

ROMULUS PRODUCT DEFINITION

Evans & Sutherland Computer Corp.  
December 14, 1984  
Document # 888E

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## ROMULUS PRODUCT DEFINITION

### INTRODUCTION

The ROMULUS Product is defined in this document. The Product is based on current programmable ROMULUS offering plus new interfaces to existing drafting and analysis packages and programming tools provided to E&S by Shape Data Ltd. The new ROMULUS product will be designed to meet the needs of the CAD/CAM marketplace by appealing to identified segments of the end-user and system builder marketplace.

There is one basic ROMULUS Product that fits every identified type of customer. This is accomplished by having each customer start with the same base module and then add other modules to meet his needs. All modules are described here as well as licensing, support, documentation, and pricing requirements. In this manner, the ROMULUS Product is easy to configure, sell and support.

### ROMULUS PRODUCT

The ROMULUS Product is a collection of product modules. It is based on the ROMULUS Kernel module which is required for all types of ROMULUS customer. Optional modules can be added to the Kernel module to provide a complete tailored product for the customer. The ROMULUS Product and optional modules are:

ROMULUS Kernel Module (required) - This is the base module and is required by ALL ROMULUS customers. The Kernel Module provides the foundation on which to build a tailored ROMULUS system.

User Interface Module (optional) - The User Interface Module, when coupled with the ROMULUS Kernel Module, comprises the new end-user configuration. It is in programmable form allowing the customer a broad range of alternatives. It provides the Menu and Keyboard Interfaces for PS 300 and Apollo and the ROMULUS Command Code for modeling, modifying, and interrogating solid models.

Exerciser and Tools Module (optional) - The Exerciser and Software Development/Integration Tools are provided to aid the customer in system integration and customization.

Sublicense Rights Module (optional) - The Sublicense Rights Module provides for sublicensing the ROMULUS system. When it is selected by an internal system builder, sublicense fees can be paid on a CPU by CPU basis or through a corporate agreement. Third party system builders must pay for sublicenses on a CPU by CPU basis.

