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Dytran Release Guide

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1 Introduction
Dytran™ 2010 is the latest and most comprehensive version of Dytran released by MSC.Software, bringing new simulation technology and improved performance.

Dytran 2010 is available on UNIX (HP-UX PA-RISC 2.0, HP-UX Itanium2), IBM RS/6000 (Power 4), SGI R10K/R12K, Sun SPARC Solaris, Solaris X64, Linux Itanium2 (Red Hat 4, Update 5), Linux Itanium2 SGI Altix (SGI ProPack4 SP0), Linux X8664 (Red Hat 4, Update 5), Linux 32 (Red Hat 4, Update 5), Windows 32 bit (XP, SP2) and Windows 64 bit (XP 64, SP2) platforms. Please see System Information in Chapter 3 of the Dytran 2010 Release Guide for more details.

Dytran 2010 includes the advanced Distributed Memory Parallel (DMP) capability for Euler and Coupling resulting in dramatic performance improvement for CPU intensive fluid-structure interaction (FSI) applications. The DMP capability includes:

- Single and Multi-Material Hydro Euler
- ROE Solver
- Failed elements in coupling surface
- Graded Mesh
- Biased meshing
- Coupling surface output and markers
- Geometric boundary conditions
- Viscosity

The Dytran 2010 DMP technology is not extended to the structural solver. The DMP capability does not require any additional licensing requirements.


Dytran uses the Macrovision FLEXlm™ licensing system. If you already have an MSC.Dytran 2008 r1 license, you will not need to obtain a new authorization code to activate Dytran 2010 on your computer. However, you will need to install the latest FLEXlm 11.6 license server.

If you need assistance while installing Dytran 2010, please call the MSC Technical Support Hotline at 1-800-732-7284, or E-mail your support questions to mscdytran.support@mscsoftware.com.
Chapter 2: Eulerian and Fluid-Structure Interaction (FSI)

- Distributed Memory Parallel Euler and Coupling  
- Benchmarks  
- Performance Results  
- Cyclic Flow Boundary  
- Enhancements to Body Force  
- Other Enhancements and Defect Corrections
Distributed Memory Parallel Euler and Coupling

The major emphasis in the Dytran 2010 release has been to dramatically increase the performance of fluid-structural interaction (FSI) solver by introducing the DMP technology to Eulerian solver and coupling surface computation algorithms. Even though the DMP capability is not extended to the structural solver in Dytran, most of the CPU time in FSI simulations, are attributed to Euler and coupling surface processors. As a result, there should be significant performance improvements in many complex FSI applications.

The DMP capability includes:

- Single and Multi-Material Euler
- ROE Solver
- Failed elements in coupling surface
- Graded Mesh
- Biased meshing
- Coupling surface output and markers
- Geometric boundary conditions
- Viscosity

Single and Multi-Material Euler

To run a simulation in single or multi-material DMP mode, the Eulerian domain is partitioned in different subdomains and each subdomain is spawned to a different processor, depending on the number of processors that is selected by the user. The structural solver is run on the master CPU and determines the new positions of the structural grid points in each new cycle. These new positions are subsequently sent to other processors to identify and update the coupling surface. The Euler solver will exert loads on the structural grid points and then sent them back to the master CPU. After accumulation of all the loads on the master CPU, the structural solver updates the structural elements resulting in new displacement and new position of the structural grid points.

Roe Solver

The Roe solver is the second-order Eulerian solver of Dytran. To update the Euler elements, the standard solvers use element values. This gives first-order results. To achieve second-order results, the Roe solver uses extrapolations of element values instead of element values. In DMP mode, these extrapolations can take place across the multiple processors.

Flow between Coupling Surfaces

DMP capability is also supported for flow between Euler domains by means of porosity definitions or by means of interactive failure. When segments of the coupling surface fail on the master CPU, this is communicated to the other processors. These processors then create special “porosity” faces that allow
flow of material through these failed segments from one Euler domain to the other. The DMP capability is also supported where the two Eulerian domains are located on different processors.

