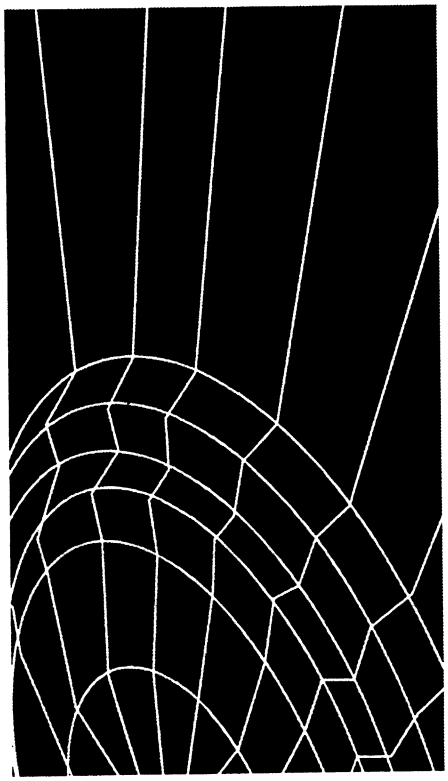
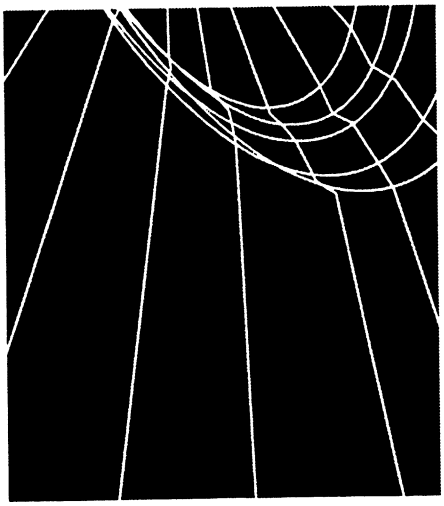


MARC
Analysis
Research
Corporation

MARC K7.2
Mentat 3.2

Release Notes



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TRADEMARKS

MARC K7.2

The current release of MARC K7.2 broadly encompasses the following quality objectives:.

- *Solution accuracy*
- *Robustness and ease-of-use*
- *Improvements in speed*

The release note addresses the following items:

I. Installation Remarks
II. Input and Documentation Changes
III. Important Analysis Consideration
IV. Notable Remarks
V. Defects Fixed in this Release
VI. Currently Known Problems in the Software
VII. List of Supported and Recommended Platforms

I. Installation Remarks

It is important that the installation of MARC K7.2 product from the CD ROM be done with the same USERID used for MARC K7.1. This is necessary to insure that the correct links to marck72 script are created, especially if the installation is being done in the same physical location.

Failure to use the same USERID will create a permissions problem leading to incorrect setup of links. Currently, the install script is designed to overwrite on the existing install subdirectory.

II. Input and Documentation Changes

(1) CONTROL: The 10th field in the second data block can take the value 4. This results in the inclusion of only the positive stresses in the initial stress stiffness during the equilibrium iterations. This leads to stable analysis of very thin shell structures, besides resulting in faster convergence.

(2) MOONEY: The bulk modulus can be independently controlled via (additional) 8th field on the 4th data block. If left blank, the program takes the default value *(same as in previous versions)* of 10^4*G, where G is the initial shear modulus.

(3) POINT LOADS: A 1 (one) in 3rd field in the 2nd data block signals existence of more than one point loadcase on the same node. The loads are then summed.

(4) RESTART LAST: (Additional) 4th field of the 2nd data block can be used to specify one additional restart file *(desired interval can be controlled)* besides the restart file written out at the last increment. This is especially useful if the results at the last increment are bad and the file written out by the RESTART LAST command is unusable.

(5) CONTACT (3D): (Additional) 13th field in the 2nd data block is used to activate the beam-to-beam contact.

(6) SOLVER: (Additional) 7th field in the 2nd data block is used to enter the number of million word blocks to be used by solver type 6 *(hardware vendor provided sparse solver)*, before the solver uses out-of-core option. Default is 100, i.e. 100,000,000 real*4 words.

(7) MAXNUM parameter in the include file of the */tools* directory represents the current maximum, of the number of entities *(nodes or elements)* in the model. This number can be changed by the analyst. This will, however, result in increased memory requirements.

(8) The default algorithm now for AUTO INCREMENT option *(using the arc-length solution methodology)* is modified Riks-Ramm method enforcing linear constraint equation. Also, the default value of the maximum fraction of the total applied load in presence of contact is 1%.

(9) Element 39 is used as a conjugate heat transfer element for both 2D as well as 3D situations in a coupled analysis.

III. Important Analysis Consideration

(1) If the analysis contains the use of RELEASE NODE option, then a dummy loadcase *(i.e. an increment containing no loading)* must be included after the loadcase containing the RELEASE NODE option.

(2) When the analysis involves rezoning with updated Lagrange elasticity, the following items must be considered:

a) Drive down the residuals to a low value in the last one or two steps of the first analysis (before restart)

b) Take very small steps in the beginning of the second analysis (i.e. after restart)

(3) One Contact body must contain only one type of elements.

IV. Notable Remarks

(1) Cauchy stresses are calculated by default for any geometrically nonlinear analysis *(i.e. with use of parameter* LARGE DISP*)*.

(2) Both displacement and residual tolerances are printed out during the iterations, irrespective of the chosen convergence criterion.

(3) Maximum number of retained nodes in any tying type *(4th field of the parameter card TIE)* is limited to 40.