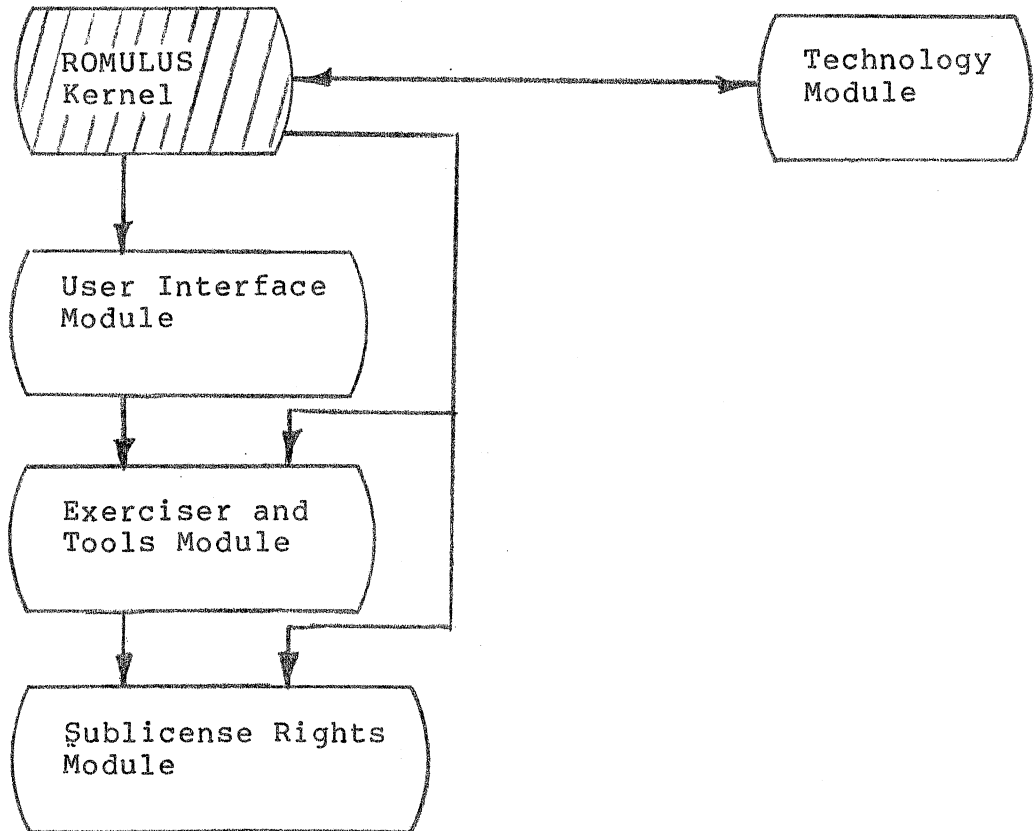


Figure 1 - Module Configuration Diagram

Technology Package Module (optional) - The ROMULUS Technology Module is a purchase of state-of-the-art solid modeling technology and includes full source for the ROMULUS system.

A. ROMULUS Product Configurations

1. ROMULUS End-User Product Configuration

The ROMULUS end-user would purchase the required ROMULUS Kernel Module and the optional User Interface Module. This would provide a programmable ROMULUS end-user system. Figure 2 is a diagram of the end-user system configuration.

End-user configuration license price -	\$ 38,000
Annual support fee -	\$ 7,700
Total -	\$ 45,700

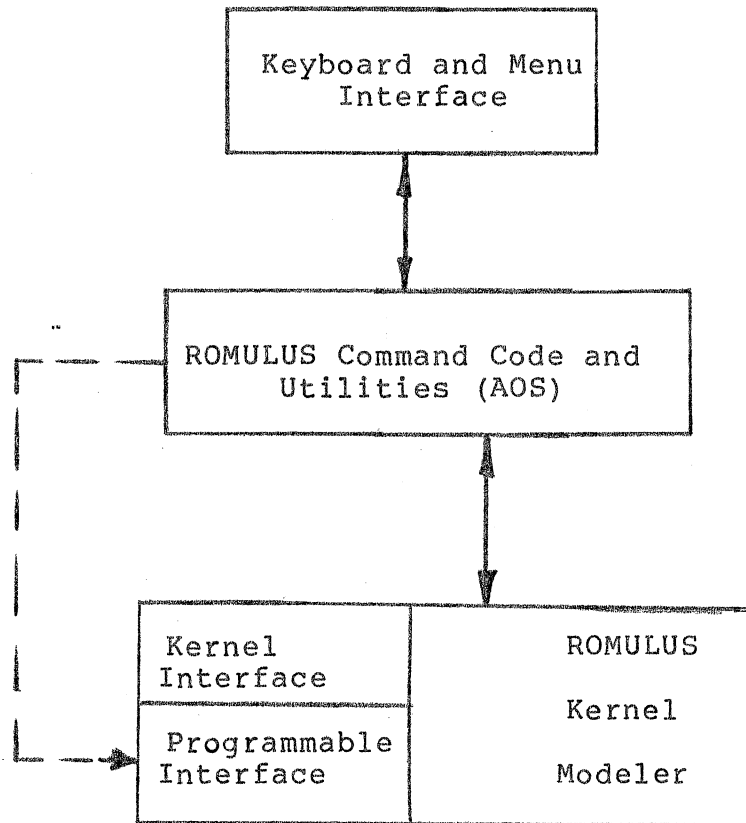


Figure 2 - ROMULUS End-User Product

A typical ROMULUS end-user is one who buys ROMULUS for use internal to his organization. He may simply want to acquaint himself with the concept of Solid Modeling or use the system in the "as delivered" form without getting involved in efforts to develop a different user interface. The typical customer views a solid modeler as a particularly useful tool for design and/or manufacturing applications. He may or may not wish to develop application software around the modeling system.

The ROMULUS User Interface module in conjunction with the ROMULUS Kernel addresses the end-user by providing the basic modeling tools in a user friendly manner and by providing the flexibility to interface to application packages easily and efficiently.