**Graded Mesh**

Graded meshes are composite meshes that result from gluing fine and coarse meshes together. In other words, an element of the fine mesh needs to be connected or “glued” to elements of the coarse mesh. In a DMP mode, the fine element and coarse element can be located on different processors.

**Miscellaneous**

The DMP capability is also extended to support a number of useful features including biased meshing, coupling surface output and markers, geometric boundary conditions, and viscosity.

**Benchmarks**

Several example problems have been created to study the performance of DMP capability in Dytran 2010. Many of these problems originate from the *Dytran Example Problem Manual*.

1. Biased Mesh with markers
2. Blast wave on biased mesh (*Dytran Example Problem Manual* - Example 4.15)
3. Bullet impact
4. Bunker blast with the multi-material solver (*Dytran Example Problem Manual* - modification of Example 4.7)
5. Bunker blast with the Roe solver (*Dytran Example Problem Manual* - Example 4.7)
6. Bunker blast with the standard single material solver (*Dytran Example Problem Manual* - Example 4.7)
7. Flow between containers with the multi-material solver (*Dytran Example Problem Manual* - modification of Example 4.6)
8. Flow between containers with the Roe solver and the standard solver (*Dytran Example Problem Manual* - modification of Example 4.6)
9. Flow between containers with the Roe solver and the standard solver (*Dytran Example Problem Manual* - Example 4.6)
10. Undex without ship (*Dytran Example Problem Manual* - modification of Example 4.16)
11. Vortex shedding (*Dytran Example Problem Manual* - Example 4.20)

For each problem, the results were compared on single and multiple processors to ensure consistency. In addition, performance improvements on different platforms were tested up to eight processors. The test platforms used in these benchmarks are Windows 64 bit and Linux x8664 with OpenMPI.
Problems 1, 2, 4-9, 11 tests “DMP for Dytran FSI”; problems 1 and 3 tests “DMP for EULER only”; problems 4-9 test “DMP for flow between Euler domains”; problems 5 and 8 test “DMP for the Roe solver”; problem 2 tests “DMP for graded mesh”.

**Biased Mesh with markers**

A blast wave propagates through a biased mesh and hits a wall and is reflected. After the reflection, the wave front leaves the Euler domain from the top, left, and right boundaries. These three boundaries are transmitting boundaries and allow the wave front to leave the Euler domain without reflections.

**Blast wave on biased mesh**

A deformable rectangle shape structure is hit by a blast wave. A combination of a fine and coarse mesh is used. The element partitioning for eight CPU runs is demonstrated in the right picture below. The result in this picture shows the CPU numbers.

At the interface between the fine light blue domain and the coarse pink domain, there are fine elements that need to be connected to coarse elements. These are on different CPUs.
Bullet impact

In bullet impacts on plates, deformations are so large that an Eulerian approach is more useful than a Lagrange approach. The bullet and plate are modeled with five Eulerian materials as shown below. Each color corresponds with a specific material.

Bunker blast with the multi-material solver

A bunker is attached to solid ground and is open on both ends. A blast wave is ignited outside of the bunker. When the blast wave hits the bunker, the bunker fails at the bottom. The first figure shows the effective stress. After failure of the structure, the blast wave flows through the failed segments from the Euler domain on the outside to the Euler domain on the inside. The mass flow is shown in the second figure. The explosive and ambient air are modeled as two distinct materials. The variable MFL-FAIL3 denotes the flow of explosive products through the failed segments.
Bunker blast with the Roe solver

This is similar to problem above except that there is only one material. Both explosive and ambient air are modeled by one material. To capture the blast, the second-order Roe solver is used. The plot below shows the outflow of both explosive products as well as ambient air through failed segments.
Bunker blast with the standard single material solver

This is similar to the “Bunker blast with the Roe solver” problem. The only change is that the single material Euler solver is used. The plot below shows the outflow through failed segments.

