NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

February 27, 1986

TO: NRAO CAD Users

FROM: H. Dill

SUBJECT: General-Notes on Use of CAD

Introductory Notes

Recently NRAO has purchased several copies of Autodesk's Autocad software and a numerically controlled milling machine. These items are powerful tools for use in the design and manufacture of parts. For these tools to be effectively used, it is going to be important that users be aware of recommended practices and support available within or external to NRAO. One method of doing this is to set up a network of users within NRAO that would be linked through a monthly or bimonthly memo. Such a memo series would outline CAD (computer-aided design) uses and their status in development, system problems, system requirements and user input.

For such a system to be successful it will require a series of memos with short concise outlined entries addressing the issues at hand. The source of each issue would be noted such that any interested parties could contact the source if the details were lengthy. Eventually a series of documents would exist from which standard practices and specifications could be generated.

CAD systems of various sorts have been in use at NRAO for quite awhile. Usually they were local systems for handling discrete tasks such as wire wrap boards, mask traces or schematic layout. As these systems advanced, especially in the areas of transferring information from one system to another, so did the complexity of the systems. Computer drafting is one example of such a system. On a local level standards can be set up by the user, but when the drafting system is capable of connecting to a milling system certain requirements will need to be met. This is where standards will have to be developed.

At first this series will deal with Autocad and the Index milling machine controller. The decision to use Autocad software was decided because it is most popular and best supported software on the market. This will change with time and at some point NRAO might want to use another type of software.

CAD Notes

1. Autocad system (minimum total cost ~$4000).
    1.1. Software costs $2025.00.
        1.1.1.   ADE-3 version.
    1.2. Digitizer tablet costs $400-800.
        1.2.1.   Digitizer is recommended, but not required.
    1.3. Computer costs $2000-4000.
        1.3.1.   Hardware may already be purchased.
        1.3.2.   Hard disk and numeric co-processor are recommended.
        1.3.3.   Software versions exist for the AT&T computer that will not
                  run on the IBM, but the IBM will run on the AT&T version at
                  reduced resolution.
        1.3.4.   Color monitor optional, contact DS-gb.
    1.4. Plotter costs $4000-12000.
        1.4.1.   Plotter can be shared by several users.
    1.5. Optional equipment
        1.5.1.   Text editor software for modifying menus etc.
        1.5.2.   Extra serial port for plotter or digitizer.
    1.6. For more information contact HD-ir, GM-ir or DS-gb.

2. Autocad system uses.
    2.1. Two dimensional drafting.
        2.1.1.   ADE-3 version offers limited 3 dimensional capabilites. This
                  is an area where at a future date another software or an update
                  should be considered.
        2.1.2.   Autocad offers a wide area of possibilities in this area.
                  These will be discussed in detail as separate notes.
    2.2. Generating silkscreen artwork.
        2.2.1.   Software to produce helvetica type letters up to 1/2 tall has
                  been purchased by GM-ir.
    2.3. Generating printed circuit boards.
        2.3.1.   This feature has not been fully explored yet. The software
                  has provisions for creating shape files that can be used to
                  generate PC entities. Several plotters can support ink pens
                  that can plot on mylar, or there exist several third party
                  sources that will transfer Autocad files to photoplots. This
                  area needs to be investigated.
        2.3.2.   Features such as auto routing are not available on Autocad,
                  but are to some degree on other software specifically for PC
                  layout.

3. N/C Milling machine.
    3.1. The system installed in Greenbank consist of a Wells Index mill and a
         Heidenhain TNC 155 controller. In addition a IBM XT computer is used
         in conjunction with some part programming software by PMX called XL/NC.
         This software allows drawing generated by Autocad or Cadkey to be
         processed and transferred to the mill. Contact FC-gb for more information
         on the present status of the NC mill.
        3.1.1.   The machine is capable of cutting 2-D profiles described by a
                  equations containing sines, cosines and variable raised to a
                  real number. Such a curve is used in the ortho mode transition
                  on the 1.5 GHz front end.