## 2. ROMULUS System Builder Product Configuration

A ROMULUS system builder can be identified as either an industrial manufacturing firm or a commercial VAR organization. This customer requires a ROMULUS product that can be tailored to total system integration and customization. He would purchase the required ROMULUS Kernel with optional Exerciser, Development/Integration Tools and Sublicense Rights. Figure 3 shows this typical configuration.

System Builder configuration license price -	\$ 62,500
Annual support fee -	\$ 12,500
Total -	\$ 75,000

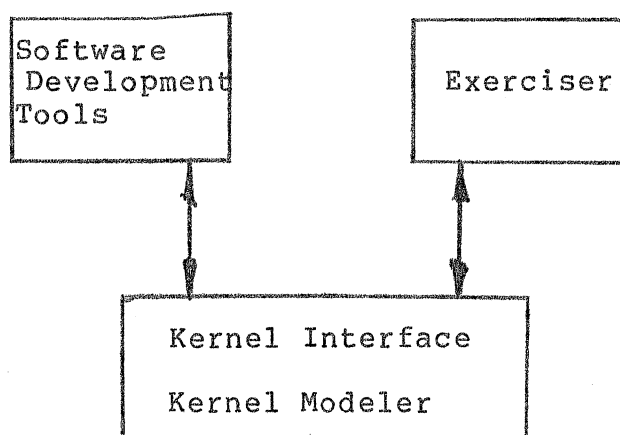


Figure 3 - ROMULUS System Builder Product

The Exerciser and Tools aid in system integration and customization. Because some ROMULUS system builders will add front- or back-ends to the modeler, tailor ROMULUS to suite their needs, and provide integrated systems for sublicensing, they require the Sublicense Rights module in order to distribute their system. The User Interface Module is usually not required for the system builder because he will use his own. However, the User Interface module is available if desired.

### 3. ROMULUS Technology Product Configuration

This customer would purchase the required ROMULUS Kernel with optional Exerciser, Development/Integration Tools, Technology Package and Sublicense Rights. Figure 4 shows the typical technology configuration.

Technology Product configuration license price -	\$507,000
Annual support fee -	\$ TBN
Sublicense by CPU	\$ 10,000
Annual sublicense support by CPU	\$ 1,000
Minimum yearly sublicense fee	\$ 50,000

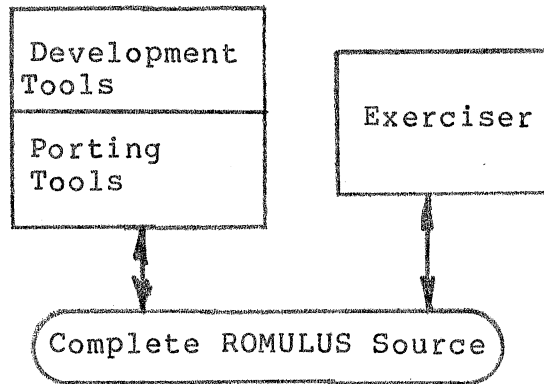


Figure 4 - ROMULUS Technology Product

The ROMULUS Technology customer is characterized as a commercial system builder who wants to totally integrate ROMULUS into an existing system or to develop a new system based on solid modeling technology. Full source is a requirement of this customer. The Exerciser and Tools are necessary to aid in system integration and customization. This customer will purchase the Sublicense Rights and will be required to sublicense on a per CPU basis and to guarantee a yearly minimum sublicense fee.

## B. ROMULUS Product License

The ROMULUS Product is only licensed for supported CPUs. A ROMULUS Kernel license can be purchased on DEC VAX/VMS, Apollo/AEGIS, and IBM/MVS computers. A User Interface license can be purchased for DEC VAX/VMS and Apollo/AEGIS only. All licenses are on a CPU basis. A terminal license will no longer be offered. The CPU license is perpetual and includes training class credit for ROMULUS training at E&S training facilities. The license allows the customer to run as many supported terminals as he deems practical on the specific CPU.

In the case of Apollo Domain networks, there is a special ROMULUS network license which allows ROMULUS to be run on any Apollo node on a network.

