Dytran™ 2017

Release Guide
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Dytran Release Guide

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Chapter 1: Introduction

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Introduction

Dytran™ 2017 is the latest and most comprehensive version of Dytran released by MSC Software providing you with new simulation technology and improved performance.

Dytran 2017 is available on Linux X8664 (Red Hat 6.3, SUSE ES 11 sp2) and Windows 64 bit (Windows 7). Please see Chapter 3: System Information of the Dytran 2017 Release Guide for more details.

Dytran 2017 includes major new capabilities that are focused in the areas of High Performance Computing (HPC) for fluid-structure interaction (FSI) applications resulting in dramatic performance improvement for CPU intensive simulations. These are:

- Orthogonal recursive bisection (ORB): More efficient and more user-friendly Euler domain partitioner.
- More efficient Couple Surface processing for models with extremely large number of elements that are part of the coupling surface with a focus on higher number of cores in the DMP simulation.

In addition, several critical software defects have been corrected in this release.

The Dytran 2017 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 a Dytran 2013 license, you will not need to obtain a new authorization code to activate Dytran 2017 on your computer. However, you will need to install the latest FLEXlm 11.9 license server. MSC Licensing software is now provided on its own Product Page on the Solution Download Center (SDC).

If you need assistance while installing Dytran 2017, please call the MSC Technical Support Hotline at 1-800-732-7284, or E-mail your support questions to mscdytran.support@mscsoftware.com.

For the latest information on supported platforms for upcoming releases of MSC products, please visit the following web site: http://www.mscsoftware.com/Support/Platform-Support/Default.aspx
2 Enhancements

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Overview

This version includes two different updates related to Lagrangian Solid Elements in Dytran.

- Add Johnson-Cook Failure Model (FAILJC)
- Add Ogden Material (RUBBER2)
Johnson-Cook Failure Model (FAILJC)

Johnson-Cook failure model improves the behavior of the elements under existing Johnson-cook relationship such as Johnson-cook yield model (YLDJC). This failure criterion is already available for Eulerian elements. The same functionality is made available to Lagrangian elements.

**Benefit**
- New failure model in nonlinear explicit analysis

**Limitations**
- Available for the materials of Lagrangian solid elements and Eulerian elements

**Outputs**
- DAMAGE output is newly added for Johnson-cook failure model

**Example**

The high impact tension is applied on the cantilever solid beams at the tip. The left faces are fixed. After the cantilever deforms, several elements at the tip are fractured.
Figure 2-1  Damage of element 76

Figure 2-2  Failure time of element 76
Ogden Material (RUBBER2)

Currently, Dytran has only Mooney-Rivlin hyperelastic model (RUBBER1) for fully incompressible materials. The Ogden material can extend the range of the simulation including fully incompressible materials such as rubber. The RUBBER2 entry defines the properties of an Ogden rubber model. It can only be used with Lagrangian solid elements.

Theoretical Background

The constitutive behavior of this material is defined as a total stress-total strain relationship. Rather than by Hooke’s law, the nonlinear elastic material response is formulated by a strain energy density function accounting for large strain components. The strain energy density function is defined according to the Ogden model:

\[ W = \sum_{i=1}^{3} \sum_{j=1}^{n} \frac{\mu_j}{\alpha_j} \left( \lambda_j \left( \frac{a_j}{\alpha_j} - 1 \right) \right) + \frac{1}{2} K (J - 1)^2 \]

where \( \mu_j \) and \( \alpha_j \), are the material constants, \( \lambda_i = \lambda_i / (\lambda_i J) \) and \( J = \lambda_1 \lambda_2 \lambda_3 \).

For rubber-like materials, the shear modulus is much less than the bulk modulus. The shear modulus,

\[ G = \frac{1}{2} \sum_{j=1}^{n} \mu_j \alpha_j \]

And the bulk modulus,

\[ K = \frac{2G(1 + \nu)}{3(1 - 2\nu)} \]

where, \( \nu \) is the Poisson's ratio which is close to 0.5.

Stretches (deformation gradient tensor) are defined as:

\[ \frac{\partial x_i}{\partial X_j} = F_{ij} \]

where \( x_i \) and \( X_j \) are, respectively, the coordinates of the deformed and the original geometry.

