

Documentation for PHOENICS

TR 110

Installation of INTEL PHOENICS
(Version 2010)

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*Computer Simulation of fluid flow, heat flow,
chemical reaction and stresses in solids*

Installation of PHOENICS 2010

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1 Introduction

1.1 Purpose of the document

The purposes of this document are:

- To explain how to install the PHOENICS program suite on a Pentium PC or compatible computer running under Windows (2000/XP/Vista).
- To describe how to test the success of the installation.
- To provide new users with a brief guide on starting to use PHOENICS.

The contents of this document are applicable to both recompilable, which enables the user to re-link the executables, and non-recompilable with which the user can only use the supplied executables.

1.2 System configuration

To install PHOENICS, the user needs to have a hard disk with at least a total of 1.2GB free space. Additional space should be available for running PHOENICS. How much space will depend on the size of simulations made; for complex models it is possible to generate individual output files which are more than 1GB in size.

Under Windows XP a minimum 512 Megabytes of RAM is required (for Windows Vista/7 a minimum of 1GB) for running PHOENICS. The amount of available RAM will limit the size and complexity of simulations made. Individual programs running under the 32-bit Windows operating systems are limited to 2GB in size. To go beyond this limit, the user will need to have a 64 bit version of the Windows operating system and use the 64-bit version of PHOENICS. There are no special graphics requirements; most modern graphics cards should have no problem running PHOENICS. However, a minimum screen resolution of 1024*768 is recommended.

An Intel Visual Fortran compiler version 9.0 or later is required for the recompilable version of PHOENICS compiled using Intel Fortran compiler. In addition, Microsoft Visual Studio is required since this contains the **linker**. With Visual Fortran version 10.1 Intel includes a copy of Microsoft Visual Studio 2005 premier partner edition, so that a separate purchase of Visual Studio is no longer necessary. For users with earlier versions of Intel Fortran, Microsoft Visual Studio .NET is suitable for Intel Fortran 9.0 and later, and Microsoft Visual Studio 2005 is suitable for Intel Fortran 9.1.

Please note that for Windows Vista and Windows 7 an Administrator account will be required to install the software.

1.3 The remainder of the document

Chapter 2 lists the items supplied with the installation

Chapter 3 describes the installation procedures

Chapter 4 shows how to test the success of the installation

Chapter 5 advises users on starting to use PHOENICS

Chapter 6 shows how to install the parallel version of PHOENICS

Appendix A gives information on how to obtain a unlocking string

Appendix B provides answers to Frequently Asked Questions and to troubleshooting

2 Specification of Items

The following items will be supplied.

2.1 Software

- A CDROM containing the PHOENICS software.
- A CDROM containing the INTEL Visual Fortran compiler (if the compiler was purchased).

2.2 Documentation

- Installation of PHOENICS 2010;TR 110 (this document)

3 Installation Procedures

The quick installation instructions are provided inside the cover of the CDROM case which should enable experienced customers to upgrade their PHOENICS version successfully. Otherwise, it is recommended to read through the following sections before starting installation.

3.1 Ensuring that there is sufficient free disk space.

At least 1.5 GB of free disk space must be available on the target machine before you start to install PHOENICS.

3.2 Checking if PHOENICS has already been installed on the target machine

If an **earlier version** of PHOENICS is already present, it must be deleted, or the name of the existing installation directory changed **before** installing the new version. You may wish to preserve user files from working directories, such as `\phoenics\ld_priv1`, and user geometry files under `\phoenics\ld_satell\ld_object\users`. These can be copied to a temporary location using Windows Explorer, and later moved to the equivalent locations in the new installation.

To delete the old installation, open Windows Explorer and drag the \PHOENICS folder into the Recycle Bin. To rename the old installation to, say, PHOENICS.OLD, open Windows Explorer, right click on the \PHOENICS folder, then on Rename and type in PHOENICS.OLD.

If a previous version of PHOENICS exists on this PC, and you do not rename or remove it, it will not be overwritten by this installation process. The installation process will finish normally, but no existing files will have been overwritten.

If you have the old PHOENICS version on your disk drive C:, and you would like to keep the old version on C:, then you can create a virtual drive and install PHOENICS on this virtual drive, with no need to rename or remove your old PHOENICS version from the C: drive.

Click on 'My computer' icon to ascertain what drive letters are in use. Usually the C: drive will be the user's local hard drive and D: a removable drive (eg CD or DVD), other drive letters may already be in use for mapped network drives. Suppose the drive P: is not in use, you can create a virtual drive P:.

First, make a root level folder with a suitable name, e.g. C:\PHOENICS2010; then in a DOS window, enter the command

```
SUBST P: C:\PHOENICS2010
```

You now have a virtual drive P: onto which you can load PHOENICS 2010 without affecting any older version of PHOENICS you may have on C:.