VAX Cluster licenses are also available to allow ROMULUS to run on any of several CPUs in a cluster.

## C. ROMULUS Product Support

Support for the ROMULUS Product will be provided by E&S as follows:

1. Advance notification of scheduled changes and enhancements, specific to release level and date.
2. Scheduled, orderly releases; not more often than two or three times a year.
3. With each software release, supply a list of fixes and changes, as well as a list of new features.
4. With each software release, supply organized manual updates.
5. Between releases, provide an update sheet of known problems.
6. Provide software releases in standard format with standard directory names and procedures.
7. Provide telephone consultation on problems to a single contact (single location).
8. Provide fixes to reported bugs in intermediate release if necessary.

Special consulting and support will be contracted separately with E&S for further support as required by the customer.

ROMULUS support will continue to be a yearly renewable support contract.

The Kernel Modeler and Interface, Exerciser, Demonstration Facilities, Development/Integration Tools and Documentation will be originally provided by Shape Data Ltd. through Version 6.0 of ROMULUS for the specified CPUs. Thereafter, these facilities, except the Kernel Modeler and Kernel Interface, will be maintained and supported by Evans & Sutherland in SLC. The Kernel Modeler and Kernel Interface will continue to be supported by SDL.



#### D. ROMULUS Product Release

The ROMULUS Kernel Product release strategy is as follows:

1. ROMULUS is released from the development team, with features, functions, and enhancements for the intended version to customer engineering and support organizations at SDL and E&S. The development version is in a VAX/VMS ANSI Fortran 66 format.
2. ROMULUS support groups at E&S and SDL will perform benchmarks, quality assurance, and otherwise check out system reporting problems to the development group for correction.  
These teams also port ROMULUS to supported CPU's and displays. These presently (with responsible teams) include:
  - VAX/VMS (SDL)
  - Apollo/AEGIS (SDL)
  - IBM/MVS (E&S)
  - PS 300 (E&S)
3. ROMULUS will remain in QA for approximately 3 months before general release to VAX customers. Apollo follows one month thereafter with IBM releases 6 weeks after the VAX release.
4. After standard releases on supported machines, subsequent intermediate releases will be correct bugs and difficulties encountered.
5. Standard releases are even numbered i.e. 5.2, 5.4, 6.0 at six month intervals. Intermediate releases are odd i.e. 5.3, 5.5 when required.
6. Special conversions and site installation of new releases will be arranged with individual customers through E&S. All new releases will be governed by the same license terms as the original ROMULUS release.

#### E. ROMULUS Product Documentation

Full Documentation of the ROMULUS Product is included with the software. The documentation covers each module of the product in detail. Present documentation, by module, includes:

##### Kernel Module

- ROMULUS Kernel Interface Guide - Provides documentation on all of the routines in the KI.
- ROMULUS Kernel Modeler Description (TBW)
- ROMULUS User and System Release Notes - Gives details of changes in the system since the previous release from the point of view of the user and system manager.

## User Interface Module

ROMULUS User's Reference Manual - Provides reference information for the use of ROMULUS commands.

ROMULUS Tutorial User's Guide - Provides a step-by-step guide to ROMULUS for the new user.

ROMULUS MCL User's Manual - Provides information for the use of the macro command language.

ROMULUS Programmer's Manual - Provides information for programmers using ROMULUS.

ROMULUS MCL Interface Guide - Provides information to the user on writing MCL functions and MCL programming environment.

AOS User's Guide - Provides documentation on the set of utility programs in ROMULUS called AOS.

ROMULUS User's Terminal Guide - Provides guidance to the user for a supported terminal type (PS300 and Apollo).

## Exerciser and Tools Module

Kernel Exerciser Guide (TBW)

How to Use Integration Tools (TBW)

## Sublicense Rights Module

Sublicense Agreement (TBW)

## Technology Module

Porting Tools and Other Support Programs (TBW)

## F. ROMULUS Product Modules

### 1. ROMULUS Kernel Module

The ROMULUS Kernel Module includes the following components:

- ROMULUS Kernel Modeler
- ROMULUS Kernel Interface
- Documentation
- Training
- Support

The principle components of the ROMULUS Kernel Module are the Kernel Modeler and Kernel Interface.