Flow between containers with the multi-material solver

In applications such as multi-compartment airbags and bird strikes, the material can flow between Euler domains. As a basic test of this functionality, flow between two container is tested. The model setup in the figure below is taken from Dytran Example Problem Manual, Example 4.6. The model tested here uses a finer Euler. Also, the initial pressures in the two containers are different as shown in the second figure. Both containers initially contain distinct materials, to test the DMP capability in a multi-material application. Time histories for the pressures in the two containers are shown below.
Flow between containers with the Roe solver and the standard solver

These are similar to “Flow between containers with the multi-material solver” but use only one material. Time histories for the pressures are shown below.

Undex without ship

A blast takes place under water. Hydrostatic flow boundaries are applied at the boundaries. The expansion of the blast wave is counteracted by the hydrostatic flow boundary and the bubble collapses after some time. In addition, the bubble slowly starts to rise up due to buoyancy effects.
Vortex shedding

A nice illustration of the effects of viscosity is flow past a cylinder. In this flow, vortices develop behind the cylinder. These vortices exert an oscillating force on the cylinder as shown in the time history plot.
**Performance Results**

Some of the QA models run for a short time and have relatively small meshes. Therefore speedups are not that representative.

**The Performance speed ups on Windows 64 bit**

<table>
<thead>
<tr>
<th>Functionality</th>
<th>1 CPU</th>
<th>2 CPUs</th>
<th>2 CPUs %</th>
<th>4 CPUs</th>
<th>4 CPUs %</th>
<th>8 CPUs</th>
<th>8 CPUs %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biased mesh with markers</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blast wave on biased mesh</td>
<td>5.8</td>
<td>6.1</td>
<td>0.95</td>
<td>7.8</td>
<td>0.74</td>
<td>11</td>
<td>0.52</td>
</tr>
<tr>
<td>Bullet impact</td>
<td>1209</td>
<td>751</td>
<td>1.60</td>
<td>506</td>
<td>2.39</td>
<td>446</td>
<td>2.71</td>
</tr>
<tr>
<td>Bunker blast with the multi-mat solver</td>
<td>81</td>
<td>53</td>
<td>1.52</td>
<td>59</td>
<td>1.37</td>
<td>62</td>
<td>1.30</td>
</tr>
<tr>
<td>Bunker blast with the Roe solver</td>
<td>76</td>
<td>63</td>
<td>1.2</td>
<td>44</td>
<td>1.7</td>
<td>72</td>
<td>1.0</td>
</tr>
<tr>
<td>Bunker blast with the standard single material solver</td>
<td>71</td>
<td>48</td>
<td>1.47</td>
<td>61</td>
<td>1.16</td>
<td>59</td>
<td>1.2</td>
</tr>
<tr>
<td>Flow between containers with the multi-mat solver</td>
<td>370</td>
<td>256</td>
<td>1.44</td>
<td>198</td>
<td>1.87</td>
<td>131</td>
<td>2.82</td>
</tr>
<tr>
<td>Flow between containers with the Roe solver</td>
<td>515</td>
<td>306</td>
<td>1.68</td>
<td>285</td>
<td>1.812</td>
<td>213</td>
<td>2.41</td>
</tr>
<tr>
<td>Flow between containers with the standard single-mat solver</td>
<td>230</td>
<td>150</td>
<td>1.53</td>
<td>139</td>
<td>1.65</td>
<td>75</td>
<td>3.06</td>
</tr>
<tr>
<td>Undex without ship</td>
<td>759</td>
<td>492</td>
<td>1.54</td>
<td>292</td>
<td>2.60</td>
<td>238</td>
<td>3.18</td>
</tr>
<tr>
<td>Vortex shedding</td>
<td>546</td>
<td>280</td>
<td>1.95</td>
<td>180</td>
<td>3.03</td>
<td>172</td>
<td>3.17</td>
</tr>
</tbody>
</table>

For the bunker simulation, coupling computations are the main cost. Since the coupling computation does not always scale well with higher number of processors used, a reduction in speed up is to be expected.

For the bunker simulation with multi-material there is even a speed down for eight CPUs. This is caused by expensive coupling surface computation. The reason is that the Euler mesh is small in comparison with the number of coupling surface segments. Further optimization of the coupling surface computation can overcome this problem and will be implemented in MD Nastran SOL 700.