The right Cauchy-Green tensor are computed as:

\[ C_{ij} = F_{ki} F_{kj} \]

The principal Kirchoff stress components are given by:
\[ \tau_{ii}^E = \lambda_i \frac{W}{\partial \lambda_i} \]  

(this is not sum)

where \( \lambda_i \) is the principal stretch.

The standard basis is extracted using standard formula:

\[ \tau_{ij} = q_{ik}q_{ji}\tau_{kl}^E \]

where \( q_{ij} \) is the component of the orthogonal tensor containing the eigenvectors of the principal basis.

The Cauchy stress tensor is calculated using:

\[ \sigma_{ij} = J^{-1} \tau_{ij} \]

**Benefit**

- The rubber model can be simulated more options.

**Limitations**

- Only available for the materials of Lagrangian solid elements.
- When the variables are not set properly, the proper stretch cannot be found.

**Example**

The shear forces are added at the center of solid element block which upper and lower faces are fixed. The results are compared with SOL700.
Effective stress contour at 2.0 seconds
# List of Software Corrections in Dytran 2017

The following software defects are fixed in this release:

<table>
<thead>
<tr>
<th>Defect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DYT-518</td>
<td>Cannot compile user subroutine with Dytran Explorer on Windows. This has been fixed in Dytran 2017.</td>
</tr>
<tr>
<td>DYT-584</td>
<td>Too many Euler cubes causes crash running DMP. The problem was fixed by an update in the DMP algorithm of Dytran.</td>
</tr>
<tr>
<td>DYT-674</td>
<td>Output files not deleted directly. Changed functionality of “Waste Basket” to that of the old Dytran Explorer.</td>
</tr>
<tr>
<td>DYT-691</td>
<td>RVEL output is always zero at time=0. Made update to compute RVEL at cycle 0. This ensure continuous plots for RVEL time histories.</td>
</tr>
<tr>
<td>DYT-698</td>
<td>ALLGRIDPOINTS output error&lt;br&gt;When requesting ALLGRIDPONTS for a grid point archive and when there are RBE2s included, the grid point archive cannot be read into Patran.</td>
</tr>
<tr>
<td>DYT-699</td>
<td>Dytran Parallel (DMP) will not run when requesting ALLGRIDPONTS for a grid point archive and when using Euler DMP the run terminates with an error.</td>
</tr>
<tr>
<td>DYT-701</td>
<td>Issues with ExtractSteps. Changed functionality of radio buttons, so user can select extraction to one ARC-file, or separate ARC files for each time step.</td>
</tr>
<tr>
<td>DYT-761</td>
<td>Dytran Explorer and Dytran run crash when hit &quot;ESC&quot; button on keyboard. An update was added to Dytran Explorer so that it no longer reacts to the pressing of the ESC button.</td>
</tr>
<tr>
<td>DYT-763</td>
<td>Adaptive Euler created duplicate user ID number of Euler mesh element. The output processing was getting confused. This was fixed and all Euler elements in all meshes now have unique ID’s.</td>
</tr>
<tr>
<td>DYT-1110</td>
<td>Fixed the incorrect handling in arc2vtk.of IDs of global variables inside THS files.</td>
</tr>
<tr>
<td>DYT-1111</td>
<td>EXCOMP1 user subroutine crashes when user variables were used.</td>
</tr>
<tr>
<td>DYT-1113</td>
<td>Dytran Explorer not hiding VTU/PVD files in output file window. Added button to toggle display of VTU/PVD files.</td>
</tr>
<tr>
<td>DYT-1115</td>
<td>Dytran Explorer graph has issues when Y-axis has zero values. Added check on xmin-xmax, when they have the same value they will be changed by minus resp. plus 10 percent of their value, unless when they are zero, in which case -0.1 and +0.1 will be used.</td>
</tr>
<tr>
<td>DYT-1117</td>
<td>Dytran Explorer 2017 graph values fly off from graph. Fixed bug in the tool and now graph shows good graph values.</td>
</tr>
<tr>
<td>DYT-1118</td>
<td>Dytran Explorer chooses scales for last THS entered. Changed search for minimum and maximum curve values, such that all active curves are included and not only the last one added.</td>
</tr>
<tr>
<td>DYT-1119</td>
<td>Dytran Explorer crashes when user tries to open different THS files sequentially.</td>
</tr>
</tbody>
</table>
## Chapter 2: Enhancements

