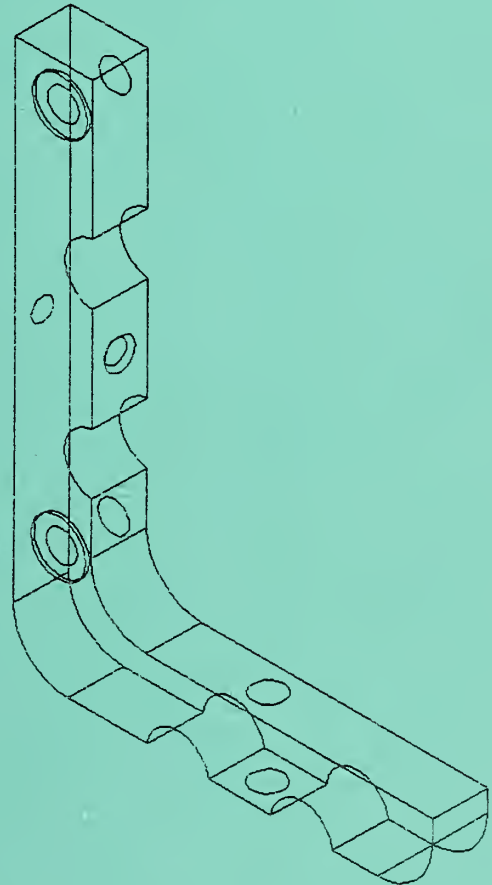NBSIR 87-3508

The Geometry Modeling System User's Guide

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Introduction

The Geometry Modeling System (GMS) is an interactive graphics program which allows the definition of features, functionality and tolerances of a part defined in the AMRF part model report format. [HOPP 86]. The system runs on a Silicon Graphics Iris™ and Sun Microsystems™ workstations. The geometry and topology of the part is previously created on a CAD system such as an IBM™ running CATIA™ with a conversion postprocessor to convert the data to the AMRF format. This data is subsequently read by the GMS, which expects the complete geometry and topology data and allows the user to define and modify the features and functionality of the part. Upon completion of a session the user can write out a full AMRF database report containing the modified part model data.

Layout

In figure 1 one can see the overall layout of the user interface. The mode and high-level area contain system control buttons. The entity manipulation area contains generic entity manipulation button. The text interaction area asks for and presents textual feedback and error messages. The menu area is where the dynamic menus appear. Finally the part display area is where the part model is displayed in a wire frame view(s).

When a part is loaded, it is displayed in the large part display area. Entities that are selected are highlighted in this area, which can be manipulated using the UNICAD™ [UNICAD 86] viewing subsystem. The text interaction area in the upper left of the screen displays messages, such as prompts and error messages, and is the area into which textual input is entered. The icons in the upper right provide high-level functions such as loading a part and exiting

GMS. Next to these is a *current mode* icon, which indicates the type of entity which is currently being used. This entitiy mode can be cycled by clicking the middle mouse button. Across the bottom of the screen are six icons which provide the actual function for the manipulation of entities. Currently copy is not implemented and edit merely deletes and then allows for the creation of a new one, providing no new functionality.

It is sometimes necessary for GMS to present the user a temporary menu. These menus are displayed on the left side of the screen, and selections are made from them with the left mouse button. GMS must also display or request