The blast wave example does not scale and shows poor performance because the Euler mesh is too small. When more CPUs are used, the Euler mesh is divided into several smaller domains. When these domains are sufficiently small, it can create an overhead and the communication times among these domains can exceed the time to actually solve and process the euler causing an speed down.
Chapter 2: Eulerian and Fluid-Structure Interaction (FSI)

Performance Results

**Blast wave**

<table>
<thead>
<tr>
<th>CPU</th>
<th>1CPU</th>
<th>2CPU</th>
<th>4CPU</th>
<th>8CPU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>2s</td>
<td>4s</td>
<td>6s</td>
<td>12s</td>
</tr>
</tbody>
</table>

**Bullet impact**

<table>
<thead>
<tr>
<th>CPU</th>
<th>1CPU</th>
<th>2CPU</th>
<th>4CPU</th>
<th>8CPU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>1400s</td>
<td>700s</td>
<td>350s</td>
<td>175s</td>
</tr>
</tbody>
</table>

**Bunker MM solver**

<table>
<thead>
<tr>
<th>CPU</th>
<th>1CPU</th>
<th>2CPU</th>
<th>4CPU</th>
<th>8CPU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>90s</td>
<td>45s</td>
<td>22.5s</td>
<td>11.25s</td>
</tr>
</tbody>
</table>
### The Performance speed ups on Linux X8664 OpenMPI

<table>
<thead>
<tr>
<th>Functionality</th>
<th>1 CPU</th>
<th>2 CPUs</th>
<th>2 CPUs %</th>
<th>4 CPUs</th>
<th>4 CPUx %</th>
<th>8 CPUs</th>
<th>8 CPUs %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biased mesh with markers</td>
<td>NA</td>
<td>1.2</td>
<td>1.1</td>
<td>4.9</td>
<td>1.0</td>
<td>5.6</td>
<td>0.89</td>
</tr>
<tr>
<td>Blast wave on biased mesh</td>
<td>5.0</td>
<td>4.4</td>
<td>1.1</td>
<td>4.9</td>
<td>1.0</td>
<td>5.6</td>
<td>0.89</td>
</tr>
<tr>
<td>Bullet impact</td>
<td>1041</td>
<td>632</td>
<td>1.64</td>
<td>410</td>
<td>2.53</td>
<td>280</td>
<td>3.71</td>
</tr>
<tr>
<td>Bunker blast with the multi-mat solver</td>
<td>128</td>
<td>98</td>
<td>1.30</td>
<td>54</td>
<td>2.37</td>
<td>66</td>
<td>1.93</td>
</tr>
<tr>
<td>Bunker blast with the Roe solver</td>
<td>139</td>
<td>104</td>
<td>1.33</td>
<td>56</td>
<td>2.48</td>
<td>66</td>
<td>2.11</td>
</tr>
<tr>
<td>Bunker blast with the standard single material solver</td>
<td>121</td>
<td>92</td>
<td>1.31</td>
<td>50</td>
<td>2.42</td>
<td>63</td>
<td>1.92</td>
</tr>
<tr>
<td>flow between containers with the multi-mat solver</td>
<td>396</td>
<td>234</td>
<td>1.69</td>
<td>141</td>
<td>2.81</td>
<td>86</td>
<td>4.6</td>
</tr>
<tr>
<td>flow between containers with the Roe solver</td>
<td>698</td>
<td>427</td>
<td>1.63</td>
<td>367</td>
<td>1.90</td>
<td>230</td>
<td>3.03</td>
</tr>
<tr>
<td>flow between containers with the standard single-mat solver</td>
<td>278</td>
<td>148</td>
<td>1.88</td>
<td>107</td>
<td>2.60</td>
<td>57</td>
<td>4.88</td>
</tr>
<tr>
<td>Undex without ship</td>
<td>705</td>
<td>385</td>
<td>1.83</td>
<td>197</td>
<td>3.58</td>
<td>149</td>
<td>4.74</td>
</tr>
<tr>
<td>Vortex shedding</td>
<td>1121</td>
<td>535</td>
<td>2.09</td>
<td>291</td>
<td>3.85</td>
<td>188</td>
<td>5.96</td>
</tr>
</tbody>
</table>
Chapter 2: Eulerian and Fluid-Structure Interaction (FSI)

Performance Results

- **Blast Wave**
- **Bunker MM solver**
- **Bunker ROE solver**
Chapter 2: Eulerian and Fluid-Structure Interaction (FSI)

Performance Results

![Flow containers STD](image)

![Bullet Impact](image)

![Undex without ship](image)
Also, here the blast wave example does not scale. The reasons are the same as for windows 64 bit.