List of Software Corrections in Dytran 2017

<table>
<thead>
<tr>
<th>Defect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DYT-1121</td>
<td>FLOW boundary output in Dytran Explorer does not work for FLOWDIR. Reduced the name of the FLOWDIR to a maximum of 8 characters after which Dytran Explorer can read the results properly again.</td>
</tr>
<tr>
<td>DYT-1124</td>
<td>Core dump of the viscous wall boundary treatment. Solved coredump and also enabled DMP for the combination MMSTREN + viscosity.</td>
</tr>
<tr>
<td>DYT-1125</td>
<td>Too many Euler cubes causes crash running DMP. The problem was fixed by an update in the DMP algorithm of Dytran.</td>
</tr>
<tr>
<td>DYT-1131</td>
<td>PARAM, EULSTRESS, MASS has a problem.</td>
</tr>
<tr>
<td></td>
<td>For simulations run with either:</td>
</tr>
<tr>
<td></td>
<td>1. PARAM, EULSTRES, MASS</td>
</tr>
<tr>
<td></td>
<td>2. The YLDMSS model.</td>
</tr>
<tr>
<td></td>
<td>3. The single Euler with strength solver.</td>
</tr>
<tr>
<td></td>
<td>The computation of the Eulerian stress tensor has been made more accurate. As a result Dytran 2017 can show small changes in results for such models.</td>
</tr>
<tr>
<td>DYT-1137</td>
<td>MEMORY-SIZE was not written correctly in out file and error message file. Printing out required and available memory information does not match MEMORY-SIZE input when DMP is used because the memory amount is calculated for each core. The available memory is calculated using the equation: memory = (Assigned memory)/(number of cores)*1.1. The new warning message will be printed out when MEMORY-SIZE and DMP are used together.</td>
</tr>
<tr>
<td>DYT-1138</td>
<td>Dytran Explorer Delete button is not working as expected. Fixed behavior of the Delete Button.</td>
</tr>
<tr>
<td>DYT-1150</td>
<td>A model that combines the usage of DMATOR and real Tetra elements (Type 14) gives a core dump. An error message was added to Dytran to catch this combination. A workaround is to use reduced CHEXA elements (Type 8). An enhancement request was added so the support of DMATOR for real Tetra elements will be considered for future implementations.</td>
</tr>
<tr>
<td>DYT-1181</td>
<td>PVISCEX input field 2 reads as integer and not real. When two or more user values in PVISCEX are used, the job fails with strange memory handling error message because the 84 user information of 1D element property is not acceptable for PVISCEX. The part is skipped when PVISCEX is used and the job does not show the problem anymore.</td>
</tr>
<tr>
<td>DYT-1184</td>
<td>Reference manual description for PSHELL1. Pictures in this description have issues. Fixed option REF and corrected position of X (integration point).</td>
</tr>
<tr>
<td>DYT-1190</td>
<td>EXEOS access violation. Fixed a bug in the EXEOS functionality.</td>
</tr>
<tr>
<td>DYT-1192</td>
<td>DAS error occurred for model that has 2 Euler meshes and 3 coupling surfaces, 2 of them share 2 holes between the 2 Euler meshes. This was fixed.</td>
</tr>
<tr>
<td>Defect</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DYT-1214</td>
<td>VELMAX1 information was not printed in the OUT-file.</td>
</tr>
<tr>
<td>DYT-1218</td>
<td>When a model is using more than 8 TABFILE entries, Dytran will give memory errors. This was fixed.</td>
</tr>
<tr>
<td>DYT-1263</td>
<td>SOFTE and VOLPLS variables in EXEOS are only defined when Euler multi-material with strength is used. In other solutions the variables can not be used. Now SOFTE and VOLPLS are defined for all types of Euler.</td>
</tr>
<tr>
<td>DYT-1264</td>
<td>Core dump when using EXOUT routine because there are multiple Euler meshes defined. This was fixed.</td>
</tr>
<tr>
<td>DYT-1265</td>
<td>Model initialization taking very long with large TABLED. Algorithm to read and store large tables has been improved.</td>
</tr>
<tr>
<td>DYT-1266</td>
<td>Large TABLED1 causes slowdown in performance. Algorithm to interpolate in large tables has been improved.</td>
</tr>
<tr>
<td>DYT-1273</td>
<td>CONM2 is not working on DMP when using tet14.</td>
</tr>
<tr>
<td>DYT-1275</td>
<td>User subroutines are not working in Dytran 2017 Beta. Documentation has been updated with examples how to include a user subroutine in Dytran 2017.</td>
</tr>
<tr>
<td>DYT-1278</td>
<td>BODYFR1+TABFILE cannot recognize file name with upper and lower case characters. This has been fixed.</td>
</tr>
<tr>
<td>DYT-1279</td>
<td>Too many Euler cubes causes crash running DMP. The problem was fixed by an update in the DMP algorithm of Dytran.</td>
</tr>
</tbody>
</table>
# List of Known Software Defects in Dytran 2017

