned drawing template is presented as Figure 3 (unfortunately, space limitations require that all examples be reproduced at 32 percent of original size).

The number of points placed in each drawing as a function of view size and curve fit setting is given in Figure 4, and the function is graphed in Figure 5. These results demonstrate that the combination of the highest magnification level (800 percent) and tight curve fit settings results in a very large increase in the number of points

placed in freehand paths relative to lower settings.

Figure 6 presents four sample drawings (at 32 percent of original size): 6a shows the shape that resulted when the scanned template was traced at 100 percent view and loose curve fit (position 5). FreeHand placed only 283 points in this path. The visual impact of the semi-controlled generalization that has taken place is unfortunately minimized in this reduced example. Figure 6b shows the other extreme: at 800 percent magnification and curve fit at the tightest setting, 8915 points were placed. If a user wished to close this path, it would have to be *manually* subdivided into about eighteen subpaths — an ugly chore. Many of the points placed in such a path contribute little to the fidelity of the drawing to the template. Figure 6c, drawn at 400 percent magnification and curve fit setting 1 (tight), compares favorably to 6b, though it is comprised of only 2493 points — 28 percent as many as 6b. Only 904 points (10 percent of the number placed in 6b) were placed in the path displayed as Figure 6d, which was drawn at magnification level 400 percent and curve fit setting 2 (moderately tight). Actual size segments of paths rendered at 800 percent magnification, curve fit 1 (Figure 7a), 400 percent magnification, curve fit 1, (Figure 7b) and 400 percent magnification, curve fit 2 (Figure 7c) are presented for comparison.

The appropriateness of the effect on line character resulting from these adjustments must be assessed on a case-by-case basis. However, we can advise that by avoiding drawing at 800 percent magnification, FreeHand users are likely to experience less difficulty in closing complex paths and noticeably fewer PostScript limitcheck errors when trying to print them.

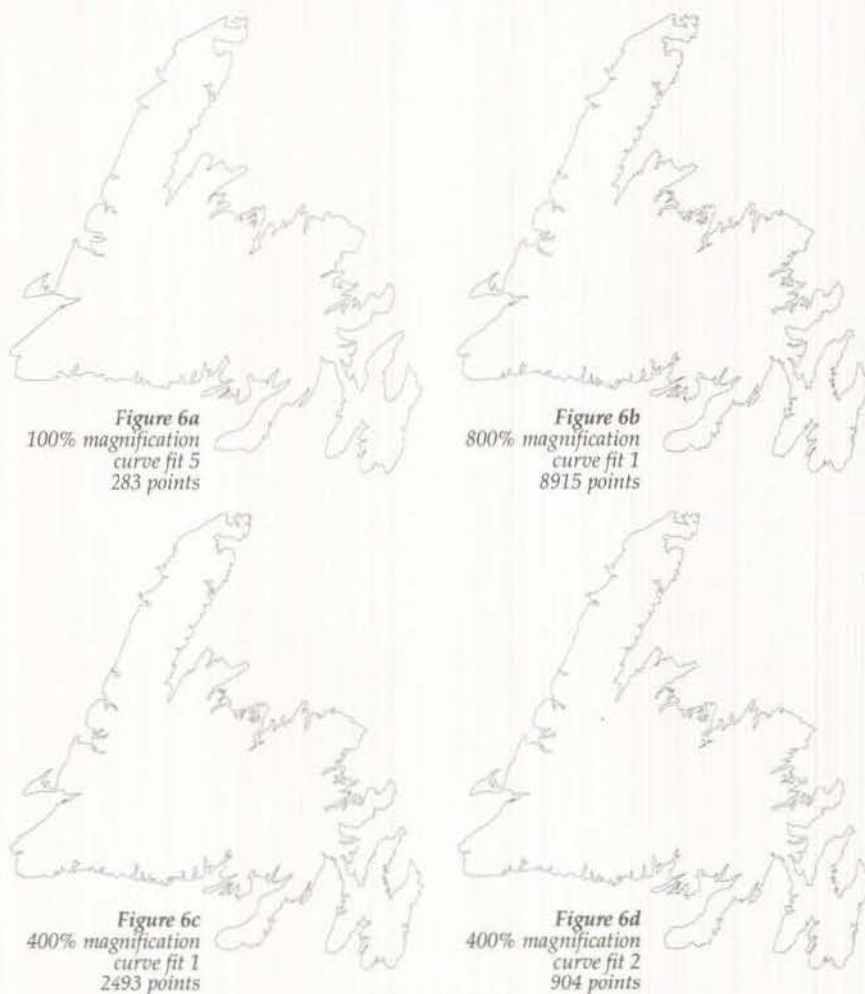


Figure 6: Effects on line character of variations in magnification level and curve fit setting (32 percent of actual size).