**Cyclic Flow Boundary**

An additional capability in this release is the cyclic flow boundary with applications in turbines, flow between rotating structures, and pipe flow problems. This capability allows the users to model only a small sector or portion of their models and can dramatically increase the performance.

By using the new FLOWC entry, the user can specify two boundary conditions that will form the cyclic boundary. Outflow at one boundary is used as inflow at the other boundary. Cyclic flow boundary also applies to pie shaped Euler mesh where the two boundaries are the lateral sides of the sector.

A new output request entry, MATBX, is also available to postprocess the time history results of the material that are residing with a “box” in the model.

Please see *Water Waves with Cyclic Flow Boundaries* in Chapter 3 of the *Dytran Example Problem Manual* for an example of the application of cyclic flow boundary and output request using MATBX.
Enhancements to Body Force

An enhancement to body force allows body forces to be applied on different material inside a particular region. The regions can be defined by a box, sphere, cylinder, or a surface. Previously, the body forces could be applied to one material only. One important feature is that this can be used to define a magnetic field where the material will move together is a region when a gravity or acceleration field is applied. This is a useful feature to define the behavior of toner and magnetic material inside copiers.

Other Enhancements and Defect Corrections

The following defects were corrected for this release:

- 1-256987841 - Error in Graded-MESH problem using SUBMESH without Coupling surface
- 1-254510325 - When converting CHEXA to MESH/BOX, the results are different
- 1-193123172 - Using COUPLE and CONTACT together sometimes results in incorrect friction.
- 1-190137967 - VELMAX works different way in multiple euler domain problem
- 1-190137921 - Euler boundary output (EBD,EBDS) doesn't work correctly
- 1-189923591 - Time in OUT file on headers is not correct
- 1-189879771 - FLODIR and WALLDIR do not recognize Multiple Euler domain
- 1-81041691 - Dytran2008r1 core dumps on SGI Altix450
- 1-80980451 - Dytran2008r1 cannot execute on SGI Altix 450
- 1-80562271 - Contact BPLANE bug
- 1-80525824 - OUTPUT variables (MFL,MFLR) does not exist in MMSTRENGTH solver
- 1-79549836 - Error of restart in case of use of MMHYDRO with viscosity
- 1-79394167 - Dytran document updates
- 1-79393211 - Temperature output not available for YLDZA with multi-material Euler
- 1-79191389 - Job crashes quickly because of failed dynamic allocation
- 1-78886571 - Some Euler is output while it has been deactivated
- 1-77975639 - Excomp contains several bugs
- 1-76464321 - 0 on COUPLE is not interpreted as "blank"
- 1-75672951 - In the example problem manual there are errors in units of sie
- 1-67976214 - MESH Card entry in Dytran deck
- 1-61867113 - Unable to map density message in the OUT file but the ARCHIVE is correct
- 1-61174411 - MSC.Dytran X64 bit version crashed with NaN
- 1-51315118 - The attached Dytran deck runs to completion, but the resulting .arc file can't be attached to Patran
• 1-41309141 - just existence of EXFAIL user subroutine which does nothing - changes results of calculations
• 1-24082829 - coredump during restart
• 1-22778077 - "stack overflow" error when trying to run multiple euler domain/multiple coupling surface analysis
• 1-21769271 - undefined error message
• 1-19124541 - missing param tolchk documentation
• 1-17144101 - FMATPLT can not be used to describe multi-material
• 1-258438269 Time-dependent flow boundary conditions could not be specified for faces in a certain direction. Added FLOWTDR.
• 1-12548488711- Strange Element Stretching in Bird Strike Analysis. Added excomp1 user subroutine for failure of composite elements. This routine allows to specify failure per deformation mode.
• 1-251471409 - Dytran Eulerian solver is unable to manage hydrodynamic materials (EOSGAM, EOSJWL, ...) with MMSTREN
• 1-253535331 - Dytran DMP version gives different results in a bird strike problem with three Eulerian domains than those of the sequential Dytran version.
• Multi-material output for surface time history requests. MASSxx with xx the material number of the Eulerian material can be requested.
• For multi-material Euler simulations with porosity mass flow and mass flow rates can be requested for each material. For example MFL-PORxx and MFLR-PORxx can be requested where xx is the material number.
• For interactive failure the mass flow through failed elements is available by requesting MFL-FAIL and MFLR-FAIL on surface time history requests. For multi-material simulations MFL-FAIL and MFLR-FAIL are available per material.
• Time history for geometric flow boundaries (EBDS) did not support geometric boundary conditions.
• Enable markers for graded meshes.
• For many simulations Lagrange elements are significantly smaller than Euler elements. Consequently the time step is so small that there is little dynamics in an Euler element during a cycle. Under these circumstances subcycling of coupling surface computation can be activated (COSUBMAX) and this can speed up the simulation significantly. But still the Euler solver computations are done each cycle. The new option EUSUBMAX has been introduced to also skip Euler computations similar to the way coupling surface computations are skipped. The speed up can be significant but this is highly problem dependent.
• 1-80525893 - Body force for specific areas; BODYFR1 was added.
• 1-80555351 - Flow boundary mirroring; FLOWC, FLOWCDR, and FLOCSQ were added.
• Time history output for elements inside a user-defined box; MATBX was added. Provides an alternative to markers when general coupling since markers are not supported by general coupling.
Chapter 3: System Information