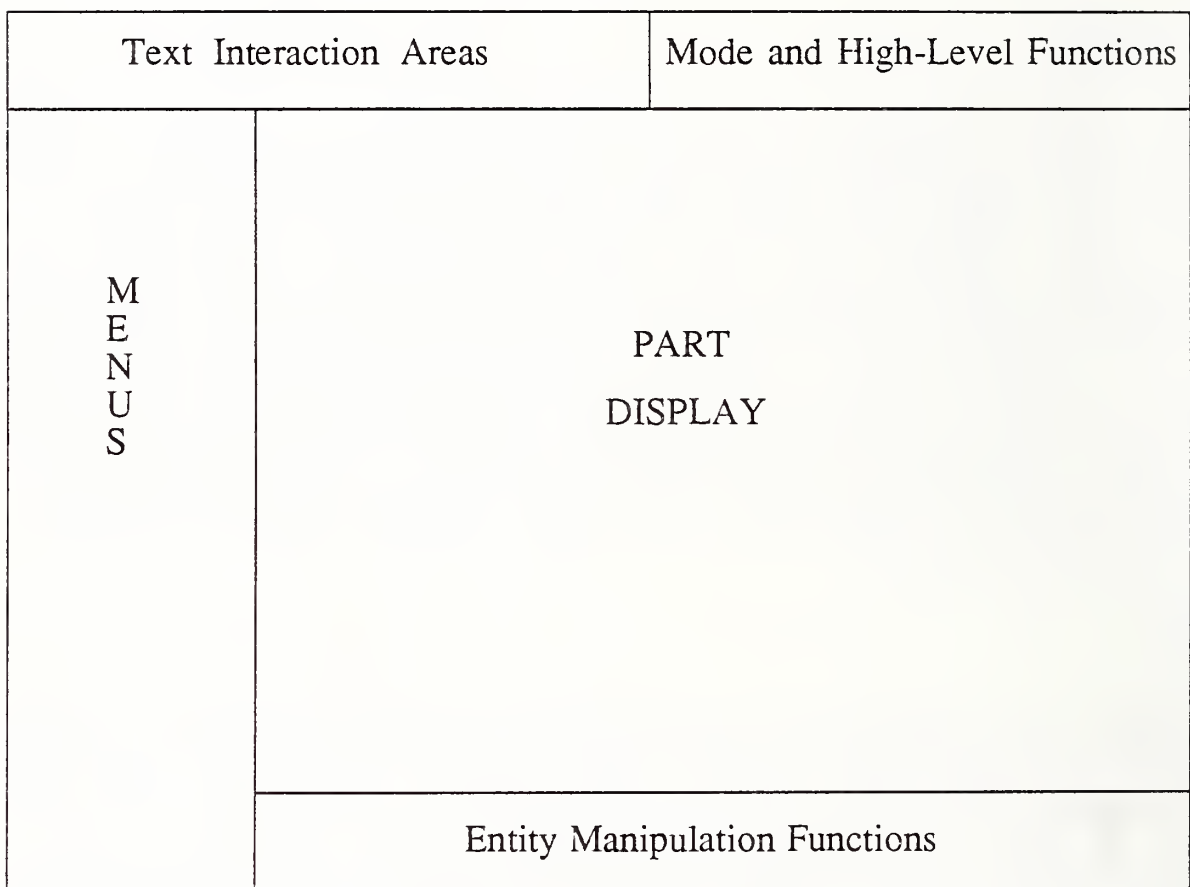| Text Interaction Areas	Mode and High-Level Functions
M E N U S	PART DISPLAY
	Entity Manipulation Functions