(4) Speed improvements *(significant in some cases)* should be noticed in the analyses involving the following:

a) Explicit Dynamics

b) Rubber analysis with total Lagrange Mooney model

c) Eigenvalue analysis using Lanczos algorithm

d) Iterative solver (type 2): recommended for very large models

V. Defects Fixed in this Release

The primary objective of the MARC K7.2 release was to significantly improve product quality, robustness, and performance and to do so using formal ISO 9000 procedures. The vast majority of defects found in MARC K7.1 have been resolved in MARC K7.2. A list of significant resolved defects categorized by functionality follows:

Adaptive Meshing and Rezoning Corrections

- ADAPTIVE option criterion (type 4) did not work in coupled analysis.
- Wrong element values written in universal file after adaptive meshing or rezoning.
- Rezoning with RP FLOW, 1 gave wrong results.
- In analyses involving rezoning or adaptive meshing, memory in the job after restart could not be increased dynamically.
- Possible problem with post file if adaptive was used in combination with nonconsecutive element numbers.
- Abnormal termination of analysis may occur if adaptive was used to refine and unrefine with the box criterion and the elements got refined and unrefined more than once.

Contact Corrections

- Incorrect results were produced with glued contact in conjunction with certain boundary conditions.
- Occasional incorrect projection of the nodes on the NURB surfaces yielded spurious deformation and stresses under certain circumstances.
- NURB representation of circle did not yield desired accuracy in interference fits of circular shaft.
- Penetration could occur if a node came in contact with a symmetry plane and rigid body.
- Discrete representation was erroneously used for ITYPE=2 rigid body.
- Potential problems if a load controlled rigid body was used with multiple deformable bodies.
- Model definition option EXCLUDE did not work in 3D analysis.
- Wrong force and moment contribution in 2D analysis for stick-slip friction model when the nodes were sticking.
- Contact of beams and bricks or shells produced wrong separation.
- History definition option EXCLUDE did not work.
- History definition option SPLINE did not work.
- Calculations due to use of RELEASE option in a 3D contact analysis were incorrect leading to instabilities during release process.
- Separation based upon stresses in a contact analysis was wrong for brick elements, lower order Herrmann elements with extra node, and generalized plane strain elements.
- Sometimes analysis contain beam-beam contact could produce exit 36 *(zero element lengths).*
- Several contact problems with beam-to-beam contact have been resolved.
- Body order dependent results were produced if a node contacted a body with glue conditions and it also contacted a body without glue conditions (e.g. a symmetry body) in which case an over constraint situation occurred.
- EXCLUDE option in 2D may have given contact with excluded segments if sliding to those segments occurred. EXCLUDE option in 2D did not see the sharp and concave corners of the body with excluded segments anymore.
- Corner conditions in 2D contact (sharp corner, concave corner) were not taken into account when node slide from first to last segment of a closed rigid or deformable contact body.

- If in a 3D contact analysis a node with two fixed displacements came into contact with a rigid body and separated later from the rigid body the fixed displacements condition may not have been satisfied.
- Possible problem if node came into contact with an analytical surface and a nonanalytical surface, e.g. a flexible or other non-analytical surface. This only happened if the analytical surface had only one NURB to describe it.

Element Corrections

- PROCESS parameter card produced incorrect mass matrix.
- Brick-to-shell transition produced wrong results with use of PROCESS parameter card.
- Equivalent point loads for a collapsed brick element gave incorrect results.
- Element type 54 gave wrong results if PROCESS option is used and if the LARGE DISP option or updated Lagrange formulation is used.
- Displacement based axisymmetric with twist gave incorrect results.
- Herrmann axisymmetric with twist elements gave incorrect results.
- Axisymmetric with twist elements in Fourier analysis gave incorrect results.
- Inclusion of PROCESS option gave incorrect results for axisymmetric with twist elements.
- Using rebar elements with post option could cause a core dump.
- Material ids for different rebar layers could not be input through user subroutine.
- Use of element type 14 *(thin walled beam without warping)* could cause core dump in a coupled analysis.
- Axisymmetric magnetostatic analysis gave incorrect results with PROCESS parameter card.
- Combination of parameters; ELASTICITY,2 and PLASTICITY, 1 to 4 in the input deck caused core dump.
- Storage of integration point coordinates was inconsistent if the PROCESS parameter card was used and if elements with different number of coordinates were used in one analysis (e.g. type 75 and type 78).
- Using a heat transfer element type in a strongly coupled fluid-thermal analysis (fluid,12 and fluid,13) ignored the application of dist fluxes.
- Incorrect results were produced with element type 22 if PROCESS parameter card is used.
- A model containing only element type 9 (truss) and including large disp and/or buckle gave wrong results or core dumped if PROCESS parameter card was used.
- Beam element may have core dumped or given NaN or Inf on some machines if the local x-axis had the same direction as the local z-axis.
- Element type 9 used in a 2-d analysis in combination with ACTUATOR option produced incorrect results.

Kinematic Constraint Corrections

- Possible exit 1001 during application of tyings using sparse direct solver.
- If SERVO LINK option occurred twice, the database was overwritten.

Load Corrections

- DIST FLUXES were wrong in a coupled analysis in combination with: transient with automatic time stepping, auto time, auto creep, auto therm creep, auto step, and auto therm with nonzero total transient time.
- POINT TEMP loads gave incorrect results.
- Load applied as force per unit length for plans strain elements did not give correct results.

Material Corrections

- Rigid Plastic flow with contact could result in problems when used in conjunction with Herrmann elements and profile solver.
- Memory fault in restarting a job, if the dynamically allocated memory was larger than that allocated on the sizing.
- Thermal analysis for rubber gave incorrect results for total and updated Lagrange formulations for plane strain, 3D, and axisymmetric cases for time independent and viscoelastic analysis.
- Thermal analysis for rubber gave incorrect result for total Lagrange formulation for plane stress case for time independent and viscoelastic analysis.
- Thermal analysis with foam materials gave incorrect results.
- Foam material model gave incorrect results with hourglass elements.
- For analytical fits to experimental data, the quality of fits for the principal stretch based models, namely, Ogden and Foam has been substantially improved.
- For all elastomeric material models, the quality of simultaneous fits for multiple modes of deformation has been improved significantly.
- Incremental and total strain energy density was not calculated if ELASTICITY,2 or PLASTICITY,5 was used.
- Total strain energies were calculated incorrectly.
- Lorenzi J-integral was wrong using elements with different degrees-of-freedom.
- There was no protection against use of Foam model with Herrmann elements.
- Lorenzi J-integral calculations were wrong for quadratic Hermann elements.