The ROMULUS Kernel Modeler is the collection of routines that deal with the geometry and topology of solid models. The Kernel Modeler handles geometry intersections, model connectivity and access, and general modeling functions.

An important technical development in the ROMULUS Kernel Product is the Kernel Interface (KI). The Kernel Interface provides a standardized interface at a system level to these customers who wish to build their own front end software. The Kernel Interface covers all modeling operations and includes an

Auxiliary Interface which addresses rendering and application (i.e. - mass properties) functions.

The Kernel Modeler and Kernel Interface are developed by SDL. They are supported by E&S, who relies on SDL for continued support of the Kernel products.

Full documentation on the functionality of the Kernel Modeler and procedural calls of the Kernel Interface is included with the Kernel Module.

The ROMULUS Kernel Product will be supported on VAX/VMS, Apollo/AEGIS and IBM/MVS and will be available on VAX in January 1985.

The Evans & Sutherland delivery schedule for this product is as follows:

- o 5.4 VAX/VMS - January 1985
- o 5.4 Apollo/AEGIS - February 1985
- o 5.4 IBM/MVS - May 1985
- o 6.0 VAX/VMS - June 1985
- o 6.0 Apollo/AEGIS - July 1985
- o 6.0 IBM/MVS - August 1985

## 2. User Interface Module

The User Interface Module is optional and includes the following components:

- Keyboard and Menu Interface
- Command Code
- Programmable Interface
- Utilities (AOS)
- Documentation
- Training
- Support

The User Interface Module, when coupled with the ROMULUS Kernel, equivalent to the old Programmable ROMULUS product, becomes the new end-user configuration. The User Interface provides the PS 300 and Apollo Graphics Menu and Keyboard Interfaces and the ROMULUS Command Code for modeling, modifying, and interrogating models. The Macro Command Language (MCL), used for parametric part definition, is also included.

The User Interface Module is in programmable form providing the customer with a broad range of tailoring alternatives. The old Executable ROMULUS product will no longer be offered. Existing executable only ROMULUS customers will be upgraded to the new ROMULUS product. The Programmable ROMULUS Fortran Library provides facilities for adding new commands to the system and for writing direct application interfaces.

The User Interface Module makes extensive use of the ROMULUS AOS Utility programs. These programs handle model access, command decoding, and message/error output as well as machine dependent functions. The AOS Utilities are provided to the user with the User Interface Module.

The User Interface option is supported on VAX family computers running the VMS operating system and Apollo computers running AEGIS. The supported graphics systems include the E&S PS 330 on Vax and Apollo and Apollo graphics on Apollo.

Evans & Sutherland delivery schedules for Versions 5.4 and 6.0 of the User Interface are as follows:

- |                                      |                 |
|--------------------------------------|-----------------|
| - 5.4 VAX/VMS/PS 300                 | - January 1985  |
| - 5.4 Apollo/AEGIS/PS 300 and Apollo | - February 1985 |
| - 6.0 VAX/VMS/PS 300 and Apollo      | - June 1985     |
| - 6.0 Apollo/AEGIS/PS 300            | - July 1985     |

Enhancements to the ROMULUS User Interface product by Shape Data Ltd. will be concluded with the release of Version 6.0. Further enhancements and extensions will come from the ROMULUS Support Group at E&S based on market demand.

Support for the ROMULUS User Interface Module will continue through 1989 insuring functionality and quality of the product. Support provided is as defined for the ROMULUS Kernel.

A complete description of Version 5.4 of ROMULUS User Interface Enhancements is included in Attachment 'A'. Attachment 'B' includes a description of Planned ROMULUS User Interface Enhancements for Version 6.0.