Figure 1. GMS Screen Layout

a large amount of textual data on some occasions (for example, to show the definition of an existing tolerance). When this occurs, a text window is temporarity displayed in the lower left corner of the screen. This window will obscure any portion of the part display which falls behind it, but the display will be restored when then window is no longer needed. See figures 2 and 3 for
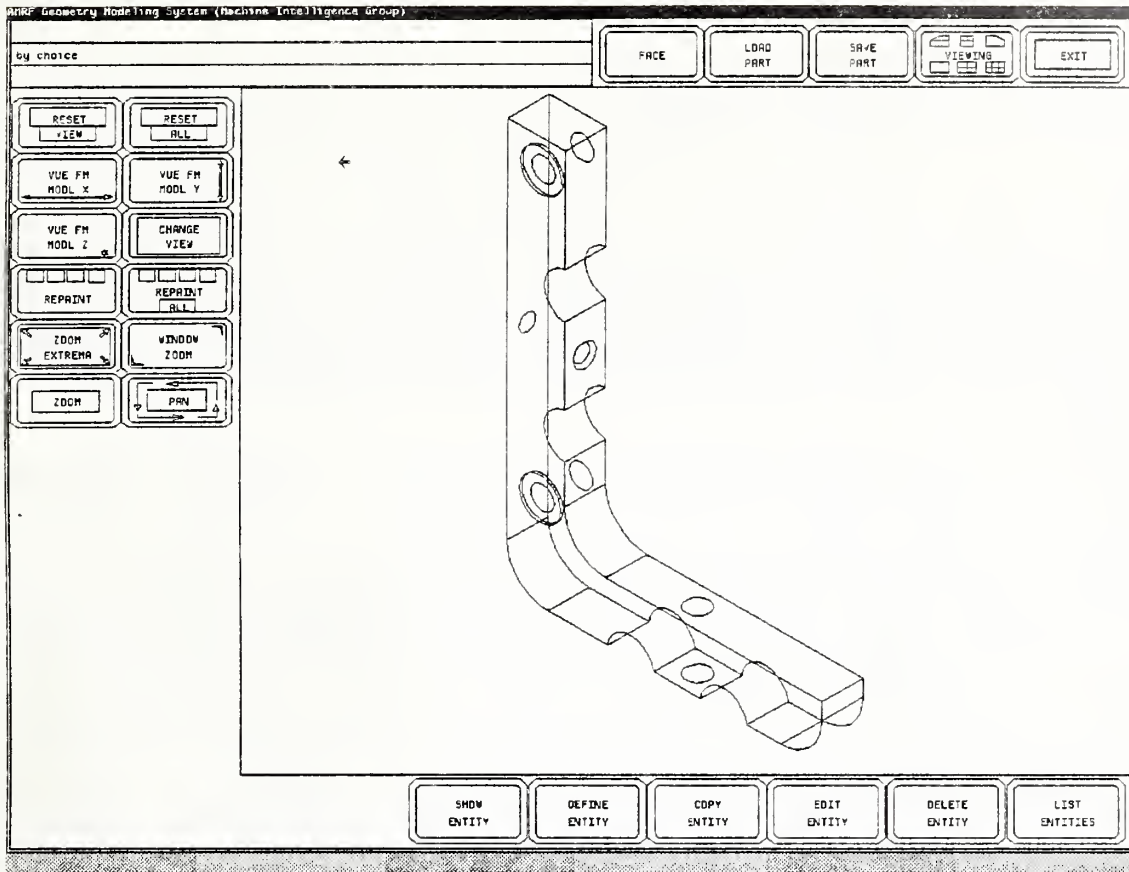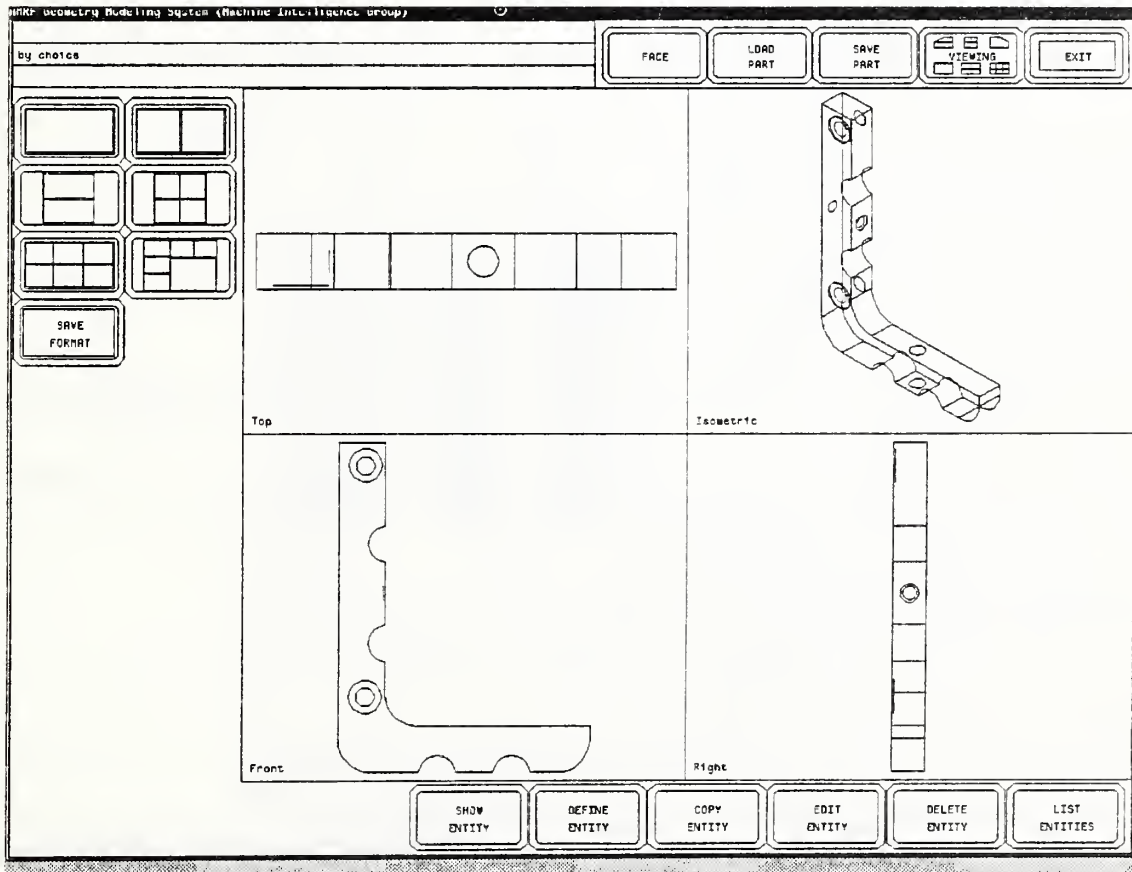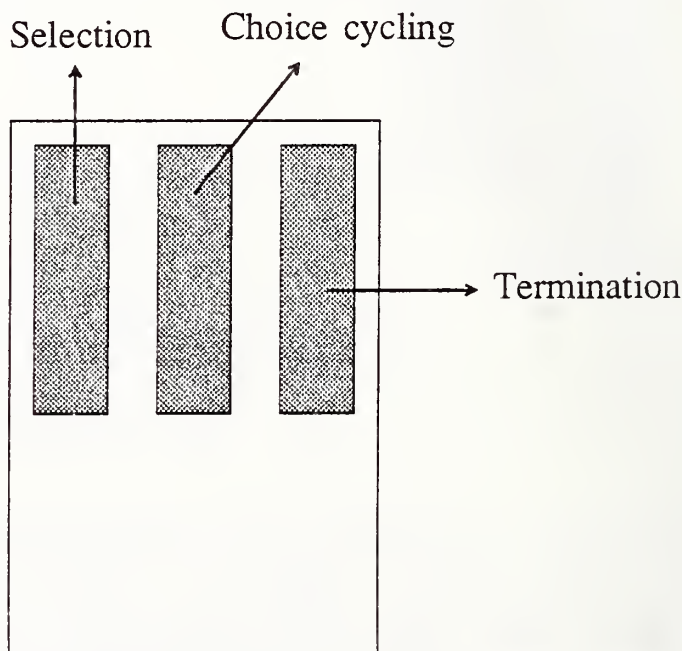
Figure 2