Nonstructural Procedure Corrections

- Out-of-core solution of radiative heat transfer gave incorrect results.
- FLUID option used to give input data error when used in the history definition part of the input file.
- FLUID analysis gave input errors if velocity change/disp change/temp change option was used.
- Fluid-solid added mass calculation was wrong.
- Fluid-solid added mass calculation was wrong if optimize was used. It also goes wrong if you do not use default solver type 0 (direct sky-line solver).
- Joule heating had wrong or zero heat generation due to the electrical part for element types 86, 131, 132, 133, and 135.

Input, Output, and Postprocessing Corrections

- Post file with elements 119 and 144, was not readable.
- If a K6 style continuous post file was created upon restart, this file would be corrupt if the model contained rigid contact bodies.
- If a K7 style continuous post file was created upon restart, the analysis would be aborted if the model contained 2D analytical rigid contact bodies.
- Post file of coupled analysis produced incorrect initial temperatures.
- Universal file was incorrect for contact analysis with increment splitting.
- Nodal quantities written to a universal file were wrong.
- Post file was not being read for eigenvalue analysis.

- Cauchy stress tensor was not filled up for updated Lagrange analysis *(the stress tensor, however contained the Cauchy stresses).*
- Use of TRANSFORM and POST options together gave memory fault or core dump.
- Demo input example e8x25.dat (acoustic example) contained wrong post codes.
- Demo input example e8x26.dat (acoustic example) contained wrong post codes.
- Problems if a material number used in the isotropic option was greater than 100.
- Input using extended precision did not work.
- Material data selected from the database in the isotropic option was incorrect with extended precision input.
- Element types 31, 52, and 98 did not support post code 180 (temperature) and post codes 51-56 or 61-66 in an harmonic analysis.
- Possible problem with post file if adaptive was used in combination with nonconsecutive element numbers.
- Possible core dump if number of sets was greater than given on setname parameter card (default 10) or total number of set items was greater than 50*number of sets (default 500).
- Marc exit 13 if unsupported optimize method is used, but no error message in the output file.

Solver Corrections

- SGI sparse solver gave exit 1001 on restart with optimization.
- Nodes in contact with rigid body could be incorrectly positioned on that rigid body if the APPBC parameter option or the sparse iterative solver is used.
- Bandwidth optimization produced incorrect results in modal superposition.
- Sparse iterative solver with preconditioner type 1 and 2 did not work.
- On IBM machines, the time specified in the jidname.log was 100./60. time too high, if the print,13 was used or if solver,2 (sparse conjugate gradient) was used.

Structural Procedure Corrections

- AUTO THERM option did not scale the loads correctly when increment splitting took place.
- Glue and/or stick conditions were violated when AUTO INCREMENT was used.
- AUTO THERM analysis would exit with 3002 if the total transient time is non zero.
- More than 1000 steps in a fixed time stepping session were not possible in modal superposition.
- Coupled analysis involving elements with different degrees of freedom produced wrong results.
- Explicit, transient dynamics (type 5) produced incorrect results when neither UPDATE nor CONTACT model definition option is used.
- Mass matrices were incorrect for element types 5, 9, and 52 for explicit, transient dynamics.
- Lanczos buckling analysis with LARGE DISP produced wrong post file.
- Distributed loads were scaled incorrectly with auto-creep option.
- Temperatures were scaled incorrectly with auto-creep option.
- Coupled analysis with auto creep was not usable with explicit creep.
- Potential convergence problems if increment splitting took place in the increment of an AUTO INCREMENT loadcase of contact analysis.
- Model definition option CHECK RESULTS did not work for eigenfrequencies in combination with Lanczos eigenvalue extraction method.

User Subroutine Corrections

- Incorrect coordinates were passed to UPOSTV.
- IMPD and ELEVAR user subroutines were not called if the option UDUMP was used.
- Finite strain plasticity ignored element thicknesses defined in USHELL.

Miscellaneous Corrections

- RESTART gave exit 1001 with certain options in the input.
- Year in the date was printed out with only 2 digits.
- Use of +T option in the include file in */tools* directory on HP platforms caused an occasional underflow and core dump.

Besides the above defects, several platform dependencies have been removed to deliver consistent results.

VI. Currently Known Problems in the Software

(1) Spectrum response analysis does not provide stresses and strains in output or post file.

(2) Radiation results may be incorrect when shell elements are used in the analysis.

(3) Incorrect results may be produced in contact with shell with the "ignore shell thickness" flag on.

(4) Analysis prematurely goes unstable with implicit dynamics in an impact situation.

(5) Results may be questionable when using hourglass elements for plasticity analysis.

(6) Slower than optimal convergence may be observed for thermally driven contact problems.

(7) Potential core dump on selecting post codes that are not appropriate for analysis type, e.g. requesting creep strains when creep is not involved in an analysis or requesting six stresses for a plane strain element.

(8) Setname should not be numerically defined.

(9) In a coupled analysis during the heat transfer portion, the temperatures are tied using tying type 100 regardless of tie type except 31, 32, 33, and 34.