Please note that any *subst* drives are not remembered after a user logout. The drive will need to be re-created at each logon. This can be achieved by creating a batch file, say *map_drive.bat*, and include this in the Startup folder under the Start menu.

3.3 Installing the Intel Visual Fortran compiler

If the delivery is for a non-recompilable version of PHOENICS, then no compiler is required.

To install the compiler, insert the CD-ROM in the CD drive. If Autorun (it is a default setting for the CD-ROM drive on PCs) is enabled, follow the instructions on your screen. If installation does not start automatically, use Windows Explorer/NT Explorer to open the CD drive and then double-click on INSTALL to start the installation process.

The default location for the **32bit** Intel Visual Fortran compiler (version V.V) is **C:\Program Files\Intel\Compiler\Fortran\ V.V \IA32**, where V.V can be 9.1 or 10.0 as appropriate.

The default location for the **64bit** Intel Visual Fortran compiler (version V.V) is **C:\Program Files (x86)\Intel\Compiler\Fortran\V.V\em64t**

If the Intel Visual Fortran compiler and PHOENICS are installed on the same disk drive (e.g. C:) then no script modification is required. However, if they are installed on different drives then the script /phoenics/d_utils/phoopath.bat will require changing. See Appendix B 'Troubleshooting' for instructions on how to do this.

3.4 Installing PHOENICS

Follow the steps below to install the entire PHOENICS program suite on to the hard disk.

1. Load the CDROM into your CD reader. The setup program will automatically start.
2. Follow the instructions on your screen

In response to the screen prompt for the location of the phoenics directory, the user must specify the target location if other than **C:\phoenics**.

Ideally the phoenics directory should be located in the root of whichever drive was selected for PHOENICS to be loaded on, but it can be installed elsewhere. An environment variable 'phoenics' is created by the installation process, and this variable is set to the pathname of the location of PHOENICS. For example, if PHOENICS is loaded into **c:\Program Files\phoenics** then the value of the environment variable 'phoenics' is set to '**c:\Program Files\phoenics**'. In a case such as this example, when PHOENICS is installed in a folder which is not in the root of a drive (i.e. not as **\phoenics**) then in order for POLIS to function the file **cham.ini** requires modification (see Appendix B, item (3) for details).

If the installation is successful, the user will see four PHOENICS icons, **PHOENICS Commander**, **PHOENICS-VR**, **WINDF** and **POLIS** created on the desktop.

The **PHOENICS Commander** icon is a shortcut for the global interface for PHOENICS; the **PHOENICS-VR** icon is a shortcut for the PHOENICS GUI; the **WINDF** icon is the shortcut for a Command Prompt window with the correct path for running the INTEL Fortran version of PHOENICS; **POLIS** icon is the shortcut for the PHOENICS On-Line Information System.

If PHOENICS is installed on one disk drive (e.g. C:) and the working directory is on a different drive (e.g. D:) then the PHOENICS-VR Icon will require changing. Click on the Icon with the right mouse button, select Properties and Shortcut, and change the drive letter in the field 'Start in: ' to be the required letter, in this case D:.

4 Testing the Installation

It is recommended that the user uses PHOENICS Commander for testing the installation.

4.1 The PHOENICS Commander

Double-click on the CHAM icon, labelled '**PHOENICS Commander**' in the desktop. The screen shown in Figure 1 should appear.