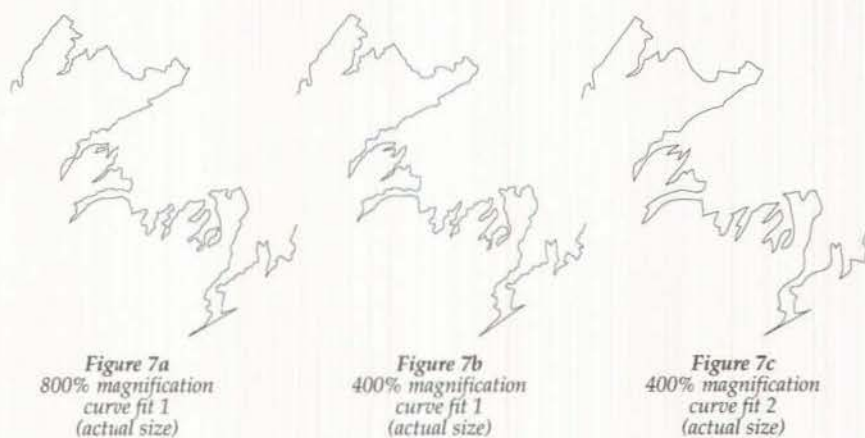


Figure 7: Effects on line character of variations in magnification level and curve fit setting.

Effect of the 'corners' parameter

We also considered the effect of the corners parameter on the quantity of points placed by the program, though we did so in a

more limited way. At 400 percent magnification and tight curve fit (setting 1), we observed a 30 percent increase in the number of points placed when the corners

scroll bar was set at position 5 ('round' — 2770 points) as compared to position 1 ('sharp' — 2125 points). Compared to the nearly 400 percent difference in the number of points placed as a function of curve fit settings at this magnification level, the effect of the corner option is relatively slight.

Summary

FreeHand is a powerful Macintosh-based PostScript drawing package of proven utility in the design and production of maps and other information graphics. Its worst shortcoming is its inability to process closed paths of greater than approximately 500 points. The placement of points along paths created with the freehand tool is determined by the software, not directly by the user. The number of points placed in a freehand path varies as a function of the magnification level at which the drawing is made, the 'curve fit' tolerance set in the freehand tool options dialog box, and (to a lesser extent) the 'corners' option setting. The drawing technique of individual operators probably has an effect also, but this factor was not evaluated. In general, we recommend that users avoid creating freehand paths at the highest level of magnification (800%). This procedure will not eliminate PostScript limitcheck errors resulting from overly complex paths, but it will minimize the number of manual path subdivisions required. Aldus Corp. — the developers of FreeHand — ought to incorporate the automatic path subdivision feature that Illustrator 88 users take for granted into future revisions of their software. This shortcoming makes it hard for us to justify our continuing preference for FreeHand.

PRIVATE SECTOR PROFILE: FERGUSON CARTOTECH

Ann K. Deakin, Ferguson Cartographic Technologies, Inc.

Ferguson CartoTech (Ferguson Cartographic Technologies, Inc.) is a Texas-based, privately held corporation that provides digital conversion, custom cartography, and map drafting services to the private and public sectors.

Ferguson CartoTech was founded in 1907 as the Southwell Map Company. It became Ferguson Map Company, Inc. in 1947 when M.L. Ferguson purchased the business. In 1976, Warren Ferguson joined the family business and determined that the company's focus should shift toward automated mapping technology and services. Subsequently, an Information Services division dedicated to AM/FM and GIS was established in Houston to supplement the San Antonio-based Cartographics and Infographics divisions. In 1986, Ferguson Cartographic Technologies, Inc. was established when the divisions were merged. Ferguson CartoTech's headquarters are now located in northeast San Antonio, Texas and employs 130 professional and technical personnel skilled in geography, cartography, graphic design, computer science, and engineering.

Ferguson CartoTech is committed to providing high quality cartographic products and, as a result, has achieved a reputation as one of North America's leading providers of cartographic services and AM/FM and GIS conversion services. Ferguson CartoTech is currently providing conversion services to Texas-New Mexico Power Company, Salt River Project Thunderstone Division (Geography and Facilities), Jersey Central Power and Light, South Central Connecticut Regional Water Authority, City Electric System of Key West, Monroe County Prop-

erty Appraiser, Southern New England Telephone, Pacific Bell, Bexar Appraisal District, and Rand McNally. Ferguson CartoTech also provides mapping services to Northside and North East School Districts, Houston School Districts, Metropolitan Transit Authority of Harris County, VIA Metropolitan Transit, City of San Antonio, GTE, Southwestern Bell, and a variety of other regional organizations.