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Software Installation

On the Windows platforms, Dytran 2010 can easily be installed from CD-ROM as it uses the standard Windows Installation Wizard. On Unix and Linux platforms, the MSC.Software standard installation script can be used to install the software on your system. Dytran 2010 is the successor of Dytran 2008 r1.

Licensing

Dytran uses the FLEXlm license manager as the licensing system for nodelock and network licensing.

To run Dytran, you need an authorization code from MSC.Software Corporation. If you already have a license for MSC.Dytran 2008 r1, you will not need to obtain a new license for Dytran 2010. DMP capability is part of Dytran Standard and no additional licenses are needed to run DMP capability in Dytran 2010.

However, you will need to install the latest FLEXlm 11.6 License server.

On Windows and Linux computers, Dytran requires an Ethernet card on your computer, even if your computer is not connected to a network. The FLEXlm licensing mechanism uses the Ethernet card to create the unique system identification encrypted in the license information file.
# Release Platforms

Dytran 2010 was built and tested on the following hardware with the listed software installed as given in Table 3-1.

<table>
<thead>
<tr>
<th>Platform</th>
<th>Operating System</th>
<th>Compiler Version</th>
<th>OpenMP Support</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 32</td>
<td>Windows XP SP2</td>
<td>Intel Compiler Intel 10.1.024**</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
<tr>
<td>Windows x64</td>
<td>Windows XP SP2</td>
<td>Intel Compiler Intel 10.1.024**</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
<tr>
<td>HP-UX PA-RISC 2.0</td>
<td>HPUX B.11.11</td>
<td>HP F90 V3.1</td>
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<tr>
<td>Sun SPARC Solaris</td>
<td>Solaris 10</td>
<td>Sun Studio 12 (Sun Fortran 95 8.3 SunOS_sparc Patch 127000-01 2007/07/18)</td>
<td>Yes</td>
<td>NA</td>
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<tr>
<td>Solaris x64</td>
<td>Solaris 10</td>
<td>Sun Studio 12 (Sun Fortran 95 8.3 SunOS_i386 Patch 127002-01 2007/07/18)</td>
<td>Yes</td>
<td>NA</td>
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<tr>
<td>IBM RS/6000 (Power4)</td>
<td>AIX 5.3</td>
<td>XL Fortran 11.1</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>SGI R10K/R12K</td>
<td>IRIX64 6.5.27</td>
<td>MipsPRO F90 7.4.2</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>Linux Itanium2</td>
<td>RedHat 4 Update 5</td>
<td>Intel Compiler 10.1.012*</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
<tr>
<td>Linux Itanium2 SGI Altix</td>
<td>SGI ProPack4 SP0</td>
<td>Intel Compiler 10.1.011*</td>
<td>Yes</td>
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<td>Linux X8664</td>
<td>RedHat 4 Update 5</td>
<td>Intel Compiler 10.1.017*</td>
<td>Yes</td>
<td>Ethernet Card</td>
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<td>Linux 32</td>
<td>RedHat 4 Update 5</td>
<td>Intel Compiler 10.1.017*</td>
<td>Yes</td>
<td>Ethernet Card</td>
</tr>
</tbody>
</table>