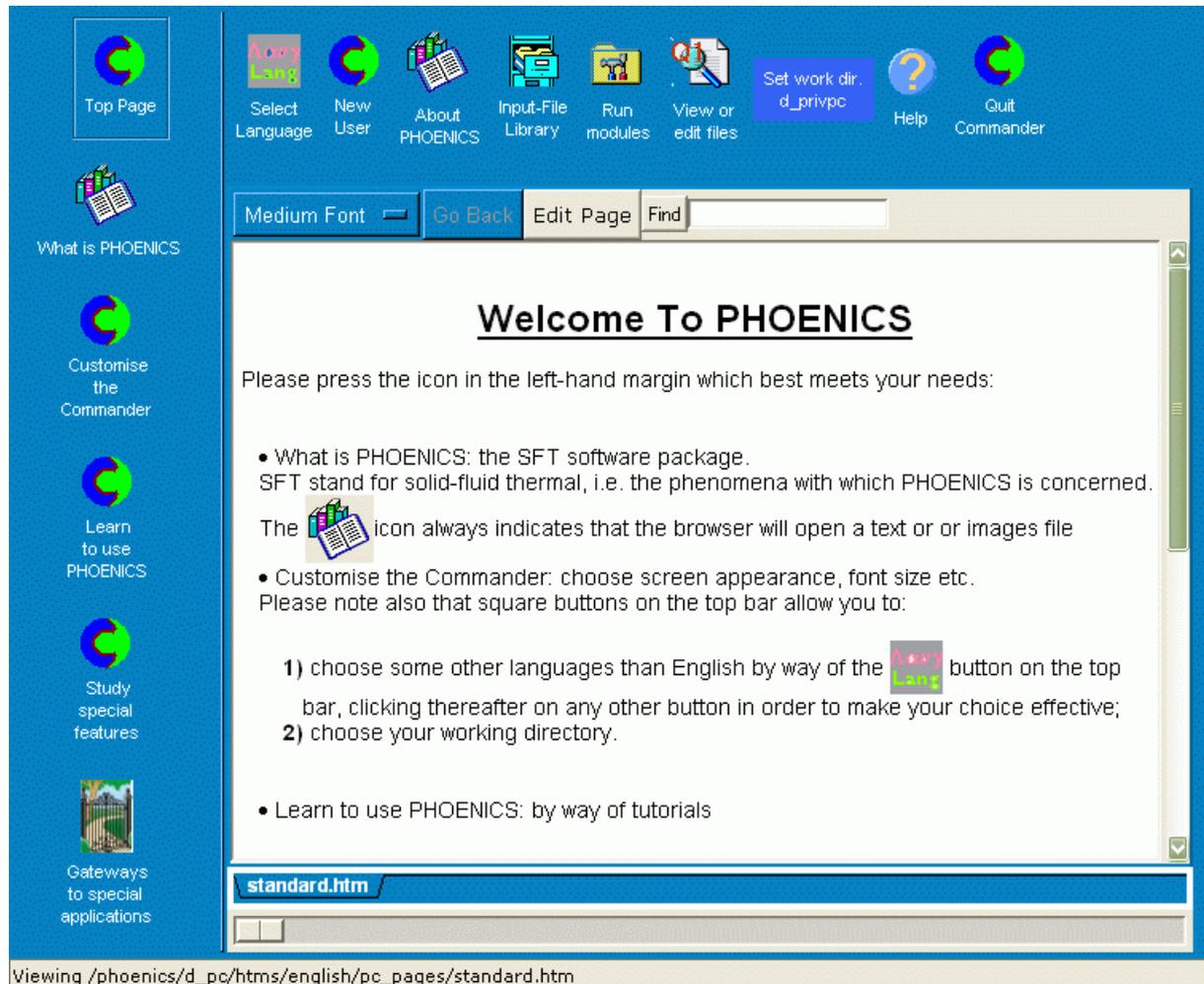


Figure 1: The top panel of the PHOENICS Commander

The PHOENICS Commander has been provided for the purpose of making PHOENICS easier to use, especially for newcomers.

It presents itself to users as a set of window-panel buttons, clicking on which lead to:

- the appearance of another panel of buttons, or
- information items, displayed via the browser, or
- the execution of selected programs.

Each button has a label which indicates its nature; and a sentence of further information appears when the mouse pointer hovers over it.

The screen messages explain the functions of each button appearing on the home page of the PHOENICS commander. It is re-printed below.

The **buttons along the top edge** provide access to the PHOENICS Computational Fluid

Dynamics Software Package. Specifically:

- Select Language: English or Russian only at present. Other languages will be made available in the course of time. Click the top-page button to make your choice effective.
- The 'New User' button will lead you to a page designed for beginners, which enables them to learn about PHOENICS, to see it in action, and to 'test-drive' it.
- 'About PHOENICS' opens up the full treasury of information about the nature and capabilities of the software.
- 'Input-File Libraries' leads to many hundreds of flow-simulation cases which you can run for yourself, with such modifications as you care to introduce.
- 'Run modules' enables you, when you are ready, to run individual modules of the package, without either restriction or close guidance.
- 'Edit Files' enables you to inspect or modify those files of the PHOENICS package which interest you.

The **buttons on the left** are:

- What is PHOENICS provides a general description of what it does and of who might use it.
- Customise the default settings of the commander (such as display options, choose working directory) in accordance with your preferences. The choices will be acted upon immediately and also saved for use in future runs of the Commander.
- Learn to use PHOENICS gives access to tutorials which facilitate understanding on many aspects of PHOENICS use.
- Study special features such as MOFOR, Parsol, GCV, In-Form.
- Gateways to special applications, including general information and access to ready-to-run cases.

4.2 Test run

Click on the PHOENICS Commander icon at the desktop to activate the PHOENICS Commander.

The PHOENICS library case 805, 'The steady flow of air over a sphere held in a wind-tunnel', is used for the test run.