VII. List of Supported and Recommended Platforms

The table below lists the platforms and the OS supported by MARC K7.2

Machine	Chip	OS	Fortran Compiler	Upgrade of OS recommended before Next Release
SUN	Sparc	2.3	2.01	*
SUN	Sparc	2.4	3.0	
SUN	Ultra2	2.5/2.6	4.2	
HP	735	9.05	9.16	*
HP	735	10.01	10.0.01	*
HP	735	10.20	B.10.20.01	
HP	800	11.0	Exemplar 1.2.1	
IBM	RS6000	3.2.5	3.02.0.2	
IBM	RS6000	4.1.5	3.2.5	
SGI	R4000	5.3	4.02	*
SGI	R8000/ R10000	IRIX64 6.2	6.2	
SGI	R5000	6.3	7.1	
DEC	Alpha	OSF 3.2	4.0	
DEC	Alpha	OSF 4.0	4.1	
DEC	Alpha	NT 4.0	DF 5.0	
PC	Pentium II	NT 4.0	MS 4.0, DF 5.0	

Mentat 3.2

Summary

The objectives of this release Mentat are:

- To deliver substantial improvements in speed and memory usage of the product.
- To replace and enhance components of the product with better and more complete implementations.

Enhancements

Improved Hex Mesher

A new version of the automated hexahedral mesher is now available. Also new menus have been written for the solids meshing menu to control the hex mesher. The new executable, `hexer.exe`, uses the Mentat database to transfer the data to and from Mentat. This eliminates the 100,000 element limit.

The new implementation allows the user to control the hard edges in the hex mesh by selecting the desired edges before meshing the model. If no edges are selected, the normal automatic edge detection routine is run. Automatic edge detection can also be manually run, which allows for previewing and editing the hard edges.

The new hex mesher now can handle gaps in the surface mesh. However, it is required that all elements in the surface mesh be properly aligned for it to work properly.

This is easily achieved using the ALIGN SHELLS procedure found in the MESHGEN>CHECK processor.

New Tetrahedral Mesher

A new tetrahedral mesher is available in Mentat. Improvements have been made in the reliability of the new mesher, both in the successful completion of the meshing process and in the quality of the resulting mesh.

New Import Executables

The IGES, DXF (AutoCAD), and VDAFS import executables are now created with version 2.1.1 of the ITI libraries. This corrects a number of problems occurring during import.

New Solid Modeler

Mentat now utilizes the 3.0 version of the ACIS solid modelling library from Spatial Technologies. This improves connectivity with other programs using ACIS.

Binary Menu Files

To enhance the performance of Mentat, menu files are now delivered in binary form. This enables them to be read in much more rapidly at start-up than in previous versions. When started with a binary menu file, Mentat starts with all menus defined and in memory, similar to the `-ra` (read all menus) option. If modifications are made to the formatted menu files, a new binary menu file must be created by running the menu compiler which is integrated into the Mentat executable. This is done by running Mentat with the `-compile` command line option:

```
mentat [-mp menu_path] [-mf formatted_menu_file] [-df macro_name] filename
```

The three options are identical to those used for Mentat. The filename argument is the output binary menu file to be produced. For example, if your current directiory is the Mentat directory, then running

```
mentat -compile menus/main.msb
```

replaces the current binary menu file with a new one. Alternatively, the binary menu file can be deleted, in which case the formatted menu files is read as normal. The search order for the starting menu file is now as follows:

- The file specified by the `-mf` option.
- `main.msb` in the current directory.
- `main.msb` in the directories specified by the `-mp` option.
- `main.ms` in the current directory.
- `main.ms` in the directories specified by the `-mp` option.

New Select Operations

The select feature has been enhanced with new select operations using associative rules. The new SELECT BY submenu contains the following procedures:

- Node selection by elements, edges, faces, points curves, surface, and transformations.
- Element selection by nodes, edges, faces, type, class, geometry, material, orientation, and contact body.
- Element edge selection by nodes, elements, and faces.
- Element face selection by nodes, elements, and edges.
- Point selection by curves, surfaces (regular and trimming), and nodes.
- Curve selection by points, surfaces, nodes, and contact body.
- Surface selection by points (regular and trimming), curves, nodes, and contact body.

Additonally, most of the above procedure can be interpreted in one of two ways:

- Any in list - Any of the entities which are associated with any member of the given list is selected.
- All in list - Only entities which are associated with all of the members of the given list is selected.

Another associative select procedure, selection of contact body entities, has been added. Giving a contact body this feature selects all nodes, elements, points, curves, and surfaces which are part of that body.

Maximum Color Depth Command Line Option

The user can now control the maximum number of bit planes used by the product using the `-mb nplane` command line option. This is available only for machines supporting multiple pseudo color depths. On certain machines, where a depth of 24 bits causes problems, this option can be used to select 16 or 8 bit planes.

Snapshot Control

To accelerate the refreshing of the graphics screen, Mentat uses a snapshot technique, which works by capturing the image just after it has been updated. This captured image can then be used to update the graphics area on an expose event, avoiding the necessity of redrawing all the graphics primitives. On certain machines, this can cause performance problems (see above) and, for those machines, the snapshot feature can be turned off by using the `-ss off` command line option.

Color Setting Dialog

The color setting dialog is now available. It includes sliders for red, green, and blue components as well as the hue, lightness, and saturation components.

Menu Colors

The menu colors can be adjusted during the execution of Mentat. There is a new menu available in the DEVICE menu. All components of the menus, including the body color and text colors, can be adjusted.

List Scroll Bars

All lists, including those in the file browser, use scroll bars instead of the up/down/top/bottom buttons.

Merging While Post Processing

The merge operation is allowed during postprocessing. Previously, the post file was closed automatically before the merge.

Merging without Renumbering

An option added to the file menu turns off renumbering when a model is merged with an existing model. By default, a renumbering of the ids of all entities is done to prevent duplicate ids.

Menu Style

Certain menu buttons (oneonly and toggle) incorporate a "light" instead of being depressed. To make the menus consistent, menus are modified to combine a button and a light into one button.