*For correct operation of Intel Fortran Compiler, MS Visual Studio, NET 2005 must be installed prior to installing the Intel Compiler.

**User subroutines can only be compiled and linked with Intel Fortan 10.1.024 in Dytran 2010
**System Requirements for DMP**

Running Dytran on multiple CPUs requires MPI to be installed on every machine used. This is true even for single processor machines.

Dytran expects hardware-specific native MPI to have been installed at default locations. When MPI is not properly installed on your Unix/Linux machine or is not installed at the expected default location, a job submission exits with an error message to this effect. To avoid problems of this nature or problems caused by different versions of MPI on several of the supported platforms, the MPI version is now part of the release and is installed at a defined location. See Table 3-2 for details.

<table>
<thead>
<tr>
<th>Platform</th>
<th>MPI Version</th>
<th>MPI Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 32</td>
<td>MPICH2</td>
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<td>Windows 64</td>
<td>MS CCP 1.0</td>
<td>C:\Program Files\Microsoft Compute Cluster Pack</td>
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<tr>
<td>SGI Altix</td>
<td>MPT 1.13</td>
<td>2</td>
</tr>
<tr>
<td>HP-UX – PA RISC 2.0</td>
<td>HP MPI 2.2</td>
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</tr>
<tr>
<td>HP-UX Itanium2</td>
<td>HP MPI 2.2</td>
<td>3</td>
</tr>
<tr>
<td>Sun Sparc Solaris</td>
<td>SUN HPC 7.1</td>
<td>/opt/SUNW/hpc/HPC7.1</td>
</tr>
<tr>
<td>Solaris x64</td>
<td>SUN HPC 7.1</td>
<td>/opt/SUNW/hpc/HPC7.1</td>
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<tr>
<td>IBM RS/6000</td>
<td>POE 4.2.2.14</td>
<td>/usr/lpp/ppe.poe</td>
</tr>
<tr>
<td>Linux Itanium2 IA64</td>
<td>HP-MPI 2.2.7/Openmp-1.2.5</td>
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<td>Linux EM64T x86_64</td>
<td>HP-MPI 2.2.7/Openmp-1.2.5</td>
<td>3</td>
</tr>
<tr>
<td>Linux 32</td>
<td>HP-MPI 2.2.7/Openmp-1.2.5</td>
<td>3</td>
</tr>
</tbody>
</table>

1. Exact location not important as long as it is installed. Install location is picked up from the registry.
2. Proper install provides soft links to /usr/bin, /usr/lib.
3. MPI is part of the release and automatically installed in $installdir/bin/exe/mpi
Memory Requirements

In general, the size of the memory required by Dytran depends on the size of the engineering problem you wish to solve. The default memory size is set to approximately 30MB. This default size is appropriate for smaller problems.

You can change the preset default in the Dytran Explorer so that it fits your personal needs. In addition, you can define the minimum and maximum memory size and use the slider in the front panel to select the desired memory size. On Unix and Linux platforms you can use the command-line option `(size=small/medium/large)` or you can enter the `MEMORY-SIZE` definition in the input file.