### 3. Exerciser and Tools Module

The Exerciser and Software Development/Integration Tools are provided to aid in system integration and include:

- Exerciser for the Kernel Interface and Modeler
- Software Development Tools
- Integration Tools
- Documentation
- Training
- Support

The Exerciser for the Kernel Interface and Modeler is a program that tests, uses and otherwise exercises the Kernel Modeler through calls to the Kernel Interface routines. It can provide an example for using the Kernel Interface when interfacing with an application program.

The Exerciser and Tools are fully documented and supported. Training is available on their use and implementation.

The ROMULUS Development/Integration Tools provide needed facilities to aid in system integration and customization. Because some ROMULUS customers will add front- or back-ends to the modeler and tailor their product to suite their needs, they are encouraged to purchase these integration or software development tools.

#### 4. Sublicense Rights Module

There are two options to providing sublicense rights in the Sublicense Rights Module:

- Per CPU Basis
- Corporate Basis

The ROMULUS Kernel module with the Sublicense Rights module, gives the ROMULUS Customer sublicensing rights to an executable version of ROMULUS (only). The customer must commit to adding value to the software capabilities before sublicensing ROMULUS within his own organization or to third parties. In both cases, a sublicense fee must be paid to Evans & Sutherland by the System Builder for each CPU sublicensed unless the second option is taken for a Corporate-wide license.

In the case of the Corporate option, available to industrial organizations only, the customer can provide ROMULUS within his own organization without CPU sublicense fees. Corporate licenses are perpetual and available only to industrial organizations.

#### 5. Technology Package Module

The Technology Package module includes:

- Full Source for Kernel Modeler, Kernel Interface, User Interface and Software Development and Integration Tools
- Porting Tools
- Consulting
- Documentation
- Training
- Support

The ROMULUS Technology Module is a purchase of state-of-the-art solid modeling technology and includes full source for the ROMULUS system.

The product is distributed and supported in VAX/VMS , IBM/MVS, or Apollo/AEGIS format only. It includes full ROMULUS source with porting and integration tools to aid the customer.

Complete ROMULUS source includes the Kernel Modeler, Kernel Interface, User Interface along with Source Code for Porting Tools, Software Development and Integration Tools.

Source for the Kernel Modeler, Kernel Interface, Development Tools, Porting Tools and Documentation will originally be provided by Shape Data Ltd. through Version 6.0 of ROMULUS for the VAX. Thereafter, these facilities, except the Kernel Modeler and Kernel Interface, will be maintained and supported by Evans & Sutherland. The Kernel Modeler and Kernel Interface will continue to be supported by SDL. Consultation, support and training will be handled by E&S. Such training, support, and consulting will be negotiated along with other issues with the customer.

This customer will most likely purchase the Sublicense Rights and will be required to sublicense per CPU basis and guarantee a yearly minimum sublicense fee.

G. ROMULUS Product Pricing

	License	Pricing Support
<u>ROMULUS Kernel (required)</u>	\$ 30,000	\$6,000/yr
- ROMULUS Kernel Modeler	(class A) \$ 20,000	\$4,000/yr
- ROMULUS Kernel Interface	(class B)	
- Documentation		
- Training		
- Support		
 <u>User Interface</u>	 \$ 8,500	 \$1,700/yr
- Keyboard and Menu Interface		
- Command Code		
- Programmable Interface		
- Utilities (AOS)		
- Documentation		
- Training		
- Support		
 <u>Software Development and Integration Tools</u>	 \$ 2,500	 \$ 500/yr
- Kernel Interface and Modeler Exerciser		
- Software Development Tools		
- Integration Tools		
- Documentation		
- Training		
- Support		
 <u>Sublicense Rights</u>	 \$ 30,000	 \$ 6,000/yr
- Per CPU Basis	\$ 10,000	\$1,000/yr
- Corporate Basis	\$125,000	
 <u>Technology Package*</u>	 \$475,000	 negotiated
- Full Source for Kernel Modeler, Kernel Interface, User Interface and Software Development and Integration Tools		
- Porting Tools		
- Consulting		
- Documentation		
- Training		
- Support		

\* If Commercial, required to use per CPU sublicense and \$50,000 minimum/year sublicense fee.