Post Scan

Post scanning now utilizes a menu to display the increment information. The number of elements available in each increment is also displayed. An increment can be skipped to by clicking on it.

Optimization

A large number of changes were made to reduce the amount of memory used by Mentat and to make the code run more efficiently. On the average, the code uses about 35% less memory than previous versions.

Optimized NURBS Performance

The NURBS evaluators were optimized decreasing evaluation times and, therefore, decreasing the display time of curves and surfaces. Draw times are, in some cases, only 50% or less of previous times.

Post Plotting

Each node and element has the memory needed for post plotting allocated only when a post file is open. This should speed up the undo backup process.

Plotting State Data

Data needed for storing the drawing state of each entity as reduced by coalescing the common parts of the data into a single piece of memory, therefore reducing the memory used by each entity. Also, plotting state data is no longer maintained for entities which are not drawn. This is particularly significant in the case of plotting solid meshes as elements not having exterior faces are not, by default, drawn.

Display Lists

The graphics display lists, which contain the graphical elements of each entity, are greatly reduced in their memory requirements. This is especially true for solid meshes.

Software 3D Graphics Performance

The software implementation of the 3D graphics system, used by the X Windows and Windows NT GDI graphics systems, is streamlined to enhance performance. This affects only those machines not using the OpenGL interface.

MARC Writer

The speed of the MARC input file writer has been increased for models with many boundary conditions and/or many loadcases. In some cases, write times are only 10% of previous times.

Show and Edit Commands

The commands `*show_nodes`, `*show_elements`, `*show_curves`, and `*show_surfaces` display more information. Also, the commands `*edit_nodes` and `*edit_points` display the original coordinates before prompting for new coordinates.

Analysis Integration

- The thickness of composite material layers can be given using either absolute or relative values. In previous versions, only relative values could be given.
- In conjunction with MARC K7.2, it is now possible to have more than one point load boundary condition on a node at the same time. The loads are summed. In previous versions, all point loads working on a node at the same time had to be combined in a single boundary condition. The same is true for point flux, point source, point charge, point current, and point current-charge boundary.
- It is possible to specify both area and length for an actuator element. Note that this must be done in the popup menu GEOMETRIC PROPERTIES>3-D>TRUSS by switching on the ACTUATOR option. The ACTUATOR popup menu has been removed.
- A toggle for beam-to-beam contact has been added in the CONTACT CONTROL menu.
- MARC UFXORD user subroutine can be flagged within Mentat.
- The MARC ERROR ESTIMATE option is supported by Mentat.
- The thickness of composite material layers can be given using either absolute or relative values. In previous versions, only relative values could be given.
- Parallel processing now is done using the MPI library. Therefore PVM controls are no longer supported or needed in the product.

Experimental Data Fitting

For Mooney, Ogden, and Foam materials, it is possible to:

- Fit the data based on relative or absolute errors.
- Predict other modes than fitted.
- Extrapolate the response outside the measured range.
- Evaluate the responses based on material constants entered by the user.
- Select which predicted modes will be plotted.
- Force the program to return with positive material constants.

For Ogden and Foam, the user can set the error tolerances for the least squares and the Downhill-Simplex method, which can affect the quality of the fit. For visco-elastic data, the input no longer need to be equispaced in time which allows data covering a large time range.

New Functions for Numerical Input, Formulas and Parameter Definition

New arithmetic and database functions to be used in numerical input, formulas or parameter definitions are implemented. A complete list of these functions is attached.

In addition, it is possible to use formulas within the macros node (x,y,z) and point (x,y,z), as well as within the vertex, edge, and face specifications element: `edge_nr`, element: `face_nr`, solid: `vertex_nr`, solid: `edge_nr`, solid: `face_nr`.

Moreover, a new (hidden) command, `*eval_define`, has been added. Both this command and the existing command, `*define (UTILS>PARAMETERS>ADD)`, can be used to define a parameter using a formula.

The command `*eval_define` first evaluates the formula before assigning its value to the parameter, so the formula is evaluated only at the time of the definition of the parameter.

By contrast, the command `*define` defines the parameter in terms of the formula itself, so the formula is evaluated each time the parameter is used.

A new set of functions which allow the evaluation of model parameters, such as the number of nodes in the current model, has been added. The section on See Available Functions contains a complete list of all available functions.

Changes to Table Read Command

The behavior of the command `*table_read (TABLES>READ)` is consistent with the commands `*table_read_raw` and `*material_read`. Upon using the command `table_read`, a new table is created into which tabular data is read from the specified file.

In previous versions, this command would read tabular data into the current table. In the current release, this earlier behavior can be obtained by using the command `*table_read_curr`. So, to ensure that procedure files created with previous versions run correctly with this release, replace all occurrences of "`table_read`" with "`table_read_curr`".

Outlines on Solid Elements

Outline edge detection has been enhanced for solid elements. Previously solitary edges, that is edges used by only one element, were included in the outline. This has been changed to use the dihedral angle of the two adjacent faces instead. All edges whose dihedral angle is greater than 30 degrees are now included as outline edges.

Edge detection for planar and shell elements remains the same, except that edges which are on the border of two elements having opposite orientation are also included in the outline. If desired, such a mesh can be easily repaired by using the ALIGN FACES operation.

Other Changes

Interruptible Drawing

Interruptible drawing is, by default, ON. This feature, which is useful for manipulating large models, is controlled in the VIEW menu and by the command line option "`-qd`". It works by incrementally drawing the geometry while checking and handling other requests like dynamic rotation. These requests are immediately handled and the geometry is redrawn in its new position in the same fashion. This allows large models to be easily positioned as only part of the model is drawn at each intermediate position.