3.1.2. Bodies for the 8.4 GHz and 5 Ghz amplifiers have been programmed and made succesfully using the Heidenhain controller to input the programs.

3.2. Cadkey drafting software was supplied as part of the machining package. It is a new competitor to Autocad and will be compared with Autocad as we use it more.

3.2.1. A translator package should allow Autocad drawing information to be used by the mill.

3.3. Part geometry is transferred from the drafting package to the machining software, XL/NC. This is in turn processed by the machine operator to determine cutting sequence etc... and then sent to the milling machine.

3.3.1. This requires that drawings to be made on the mill follow a format that is most efficient for the operator to use. For example all holes on one layer, geometry outline on another etc... More information on this aspect needs to be determined.

3.3.2. Milling machine programs will be stored on the IBM and downloaded to the mill.

3.3.2.1. The software for connecting the mill controller and the IBM has a few bugs to iron out.

3.4. The VLA shop is interested in purchasing a Hurco KM3XB CNC 3 axis milling machine.

4. Drawing conventions.

4.1. Computer drafting (CD) creates several new filing problems.

4.1.1. File naming.

4.1.1.1. Issued drawings should be stored in a directory for the project number. These can be backed up on disks by directory.

4.1.1.1.1. File name would be the (drive):\(project number)\Z(type)(sequential number).DWG for example c:\53200\ZM004.DWG. \(note in actual use not all this information needs to be supplied.)

4.1.1.2. The "Z" will be a new drawing size that means a computer drawing. Plotted drawings that are issued will be stored as master drawings and issued their own drawing numbers. Thus several drawings can be generated from one computer drawing.

4.1.1.3. Working drawings can be kept in a temporary directory that is maintained by the user.

5. Drawing practices.

5.1. All drawings should be done full size. Information passed to the other programs uses the vector information stored by Autocad.

5.1.1. Dimensions that appear on the print that do not reflect the actual vector length should be noted if the drawing information is to be used to generated NC mill programs.

5.2. Use of the POINT command seems to be the easiest method of part layout.

5.2.1. A layer called PT is used to set up a reference grid for laying out the part.

5.2.2. Points are set up, and can be reference for locating additional points.

5.2.3. For more info contact GM-ir.

5.3. Digitizer menus.

5.3.1. Digitizer menus are available from third party sources, and are fairly easily written.

5.3.2.   For NRAO's use it may be to our advantage to define a standard configuration of the tablet and then adapt menus to fit this configuration. This would allow menus to be quickly switched for different applications.

5.4. Title blocks

5.4.1.   Several sites already have title block printed paper. In this case it is best to print drawings on paper and fill in the title blocks by hand.

5.4.2.   For other cases the title block should be brought into the drawing as a block scaled to the plotted size. In this way each plot has the potential of becoming a master drawing. For more info contact GM-ir.

6.   Problems.

6.1. Printer interfaces

6.1.1.   The Okidata printer with the IBM plug and play board does not work with the Epson FX printer plotter driver supplied by Autocad. A modified version exist contact GM-ir for info.

6.2. Plotting

6.2.1.   Use of the poly line command leaves a semi-circular dot (pen diameter) as the final point on the polyline. This needs to be considered when doing critical trace work. It seems to be a problem in the plot routine that places the pen down at the final point.

6.2.2.   Ink on mylar plots are possible, but take a fair amount of effort and care to do. It is best that one person at each site become proficient at ink plots and that several jobs be run consecutively if possible. Contact GM-ir for more info.

Names and phone numbers of initials used are as follows:

FC-gb	Fred Crews	Green Bank	GB-215
DS-gb	Don Stone	Green Bank	GB-203
HD-ir	Harry Dill	Ivy Road	CV-236
GM-ir	Greg Morris	Ivy Road	CV-289

Conclusion

In order for this memo series to work, we will have to have input from users. Information to be added to this series should be sent to Greg Morris (IR) where it will be filed and a summary of it listed in the next memo. As this information accumulates, we can start to formulate standards and guidelines for new users.

Distribution:

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