## ROMULUS SOFTWARE DESCRIPTION

### A. ROMULUS Version 5.4 Product Description

This is a short description of the facilities to be released with ROMULUS Version 5.4.

Construction: Manipulation of unbounded geometries (points, lines, circles, planes, surfaces). Definitions can be related to previously defined constructions.

Modeling: 3D model-building primitives for creating cuboids, spheres, cylinders, truncated cones and toruses. Creation of wire objects. Creation of sheet objects from existing object or by drawing profiles. Linear and rotation sweep operators on wire and sheet objects; mirror operator Boolean operators to unite, subtract and intersect groups of objects including sheets.

Features: Grouping of any set of faces as a feature. Faces can be selected by surface type, direction, concavity and other parameters. Features can be copied or removed to create a new body. They can be moved or rotated within the existing body.

Local Operations: Modification of a body by adding fillets and chamfers. This applies to wire, sheet and solid bodies. Draft angles may also be applied to facesets. Bending and unbending of thickened or unthickened sheet metal parts.

Sections: Computation of arbitrary sections of models. Sections can be cut using any profile made up from straight lines and arcs.

Rendering: Color shaded images of groups of bodies. Each face can be assigned a different color. Reflective properties and depth modulation can be defined. Diffuse and point light sources can be controlled.

Generation of drawings in single view, or first or third angle orthogonal drawings in axonometric or perspective projection. Generation of line drawings of models with hidden edges removed and faces shaded to give a solid rendering. Mono or stereo views.

Attributes: Attach, detach and enquire about user defined attributes associated with entities in the solid model. Attributes are defined in an external text file.

Dimensioning: Addition of dimensions to the object, which can be displayed in orthographic and asometric drawings. Changes to the object geometry are automatically reflected in the dimensions.



Graphical Interaction: Graphical selection of objects, features, edges and points for manipulation. Choice of dynamic menu, tablet or keyboard input (according to display type). Input of points by cursor (optionally with gridding) or keyboard. Incremental output to terminal of each change to the object. Roll back facility for "undoing" modeling operations.

User Programming Language: A powerful structured BASIC-like language (MCL), which can be used to define new commands, build parametric families of parts, add applications, or interface to external applications.

Utility Subsystems: Basic software providing portable input, output, storage and information interfaces. Includes command and argument decoder, formatted message output, device independent graphical output, error recovery, data structuring system and transparent task communication and chaining.

Archiving and Communication: Storage and retrieval of individual bodies and assemblies as library components. Generation of a textual, machine independent form of an object data structure for transmission or long term storage.

Interfaces:

IGES: Output of drawings in IGES 2D format. This provides a link to most drafting systems available on the market.

DOGS: Output of drawings in a format compatible with these drafting systems.

GNC: Output of object geometry in a form suitable for input to the GNC(3D) numerical control tape generating programs.

FEMGEN: Subdivision of object into simple volume elements and generation of output description of these elements in a form suitable for input to the FEMGEN mesh generator program for finite element analysis.

PATRAN: Output of ROMULUS geometric models in PATRAN neutral file format for input to finite element mesh generator.

KERNEL INTERFACE: High level procedural interface developed for system integrators.

Applications: Geometric and mass properties: Area, volume, centroid, volume moments of inertia, radii of gyration, cross products of inertia, principle moments and principle axes. These calculations are available (where appropriate) for arbitrary groups of sheet or solid objects. User-selectable accuracy and final error estimates.

Interference detection: Detection of clashes between components.

## B. ROMULUS Version 6.0 Planned Product Enhancements

This is a short description of the planned enhancements for release with ROMULUS Version 6.0.

- Assemblies, shells and instances
- Permanent facesets in model
- Full blended surfaces in model
- Kernel interface extensions
  - Auxiliary interface
  - Graphics interface
- Improved dimensioning
- Extended local operations
  - Thicken sheets
  - Unbend and bend allowance
- Faster and better rendering of shaded pictures
- IGES 3D interface
- ROMAPT I for CNC machining
- General improvements in speed, accuracy and robustness.