Element Edge and Face Plot Defaults

Previously the default plot settings for element edges and faces were to plot all edges and faces. In Mentat 3.2, the default is to plot only those on the surface of the model. This is done to minimize memory usage and maximize plotting speed. To view all the edges and faces of a solid mesh, choose the FULL option in plot settings for EDGES and FACES.

Obsolete Commands

For various reasons, the following commands are no longer available:

- popup_buffer
- pvm_activate_host
- pvm_all_hosts
- pvm_clear_hosts
- pvm_deactivate_host
- pvm_directory
- pvm_read_file
- pvm_read_master
- pvm_write_file
- set_automesh_length
- set_image_ps_encapsulated
- set_tetmesh_aspect
- set_trimesh_aspect
- vci_check_curves
- vci_check_surfaces
- viewfile

Bug Fixes

Advancing Front Mixed Meshing

Creating mixed quadrilateral and triangle meshes with the advancing front mesher after specifying a low distortion threshold sometimes produced poor quality meshes. The mesher is enhanced to fix this during the enhancement phase.

Slow Post File Reading

Post files having large numbers of element types 49 or 72 were, at times, extremely slow to read. This is fixed.

Slow Post File Reading

Post files having large numbers of element types 49 or 72 were, at times, extremely slow to read. This has been fixed.

Compatibility Across Platforms

Post files, both formatted and binary, can be read on any supported platform regardless of the machine on which they were generated. For example, a binary post file created by MARC on an HP server can be read into Mentat on an SGI or an NT computer.

Symmetry During Postprocessing

Performing symmetry during postprocessing now works properly.

Utilities Menu Available From Animation

The animation menu allows the user to go to the first level of the utilities menu.

File Browser Available for Rendering

The file browser appears when submitting a rendering job to allow the selection of the rendering file name.

Rigid Links, Rigid Elements, and Concentrated Masses in Universal Files

Rigid links, rigid elements, and concentrated masses are properly read from an SDRC IDEAS universal file.

PostScript Fonts and Line Weights

In previous versions, the size of text and the width of lines in a PostScript output file would become smaller as the resolution of the image was increased. Mentat 3.2 avoids this problem by scaling the lines and fonts relative to the resolution.

Large Models with Sets

Many operations, especially those with large sets and involving deletion of entities, have been optimized to run very efficiently. The delete operation was enhanced to eliminate searching of the sets for those entities, therefore greatly accelerating the process.

Editing Post Files

While a post file is open, it is important that the elements, or any other entities which are part of the post file, not be deleted. The code allows locking of entities. All post entities are now locked while the post file is open. This prevents their deletion and subsequent crash.

MARC Input Reader

A number of bug fixes were made to the MARC input file reader, including:

- Elimination of huge scratch files.
- Cracking data not being read.
- Composite properties not being read.
- Gurson damage data not being read.
- Rubber damage data not being read.
- Composite failure data not being read.
- Plasticity procedure parameter not being read.

MARC Input Writer

A number of bug fixes were made to the MARC input file writer, including:

- Creep loadcase with N>1 fixed steps would write only one CREEP INCREMENT block.
- Fourth field of DIST LOADS and FLUXES parameters incorrectly written.
- Wrong MARC input file writer if STATE VARIABLE block is first active and then inactive.
- The CONTACT TABLE option was incorrectly written if the model contained contact bodies with zero entries.

Material Experimental Data Fitting

A number of bug fixes have been made, including:

- The plotted extrapolation bounds were not correct.
- The response of Mentat was incorrect if the number of data points exceed the limit of 200.
- Mentat would crash if the used wanted to manually enter Ogden material constants.
- It was impossible to simultaneously fit all the Ogden constants (either the moduli and exponents or the bulk modulus).
- For foam material, the fictive Poisson's ratio was taken into account incorrectly.
- The equations used for foam might lead to incorrect results for biaxial, planar shear, and volumetric data.
- The logic for multiple visco-elasticity data sets was incorrect.
- The fitted multipliers for energy reladation data were wrong.

Subdivision with Boundary Conditions

When subdividing an element which had boundary conditions applied to either the exterior edges or faces, the boundary conditions would sometimes be improperly applied to interior edges and faces. This is fixed to maintain the proper boundary conditions during the subdivision process.

Invisible Sets in Post Files

Elements sets were sometimes invisible if a previously opened post file had an element set of the same name which was also invisible. This is fixed.

Boundary Condition Plotting Control

The toggling of the drawing of boundary conditions improperly required a regeneration. Now, it requires only a draw to see the plotting change.

Drawing Solids Missed Faces

When visualizing solids, sometimes particular faces were not drawn. This is fixed.

Face Load Menu Incorrect

The menus for face loads in the boundary conditions menu incorrectly represented the user subroutine entry. This is fixed.

Conversion of Solid Cylinder to Surface

The conversion of the cylindrical face of a solid cylinder caused Mentat to crash. This is fixed.

Exit Number Not Correctly Displayed

In the job submission menu, the exit number was not properly updated if the log file for that job did not exist. The job is now reset if the log file cannot be found.

Writing Parallel Processing MARC File

Writing MARC input files for a multiple domain analysis is now possible if a link fails to have a tied node.

Adding Elements to Multiple Domains

Manually adding elements to different domains would crash if the command were not reissued before every element domain list was given. This is fixed.

Symbol Plot Colors

During postprocessing using the symbol plot scalar plotting the number of colors used by the symbols did not match the number of colors in the legend. This is fixed.

Post Show Node

During postprocessing the "show node" operation sometimes returned the wrong value. This is fixed.

End-of-List for Node Paths

When specifying a node path, the END LIST button is available.

Double Elements Not Plotted

In some analyses, two sets of identical elements are required in the model. When plotting edges and faces on the surface only, which is now the default, these elements would not be plotted. This is fixed.

Identify for Line Elements

Line elements did not have their color properly set when the identify option was used. This is fixed.