Figure 3

some example screen images of GMS.

Entities

GMS provides functions to create delete, and examine five types of entities: face (read only), features, datums, datum reference frames, and tolerances. These correspond exactly to the block in the AMRF part model report with the same names.

The most common function performed on an entity is picking. Entities can be picked in two ways: by text or graphically. Graphical picking is implemented for all entities except datum reference frames. To pick an entity graphically, position the cursor on one of the edges in the displayed object. GMS will make a guess as to which of the entities containing that edge is the desired one, and highlight the geometry associated with it. It will ask "Is this the correct <entity>?". If GMS has guessed correctly, simply answer 'y' or click on the left button, and the entity will be selected. Otherwise, answer 'n' or click on the middle button, and GMS will make a new guess. GMS will continue to cycle through the possible selections in this way until one is selected or until the right mouse button is clicked, which aborts the selection process. Note that the edges of a tolerance are considered to be those of the feature controlled by the toloerance.

This process of picking, system guessing and usercycling through the possibilities is used in many places in the system. The reason for this sometimes annoying process is that the only low level graphical picking implemented is on edges, i.e. line segments. Edges are always part of two faces, so the ambiguity must be resolved by giving the user a choice among the two faces, (when the entity being picked is FACE). The same ambiguity occurs with the other entities, as the edges are associated with an ambiguous entity choice and the user resolves the choice by cycling.

The system is icon-driven: all

Figure 4. GMS Mouse Button Conventions

of the functions required in normal operation are obtained by picking the appropriate icon with the mouse. A convention is maintained throughout the system with respect to the functionality of the mouse buttons (fig 4). The left button is always used to make selections: to pick an icon, make a selection from a menu, or select geometric and functional entities on the part. The middle button is used as a toggle: between input modes or through a list of possible choices. The right button is used to terminate or abort an operation: to signal completion of a form or the end of a list of selections.

High-Level Functions

There are four high-level functions available. Each is obtained by selecting the appropriate icon from the high-level function area. These icons are always present, and can be selected at any time. The available functions are:

Load Part — Parse an AMRF database report and display the part described. The user is prompted for the name of the file to be parsed, or for the part name if the AMRF database is available (future extention). The file is obtained from disk (or from the AMRF database), and is parsed and displayed. If a part is already in memory, the user is first asked whether to wipe out the existing part from memory. A response of 'n' aborts the load operation.

Save Part — If a part is currently in memory, the user is asked for a name under which to save it. Hitting return causes the default, i.e. the name under which the part was loaded, to be selected. The part is saved under the given name and, if the AMRF database is available it is informed of the presence of the new part (future extension).

Viewing — This option calls the Viewing subsystem provided by UNICAD. This system provides functions such as multiple viewports, various viewing angles, view scaling, and dynamic view transformations. For more information see the UNICAD documentation [UNICAD 86].

Exit — The user is asked to confirm exit. A 'y' response causes GMS to exit gracefully, while any other response leaves the user in GMS.

Mode Icons

Next to the high-level function icons is a single icon which displays the current entity type. Whenever an entity manipulation function is selected from the bottom row of icons on the screen, the type of entity which will be used is the type indicated by this icon. The current entity mode can be changed any time at the top level by clicking the middle mouse button. Any such change will be reflected by a change in the entity mode icon displayed. The entity mode cannot be changed in the middle of an entity operation, for example while creating a feature.

Entity Manipulation Functions

Across the bottom of the screen are six icons, which select functions which manipulate the various entities which GMS knows about. These icons are always present and can be selected at anytime when the cursor is displayed as an arrow or a plus sign. Each function looks at the current entity mode, indicated by the entity mode icon, to determine what type of entity to deal with. Note that the current entity mode cannot be changed from within one of these functions. The following functions are available.

Show   Repeatedly asks the user to pick an entity of the appropriate type and displays the definition of the entity picked. The definition is displayed until a key is struck, at which point another entity may be picked. This process continues until the user clicks the right mouse button when asked to pick an entity.

Define   Prompts the user for the various items of data needed to create an entity of the current type. If all data are entered correctly, the new entity is created and added to the database. Otherwise, the operation is aborted and no entity is created. Clicking on the right button at any time during the definition process also causes the operation to be aborted.

Copy   Not implemented at this time. This option will create a duplicate of a picked entity, asking for a new id for the copy.