GLOBAL COMMONS DATABASE

Environmental impact statements (EIS) are used to document the effects of governmental actions on areas under U.S. jurisdiction. However, there is no agreement on how impacts from such actions should be documented in areas of the world beyond territorial boundaries. These unclaimed territories (generally in the oceans) are termed the "global commons." In 1978, Presidential Executive Order 12114 made the U.S. responsible for actions taken in the global commons; ensuing regulations (DoD 6050.7 and AR 200-2) made this official Department of Defense and Army policies.

The Army conducts activities within the global commons. It has asked the U.S. Army Construction Engineering Research Lab (USACERL) to develop a way to evaluate the environmental effects associated with such acts.

Data necessary for analysis of proposed Army actions have been identified, and are being acquired and input to USACERL's 'GRASS' Geographic Information System. GRASS programs will be used to model the execution of proposed alternatives, allowing their effects to be compared. Relevant global data include vegetations, soils, bioproductivity, sensitive species, oceanography, topography, climatology, demographics, economics, cultural concerns, fisheries, and other data.

In the process of evaluating environmental constraints on activities undertaken in the global commons, USACERL has accumulated an extensive digital global dataset, with potential users for many applications. For further information contact: Robert C. Lozar, USACERL, (217) 373-6739, ext. 739.
(*Grassclippings* 3:3, Fall 1989)

DMA/ESRI GLOBAL DATABASE

The Defense Mapping Agency (DMA) announced that it has awarded ESRI with a \$10 million contract to develop a 'digital chart of the world.' The project will begin immediately and is scheduled to be completed by December 1991.

The project will involve putting a 'complete' digital map of the world (utilizing the Operational Navigational Charts developed by the DMA as a source material) onto CD ROM. The final product will allow users to access the data using personal computers.

The project is composed of two stages: a prototype stage and a production stage. During the prototype stage, ESRI will research and develop data structure tools, building on the knowledge and experience ESRI has put into its ARC/INFO GIS software. The second stage of the project will be the full-scale production of the world database. ESRI will scan and process the entire ONC series (270 charts) maintained by the DMA.

For more information contact: Karen Hunter, Environmental Systems Research Institute, (714) 793-2853 ext. 582.

LOUISIANA COASTAL GIS NETWORK

The Louisiana State University (LSU) has received a \$200,000 award from the U.S. Geological Survey to develop a computer

network that will allow various universities and agencies to share information on Louisiana's coastal land loss.

The Louisiana Geological Survey and both LSU's Department of Geography and Anthropology and Computer-Aided Design and Geographical Information System (CADGIS) Research Laboratory are cooperating on the project. LSU officials expect the one-year award to be continued for four more years, for a total award of more than \$1 million.

Louisiana accounts for 80 percent of the nation's lost wetlands and is being looked at carefully by coastal planners around the world, said Don Davis, project coordinator with the Louisiana Geological Survey at LSU. "Louisiana's problem will be the nation's problem and the world's problem," said Davis.

The five-year cooperative project, known as the Louisiana Coastal Geographic Information System Network (LCGISN), is part of an ongoing U.S. Geological Survey study of coastal erosion and wetland loss throughout the country. Major projects are also underway in the Great Lakes region, along both the east and west coasts and along the Mississippi-Alabama coast.

Goals for the network include:
— Improving communication among coastal researchers, planners, universities and local, state, and federal agencies;
— Identifying where coastal information is available, simplifying the way the data are organized, incorporating it into the new system and sharing data among system; and
— Eliminating duplication of research efforts.

For further information, contact: Chip Groat or Don Davis at (504) 388-5320, Randolph McBride at (504) 388-8612, or Clancy Soileau at (504) 388-8654.
(*LSU News Service*)

FUTURE NAUTICAL CHARTS TO BE METRIC

The National Ocean Service (NOS) is planning to produce future nautical charts referenced to metric rather than English units. This is due in part to the Omnibus Trade Act of 1988 which establishes the metric system as the preferred system of measurement in U.S. trade and commerce. The act gives federal agencies until 1992 to adopt the metric system in their business dealings.

The offshore and coastal charts now published in fathoms will be converted to meters first, and those in feet and fathoms will be retained until total conversion is complete. No dual publications of feet and meters will be possible. At present no definite timetable for the conversion has been established. During the conversion period, NOS will make an effort to educate users on the advantages and use of the metric system.
S.C. Cartographic Information Center Bulletin (Summary 1989)

fugitive cartographic literature

Interesting articles about cartographic information often appear in unexpected outlets. The goal of this section is to bring those publications to the attention of our readership. We invite synopses of papers appearing in journals other than those devoted to cartography, geography, and map librarianship.

Rossano, Matt J. and Warren, David H. (1989) Misaligned maps lead to predictable errors.
Perception, 18:2, pp. 215-229.
reviewed by Pat Gilmartin, University of South Carolina

The authors of this article conducted three experiments to investigate subjects' abilities to judge direction when using misaligned maps; that is, maps on which the top, or "up," does not correspond with forward, or