Composite Display Update

Previously, the composite display would not always update when the parameters of the composite were changed. This is fixed.

Dynamic View in OpenGL over Network

Using the dynamic view option in the OpenGL version over a network, Mentat tended to draw the intermediate positions of the model rather than the position indicated by the current position of the mouse. This now works and greatly increases the performance in this environment.

OpenGL on NT Memory Reduced

Memory usage has been greatly reduced for the Windows NT OpenGL version of Mentat.

Known Bugs

The following is a list of bugs known to exist in this release. These will be fixed in a subsequent release.

Reading Radiation Viewfactors

There is no support for reading radiation viewfactor information from MARC input files.

Deformed Scaling for Post Dies

The scale factor for plotting die displacements during postprocessing is always one. This is different than elements which may have their deformations arbitrarily scaled using the manual deformation option.

Available Functions

The complete list of available functions is:
(Functions marked with an * are new in Mentat 3.2)

Arithmetic Functions

Function	Description
`cos(arg1)`	Cosine of arg1 radians
`sin(arg1)`	Sine of arg1 radians
`tan(arg1)`	Tangent of arg1 radians
`dcos(arg1)`	Cosine of arg1 degrees
`dsin(arg1)`	Sine of arg1 degrees
`dtan(arg1)`	Tangent of arg1 degrees
`acos(arg1)`	Arccosine of arg1 radians

Function	Description
asin(arg1)	Arcsine of arg1 radians
atan(arg1)	Arctangent of arg1 radians
atan2(arg1,arg2)*	Arctangent of (arg1/arg2) radians
dacos(arg1)	Arccosine of arg1 degrees
dasin(arg1)	Arcsine of arg1 degrees
datan(arg1)	Arctangent of arg1 degrees
datan2(arg1,arg2)*	Arctangent of (arg1/arg2) degrees
log(arg1)	Base-10 logarithm of arg1
ln(arg1)	Natural logarithm of arg1
exp(arg1)	E to the power arg1
cosh(arg1)*	Hyperbolic cosine of arg1
sinh(arg1)*	Hyperbolic sine of arg1
tanh(arg1)*	Hyperbolic tangent of arg1
acosh(arg1)*	Inverse hyperbolic cosine of arg1
asinh(arg1)*	Inverse hyperbolic sine of arg1
atanh(arg1)*	Inverse hyperbolic tangent of arg1
sqrt(arg1)	Square root of arg1
rad(arg1)	Angle in radians of arg1 degrees
deg(arg1)	Angle in degrees of arg1 radians
abs(arg1)	Absolute value of arg1
int(arg1)	Largest integral value not greater than arg1
frac(arg1)	Fractional part of arg1
max(arg1,arg2)*	Maximum of arg1 and arg2
min(arg1,arg2)*	Miminum of arg1 and arg2
dist2d(arg1,arg2,arg3,arg4)*	Distance in 2-D space between a point with coordinates (arg1,arg2) and a point withcoordinates (arg3,arg4)
dist3d(arg1,arg2,arg3,arg4,arg5,arg6)*	Distance in 3-D space between a point with coordinates (arg1,arg2,arg3) and a point with coordinates (arg4,arg5,arg6)

Database Functions

Arguments printed in capitals may be negative; in which case, the database is searched in reversed order.

Function	Description
npoints()*	Number of points in database
point_id(ARG1)*	Id of ARG1-th point in database
max_point_id( )*	Largest point id in database
point_surface_id(arg1)*	Id of surface trimmed by point arg1
point_x(arg1)*	Global X-coordinate of point arg1

Function	Description
point_y(arg1)*	Global Y-coordinate of point arg1
point_z(arg1)*	Global Z-coordinate of point arg1
point_u1(arg1)*	First user coordinate of point arg1
point_u2(arg1)*	Second user coordinate of point arg1
point_u3(arg1)*	Third user coordinate of pointarg1
point_s1(arg1)*	First surface parametric coordinate of point arg1
point_s2(arg1)*	Second surface parametric coordinate of point arg1
ncurves( )*	Number of curves in database
curve_id(ARG1)*	Id of ARG1-th curve in database
max_curve_id( )*	Largest curve id in database
ncurve_points(arg1)*	Number of points of curve arg1
curve_point_id(arg1,ARG2)*	Id of ARG2-th point of curve arg1
curve_surface_id(arg1)*	Id of surface trimmed by curve arg1
curve_length(arg1)*	Length of curve arg1
curve_ndiv(arg1)*	Number of divisions of curve arg1
nsurfaces( )*	Number of surfaces in database
surface_id(ARG1)*	Id of ARG1-th surface indatabase
max_surface_id()*	Largest surface id in database
nsurface_curves(arg1)*	Number of trimming curves of surface arg1
surface_curve_id(arg1,ARG2)*	Id of ARG2-th curve in database that trims surface arg1
nsurface_points_x(arg1)*	Number of defining points in first parametric direction of surface arg1
nsurface_points_y(arg1)*	Number of defining points in second parametric direction of surface arg1
surface_point_id(arg1,ARG2,ARG3)*	Id of (ARG2, ARG3) -the defining point of surface arg1
nsolids()*	Number of solids in database
solid_id(ARG1)*	Id of ARG1-th solid in database
nsolid_lumps(arg1)*	Number of lumps of solid arg1
nsolid_faces(arg1)*	Number of faces of solid arg1
nsolid_edges(arg1)*	Number of edges of solid arg1
nsolid_vertices(arg1)*	Number of vertices of solid arg1
solid_area(arg1)*	Surface area of solid arg1
solid_volume(arg1)*	Volume of solid arg1
nnodes( )*	Number of nodes in database
node_id(ARG1)*	Id of ARG1-th node in database
max_node_id( )*	Largest node id in database
node_x(arg1)*	Global X-coordinate of node arg1
node_y(arg1)*	Global Y-coordinate of node arg1
node_z(arg1)*	Global Z-coordinate of node arg1
node_u1(arg1)*	First user coordinate of node arg1
node_u2(arg1)*	Second user coordinate of node arg1