Dytran traces the usage of memory and prints a summary at the end of the output file of each analysis. The memory size listed in the summary is exact. It reflects the memory required for storing the model in core memory after one integration step. Additional memory required during the analysis is automatically allocated and de-allocated.

When you change the memory setting for an analysis through the Dytran Explorer, the settings will be stored to be used the next time that you run the analysis. Under certain conditions, Dytran may stop and issue a message that it cannot allocate the required memory. Since the memory allocation in Dytran is dynamic, the system may require additional memory during an analysis. If the memory is available, it will be allocated and de-allocated when it is no longer needed. When your computer runs out of memory, the Dytran analysis may stop when it needs more memory to continue. You may solve this problem by closing applications on your computer that you do not need, or you can decrease the size of the core memory that Dytran allocates for the analysis if you are using substantially more than the analysis requires. You can find the information on the memory size requirements of the analysis in the memory summary at the end of the analysis. We recommend to use Dytran on a computer that has at least 256 MB of RAM.
4 Using Dytran

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- Running Dytran on Windows  34
- Postprocessing Dytran Results  35
- Postprocessing Dytran Results of Windows on UNIX  35
Running Dytran on Unix and Linux

On Unix and Linux platform, you would use the command line interface like:

- `dytran jid=xxx` (to submit a regular Dytran job)
- `dytran jid=xxx bat=no` (to submit Dytran in interactive mode)
- `dytran jid=xxx exe=my_exe.exe` (to submit a Dytran job with a customized executable)

To submit DMP jobs, you must specify the number of processors as well:

- `dytran jid=xxx dmp=yes ncpus=2`
- `dytran jid=xxx dmp=yes ncpus=4 bat=no`

**Note:**
- `xxx` should be replaced by the name of your input deck without the `.dat` extension.
- Currently, it is not possible to create customized executables for DMP.

Running Dytran on Windows

On Windows, submit a Dytran analysis by double clicking the Dytran icon. The icon should be available on your desktop. Alternatively, you can use the Start Menu to locate Dytran under the Programs Folder. Once you picked either the icon or the menu entry, the Dytran user environment appears on your screen. The Dytran Explorer provides an on-line help system that contains information about the functionality of the Dytran Explorer. The Dytran Explorer provides some basic postprocessing and animation tools.

To submit DMP jobs, open Start/run command window, and type:

```
{Dytran directory}\Dytran\2010\dytranexe\run_dytran.bat jid={job-name} dmp=dytran nproc={number of processors}
```

For instance:

1. Name input model is `bunker.dat`.
2. Dytran is installed at `C:\MSC.Software`.
3. Model needs to run on four CPUs in DMP mode.

The correct command would be:

```
C:\MSC.Software\Dytran\2010\dytranexe\run_dytran.bat jid=bunker dmp=dytran nproc=4
```

**Note:** Currently, it is not possible to create customized executables for DMP.
Postprocessing Dytran Results

Dytran results can be postprocessed with Patran. With MSC.Patran, the Direct Result Access (DRA) method is available for native Dytran output files (ARC, THS).

In addition, on Windows, you can use the VisualVrml postprocessing, animation and Visual TimeHistory tool. The tool is built-in inside the Dytran Explorer and offers web-based postprocessing capabilities.

Postprocessing Dytran Results of Windows on UNIX

If you wish, you can post process the analysis results obtained from a Windows platform on a UNIX computer. In this case, you need to convert the binary result files (.ARC and/or .THS) files to a UNIX format. You can perform this conversion by using the right-mouse button menu in the Dytran Explorer. Point your mouse at the file that you wish to convert, click the right mouse button, and select the Convert to binary… menu item. The converted files will have the sb_ prefix. For Compaq Alpha workstations, the native Windows result files can be used directly without conversion.

Alternatively, when running on windows, you can select the option to output result files in UNIX format by default. To set this option, select the Preferences from the Options menu. Choose Formats and select Convert output files automatically to UNIX-format. If you select this option, the regular Windows result files and the converted UNIX-format files are written at the end of the analysis. You can recognize the UNIX-format files by the ux prefix.