The following are known software defects in this release:

<table>
<thead>
<tr>
<th>Defect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DYT-328</td>
<td>TIC3 doesn't work correctly with shell cone in Dytran. Rotation does not work.</td>
</tr>
<tr>
<td>DYT-352</td>
<td>Could not output fiber and matrix failure index successfully when selecting Classic Laminate Theory.</td>
</tr>
<tr>
<td>DYT-447</td>
<td>Beam offset leads to incorrect results.</td>
</tr>
<tr>
<td>DYT-459</td>
<td>Catastrophic error occurs when BJOINs are used together with contact and PARAM, CONTACT, VERSION, V4 is used.</td>
</tr>
<tr>
<td>DYT-481</td>
<td>Scheduler and Queuing of Dytran Explorer does not support DMP run.</td>
</tr>
<tr>
<td>DYT-556</td>
<td>CONM2 with RBE2 doesn't give nodal outputs.</td>
</tr>
<tr>
<td>DYT-595</td>
<td>RBHINGE not working properly.</td>
</tr>
<tr>
<td>DYT-606</td>
<td>When SET card is incorrectly used the DMP simulation does not terminate with a proper error message.</td>
</tr>
<tr>
<td>DYT-607</td>
<td>Limitation of number of Euler material. When number is too high, the DMP simulation does not terminate with a proper error message.</td>
</tr>
<tr>
<td>DYT-1114</td>
<td>Dytran Explorer command window shown.</td>
</tr>
<tr>
<td>DYT-1130</td>
<td>MASS was increased from 2 FLOWDIR Boundary crossing.</td>
</tr>
<tr>
<td>DYT-1132</td>
<td>Multiple RELLIPS penetrated into RIGID surface.</td>
</tr>
<tr>
<td>DYT-1140</td>
<td>DMP error occurs when CONTACT and RCONN are used in the same model</td>
</tr>
<tr>
<td>DYT-1141</td>
<td>Initial rotational velocity (TICGP) in local coordinate system is not working correctly.</td>
</tr>
<tr>
<td>DYT-1142</td>
<td>DMP error occurred, that can run on single CPU mode. Model contains contact definitions on marker grid points.</td>
</tr>
<tr>
<td>DYT-1282</td>
<td>Dytran Explorer 2017 stop button not working when try to kill the Dytran run.</td>
</tr>
</tbody>
</table>
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Software Installation

Dytran 2017 on Windows and Linux platforms can be downloaded from MSC.Software’s Solutions Download Center:

https://mscsoftware.subscribenet.com/

On the Windows platforms, Dytran 2017 can easily be installed as it uses the standard Windows Installation Wizard. On Linux platforms, the MSC.Software standard installation script can be used to install the software on your system. Dytran 2017 is the successor of Dytran 2017.

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 2017, you will not need to obtain a new license for Dytran 2017. DMP capability is part of Dytran Standard and no additional licenses are needed to run DMP capability in Dytran 2017. However, in all cases, you do need a new installation of the license server software. Specifically, the FlexLM license server needs to be at level 10 or higher. For this purpose, an installation of FlexLM v11.9 is part of this release on all supported platforms. It is noted that Dytran 2017 is not able to check out licenses when the FlexLM server is lower than version 10.