Function	Description
`node_u3(arg1)*`	Third user coordinate of node arg1
`nelements( )*`	Number of elements in database
`element_id(ARG1)*`	Id of ARG1-th element in database
`max_element_id()*`	Largest element id in database
`element_node_id(arg1,ARG2)*`	Id of ARG2-th node of element arg1

Examples:

Function	Description
`node_id(1)`	returns the id of the first node in the database
`node_id(4)`	returns the id of the fourth node in the database
`node_id(nnodes( ))`	returns the id of the last node in the database
`node_id(-1)`	returns the id of the last node in the database
`node_id(-2)`	returns the id of the last but one node in the database
`node_id(0)`	is not a valid syntax

Constants and Operators

Known constants: pi, e

Operators

Operator	Syntax	Description
+	a+b	a plus b
-	a-b	a minus b
*	a*b	a times b
/	a/b	a divided by b
%	a%b	a modulus b (remainder)
^	a^b	a raised to the power b
Note: Blanks are not allowed.		

Supported platforms

The following platforms and operating systems are supported by Mentat 3.2

Please note that operating systems with a "*" in the last column will no longer be supported after this version. Users are requested to upgrade to a more recent version of the O/S when possible. All O/S versions of Mentat are on the delivery CDs.

Vendor	OS	Hardware	OGL	Last Supported Version
DEC	OSF1 3.2	DEC Alpha	y	*
	OSF1 4.0	DEC Alpha	y	
	NT 4.0sp3	DEC Alpha	y	
HP	HPUX 9.0.5	700 series (PA1.1)	n	*
	HPUX 10.0.1	700 series (PA1.1)	n	*
	HPUX 10.20.0	C series (PA 2.0)	y	
IBM	AIX 3.2.5	RS6000	y	*
	AIX 4.1.4	RS6000	y	
SGI	IRIX 5.3	mips2	y	*
	IRIX 6.3	mips2	y	
Sun	Solaris 2.4	sparc	n	*
	Solaris 2.5	ultra	y	
Intel	NT 4.0sp3	Intel Pentium	y	

OpenGL Compatibility

When running over a network, the following combinations of client machine (where Mentat is running) and graphical server (where the user is viewing the program) have been found to work properly using OpenGL:

	Server					
Client	DEC	HP	IBM	SGI	SUN	NT[2]
DEC	y[1]	n	y	n	y	y
HP	y	n	y	y	y	y
IBM	y	y	y	y	y	y
SGI	n	y	y[1]	y	y	y
SUN	y	y	y	y	y[3]	y
NT	n	n	n	n	n	y

[1]Double buffering not available.
[2]Requires additional software (see http://www.hummingbird.com)
[3]Single buffering may not work on some Solaris 2.6 machines.

Graphics Versions on Windows NT

On Windows NT, two versions of Mentat are available: GDI and OpenGL. The GDI version is based upon the two dimensional native graphics system available on all NT systems. In this case, all 3D graphics is done by Mentat in software and translated into 2D calls.

The OpenGL version of Mentat relies on the Windows NT operating system to perform the 3D graphics operations. In this instance, the operation of Mentat may be greatly accelerated by the use of a graphics board which supports OpenGL. However, even in the absence of hardware acceleration, graphical performance is substantially better in the OpenGL version of the product than the GDI version of the product. In this nonaccelerated configuration, there is a slightly greater use of memory by the product.

There are many graphics boards which accelerate OpenGL in Windows NT. Unfortunately, not all of them perform properly. The following boards have been successfully tested using the latest drivers available from the manufacturer:

- Matrox Millenium II
- Diamond FireGL 4000
- HP Visualize FX4
- ATI 3D Pro Turbo
- ELSA GLoria-XL
- ELSA GLoria-L/MX
- AccelGraphics
- AccelPRO 2000

Other Windows NT Notes

The ALT key is not available for toggling dynamic viewing. This is because the ALT key is used to enable the system menu.

At times, the screen may be required to be redrawn to refresh the graphics area and the menus. This can be done by pressing the F12 key. You may see some dialog boxes that do not appear to close when you press the OK button. If this happens, press the F12 key to redraw. A workaround is to disable the screen snapshots feature by using the option "`-ss false`" in the `mentat.bat` script. (see below)

Some users have experienced noticeable delays during certain operations such as adding nodes, etc. This is due to a problem with the screen snapshots procedure on some graphics hardware. The only workaround is to add the option "`-ss false`" in the `mentat.bat` script in the mentat320\bin directory. This will disable the feature.

Interruptible drawing does not work reliably and, by default, is off.

When starting Mentat, do not activate other windows before the Mentat window appears. If you do, the graphics window may not draw properly. To remedy this problem, you have to switch to view 2, and then back to view 1 to get the window to draw properly.

To setup your Windows Network printers to work with Mentat, run the `setup_printer` program in the Mentat bin directory. This program redirects an LPT port to a network printer. The `pscolor*.bat and psgray*.bat` scripts are used by Mentat to direct the output to those printers. You do not need to run `setup_printer` to print to a local printer connected to LPT1.

Is is recommended that you run the OpenGL version of Mentat in the highest color mode that your graphics card supports. On most accelerated graphics cards, the lower resolution modes do not properly support OpenGL. You should also avoid 256 color mode even if you are using a standard nonaccelerated graphics card.

A three-button mouse is highly recommended. If you have a two-button mouse, hold down both buttons to do a dynamic rotation in the graphics window. Instead of pressing the middle mouse button over a menu to obtain help, position the cursor over the menu and press the F1 key.