Edit   The edit option is not fully implemented. Currently, an entity may be picked and is deleted from the database on confirmation. The

definition process for a new entity of the same type is then begun.

Delete   Entities of the current type can be selected and deleted from the database. Each selected entity is highlighted in red before being deleted, and confirmation is required to actually delete the entity. Selections can be made repeatedly until the right mouse button is clicked when a selection is expected, to terminate the deletion cycle.

List   Displays a list of the id's of all entities of the current type which are in the local database. The list remains on the screen until a key is struck.

Forms

GMS at times must read in a large amount of textual data. The mechanism through which this is done is a form. The low level utility implementing the forms functions are provided by UNICAD utilities. A form is displayed in the same location as the text window in the lower left corner of the screen. It consists of a set of prompts, which cannot be modified by the user, and a set of input fields, which the user is expected to fill in. There are two main types of input fields: text entry fields and toggle fields. A toggle field is one which has a limited set of values which can be cycled through by typing a period '.' on the keypad. A toggle field is indicated by an asterisk '*' at the beginning of its value. All other fields are for pure text entry: text typed when the cursor is in a text field is appended to the field's value (ctrl-U is used to clear a field). A field which has an exclamation '!' at the beginning of its value is mandatory and the form cannot be exited until a value has been entered for that field. Movement between fields of a form is accomplished with the up and down arrow keys, which operate in the obvious fashion. Hitting <return> also moves the cursor to the next field in a form. A form remains on the screen until the user clicks the right mouse button, at which point it is removed.

Keyboard Functions

There are several functions, not usually required in normal operation, which can be called from the keyboard at any time when text input is NOT expected. These functions are invoked simply by hitting the appropriate key on the keyboard. Functions callable in this manner include:

C	Print the current group technology code.
D	Start the UNICAD drafting subsystem
G	Enable the entering of a group technology code via a series of menus
M	Start the UNICAD modeling subsystem.
Q	Exit the current subsystem
R	Repaint the screen
S	Sleep for 2 seconds, useful for creating scripts of actions
T	Pick by text
U	Load a UNICAD .u file (UNICAD geometry format)
V	Save a UNICAD .u file (UNICAD geometry format)
Y	Window zoom (user defines rectangle whichs will fill viewport)
Z	Extrema zoom (bounding box of object fills viewport)

Implementation

The GMS was implemented on a Silicon Graphics Iris workstation. The system was written using UNICAD's M/P/E system. UNICAD's utilities provided subsystems which we incorporated into our application and also provided for the managment of low level functions such as device I/O. Another factor in using these utilities is portability. Most of GMS also runs on a Sun Microsystems workstation (with the associated performance sacrifices due to hardware differences). All of the code other than the UNICAD utilities were written in C under UNIX™. In addition, the parser [RESSLER 86] which interprets the AMRF part model report was written using LEX and YACC both of which are highly portable.

When running GMS on the Iris or Sun one may run it from within the window subsystem although it requires the full screen and cannot be scaled. This is useful because one may want to control other processes (such and network interfaces), and can simply push the GMS application window back and then work with the other windows.

References
[HOPP 86] Hopp, T., "AMRF Database Report Format: Part Model", Detailed specification of report format, syntax (BNF) and semantics. NBSIR in preparation.

[UNICAD 86] UNICAD, "Viewing Subsystem", M/P/E Reference Manual Release 1.0 Boulder, Colorado.

[RESSLER 86] Ressler, S. "Using the AMRF Part Model Report" NBSIR in preparation.

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☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

The Geometry Modeling System (GMS) is an interactive graphics program which allows the definition of the features, functionality and tolerances of a part defined in the AMRF part model report format. The geometry and topology of the part is previously created on a CAD system with the appropriate postprocessor to convert the data to the AMRF format. This data is subsequently read by the GMS which expect complete geometry and topology data and allows the user to define and modify the features and functionality of the part. Upon completion of a session the user can write out a full AMRF database report containing the modified part data.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

Boundary representation, computer graphics, CAD, CAM

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