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 2017 was built and tested on the following hardware with the listed software installed as given in Table 3-1.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>OS</th>
<th>FORTRAN Version</th>
<th>Visual Studio</th>
<th>MPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux X8664</td>
<td>RHEL 6.7</td>
<td>Intel 16.0</td>
<td>NA</td>
<td>OpenMPI 1.8.5 (Default)</td>
</tr>
<tr>
<td></td>
<td>RHEL 7.1</td>
<td></td>
<td></td>
<td>HP MPI 9.01.02.00r</td>
</tr>
<tr>
<td></td>
<td>SuSE 11 sp3</td>
<td></td>
<td></td>
<td>Intel MPI 5.0.1.035</td>
</tr>
<tr>
<td></td>
<td>Windows7</td>
<td>Intel 16.0</td>
<td>Visual Studio 2015</td>
<td>Miscosoft HPC Pack 2012 R2 (Default)</td>
</tr>
<tr>
<td></td>
<td>Windows10</td>
<td></td>
<td></td>
<td>HP MPI 9.01.02.00r</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Intel MPI 5.0.1.037</td>
</tr>
<tr>
<td>Windows X8664</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 calculated by the Dytran Solver. It makes an estimate based on the number of elements, number of grid points, boundary conditions, output requests, and others. Typically, the memory does not have to be adjusted anymore since the Dytran 2013 release, but it may still occasionally need adjustment.

On Linux platforms, the user has the command-line option (size=small/medium/large), or the user can add 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.

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 the computer runs out of memory, the Dytran analysis may stop when it needs more memory to continue. The user can solve this problem by closing applications on the computer that are no longer needed, or the user can decrease the size of the core memory that Dytran allocates for the analysis if Dytran decided to use substantially more than the analysis requires. The information on the memory size requirements of the analysis can be found in the memory summary at the end of the analysis. MSC Software Corporation recommends using Dytran on a computer that has at least 4 GB of RAM.
4 Using Dytran

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Running Dytran on Linux

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

- `{Full path to Dytran installation}/2017/bin/dytran jid={jobid}

Alternatively, the user may choose to create the following alias:

- `% alias dytran {Full path to Dytran installation}/2017/bin/dytran

With this alias dytran jobs can be executed. For example:

- dytran jid=xxx (to submit a regular Dytran job)
- dytran jid=xxx bat=no (to submit Dytran in interactive mode)
- dytran jid=xxx ncpus=2 (to submit Dytran using two cores for Shared Memory Parallel)
- 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 (to submit Dytran using two cores Distributed Memory Parallel)
- dytran jid=xxx dmp=yes hlist=hostlist.txt bat=no (to submit Dytran in a cluster using a host list)

Note: xxx should be replaced by the name of your input deck without the .dat extension.
Running Dytran on Windows

On Windows, analysis can be submitted with Dytran.Explorer, a graphical interface to control Dytran jobs and post process the results files. Double click on the Dytran icon on your desktop after the installing Dytran 2017 to start Dytran.Explorer. Alternatively, you can use the start Menu to locate Dytran.Explorer under the Programs Folder. The Dytran.Explorer provides an on-line help system which includes online documentation. Basic post processing and animation tools are available by right-clicking on the results files displayed in Dytran Job window.

To submit DMP jobs, open a DOS command window and type:

{Full path to Dytran installation}\Diyrtran\2017\python\python.exe {Full path to Dytran installation}\Diyrtran\2017\bin\dytran jid={job-name} dmp=yes 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\Diyrtran\2017\python\python.exe
C:\MSC.Software\Diyrtran\2017\bin\dytran jid=bunker dmp=yes nproc=4

User Subroutines

For user subroutines, the correct version of the Intel Fortran compiler and Microsoft Visual Studio must be installed (See Chapter 3: System Information for detailed version information).

Before Version 2017, the user had to compile the individual user subroutine and create new Dytran executable. In this new version, the user will create a user dynamic library which the existing Dytran executable will try to location and access during the simulation. Also new this version is that we allow the user to include either FORTRAN subroutines or C subroutines.

The template for the user subroutines are included in the Dytran 2017 installation. The FORTRAN version is:

C:\MSC.Software\Diyrtran\2017\usr-subrtns\dytran_usersub.f

The C-subroutine is:

C:\MSC.Software\Diyrtran\2017\usr-subrtns\dytran_usersub.c
The user should copy this file to the running directory, and then replace the dummy subroutine with the user-defined subroutine.

**Note:** All unused subroutines should remain inside the template!

• Compile the FORTRAN subroutine with:
  ```
  ifort.exe /nologo /c /cm /MD /4I8 /fp:precise /traceback /O2 /Qsave /Qzero /X /Og /Ot /IC:\MSC.Software\Dytran\2017\usr-subrtns dytran_usersub.f
  ```

• Or: Compile the C subroutine with:
  ```
  cl.exe /c /nologo /Og /Op /Ot /X /MD /traceback /O2 -Dwintel64 -DCALLED /IC:\MSC.Software\Dytran\2017\hinc /IC:\Program Files (x86)\Microsoft Visual Studio 12.0\VC\include dytran_usersub.c
  ```

Before linking, copy the following utility files from the installation to the local working directory:

- get_time.obj
- get_timestep.obj
- iget_nswrap.obj
- iget_runtype.obj
- iget_step.obj
- iput_nswrap.obj
- print_out.obj

Now create the dynamic library with:

```
ifort.exe /o ./dytran_usersub.dll /nologo /LD get_time.obj get_timestep.obj iget_nswrap.obj iget_runtype.obj iget_step.obj iput_nswrap.obj print_out.obj dytran_usersub.obj -link /INCREMENTAL:NO /def:C:\MSC.Software\Dytran\2017\usr-subrtns/dytran_usersub.def dytran_1.lib dytran_2.lib dytran_3.lib dytran_4.lib dytran_5.lib dytran_6.lib dytran_7.lib lapi_imp.lib sfstubs.a dmpstub.a dystubs.admpstub.a /LIBPATH:C:\MSC.Software\Dytran\2017\dytranexe
```

In order to run the serial version of Dytran 2017, first set the following environment variables:

```
set MP_SPIN=10000000
set DPL_NCPUS=1
set OMP_NUM_THREADS=1
set DPL_MAXCPUS=1
set DPL_FLEXLM=True
```

Then add to the PATH the local working directory, so the executable can find the dynamic user library:

```
set PATH={full path to local working directory};%PATH%
```

Then execute Dytran with:

```
C:\MSC.Software\Dytran\2017\dytranexe\dytran.exe jid={input file name},OUTPUT={root name of all output files}
```
In order to run DytranDMP with user subroutines, use the batch script that is available in the installation and use the new option called `userdll`. The value of this option is the complete path the location of the dll:

```
{Full path to Dytran installation}\Dytran\2017\python\python.exe {Full path to Dytran installation}\Dytran\2017\bin\dytran jid={input file name} dmp=dytran userdll={full path to local working directory} nproc={number of processors}
```

### Running Dytran Shared Memory Parallel (SMP)

In order to run the serial version of Dytran 2017 using SMP, first set the following environment variables:

```
set MP_SPIN=10000000
set DPL_FLEXLM=True
```

Then add to the PATH to following directory:

```
set PATH=C:\MSC.Software\Dytran\2017\usr-subrtns;%PATH%
```

Then set the following variables to the desired number of SMP processes desired:

```
set DPL_NCPUS={n}
set OMP_NUM_THREADS={n}
set DPL_MAXCPUS={n}
```

**Note:** The value of n must be the same for all three environment variables!

Then execute Dytran with:

```
C:\MSC.Software\Dytran\2017\dytranexe\dytran.exe jid={input file name},OUTPUT={root name of all output files}
```

### Running Dytran with ATB input files

In order to run the serial version of Dytran 2017 with ATB, first set the following environment variables:

```
set MP_SPIN=10000000
set DPL_FLEXLM=True
set DPL_NCPUS=1
set OMP_NUM_THREADS=1
set DPL_MAXCPUS=1
```

Then add to the PATH to following directory:

```
set PATH=C:\MSC.Software\Dytran\2017\usr-subrtns;%PATH%
```

Then execute Dytran with:
C:\MSC.Software\Dytran\2017\dytranexe\dytran.exe jid={input file name},OUTPUT={root name of all output files},ATB={atb input file}