The following instructions cover the steps of:

- running the pre-processor, VR-Editor with a pre-existing input-data file;
- running the solver module, 'EARTH';
- displaying the results by way of the post-processor, VR-Viewer.

Step 1. Click (a single click will suffice) on the **'New User'** button along the top edge and then click on the **'Quick Start'** button on the left. You should read the instructions on the upper part of the screen. Then click **'Sphere'** button. This is to demonstrate PHOENICS the non-interactive pre-processor, Satellite, the Solve and the post-processor, VR-Viewer. This case simulates a sphere in the wind-tunnel. Once the run has started, the pre-processor completes quickly and it will immediately run the solver as explained in Step 2.

Step 2.

The left window shows the variation of the values at a single point. They should attain constant values, so that the curves become horizontal.

The right window shows the residual errors. They should diminish; so the curves should drop downward.

The solution should terminate of its own accord in one or two minutes. However, the calculation can be stopped at any time by pressing any keyboard key, and selecting the 'ENDJOB' option with the mouse.

Step 3.

When the calculation is complete, the VR-Viewer will be activated and a dialog box will appear on the screen for selecting data files. Click 'OK' to use the current result files. A new screen view will appear.

Switch on the pressure contours on planes (red quadrilateral button on the control panel).

Choose X, Y or Z plane contours. Change to contours of velocity magnitude with the V button.

Other scalars may be contoured from the C button. Move the plane using the 'Probe Position' buttons.

Turn on velocity vectors with the V button. You may click on 'VR-Viewer' button at the lower edge of the panel for more information about how to use VR-viewer.

The test is now complete.

5 Starting to use PHOENICS

Users are advised to explore the following buttons under "**New User**" in the PHOENICS Commander in order to learn how to use PHOENICS 2010.

- Double-click on the '**Phrase book**' to learn a few words often encountered when using PHOENICS
- Double-click on the '**Welcome message**' button to access a choice of material according to the background of users;
- Double-click on the '**Slower Start**' button and follow the advice provided to explore 'Flow around Sphere' case step-by-step at user's own pace ;
- Double-click on the '**Beginner's tutorials**' button to explore tutorial cases;
- If the new user has gained sufficient knowledge about how to use PHOENICS, then click on '**Ready to run**' button. There are many more classified group of cases such as In-Form, PARSOL etc. The user may also find wide-range library cases by clicking-on '**Input-file library**' button at the top edge of the panel.

For further detailed information,

- Double-click on the '**About PHOENICS**' button at the top to access the PHOENICS On-Line-Information System.

6 Parallel PHOENICS

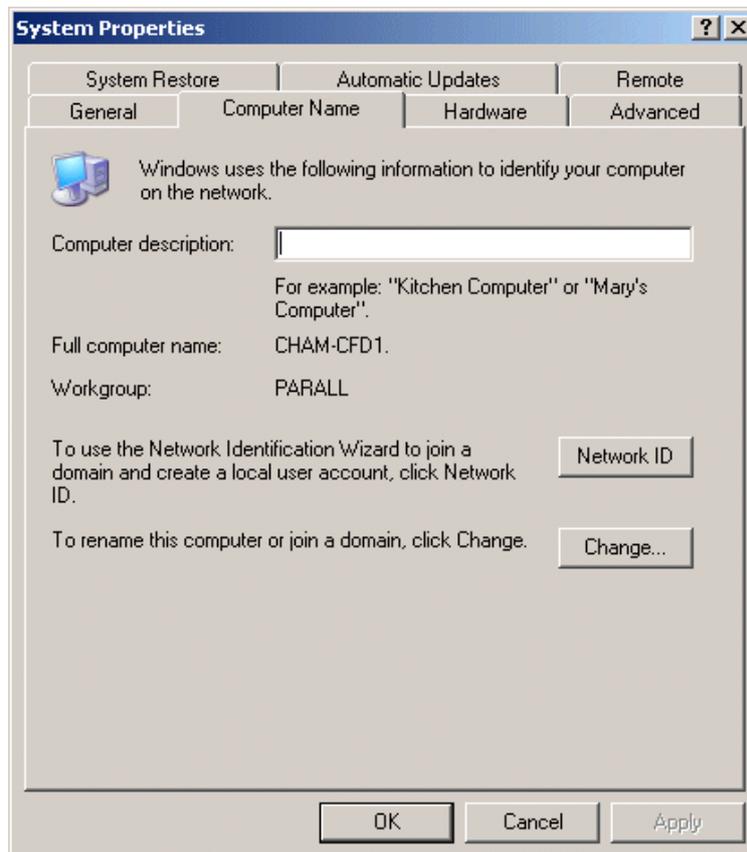
6.1 Introduction

This chapter describes the installation of MPICH.NT for the user who purchased a licence for running Parallel PHOENICS on machines that are running Windows 2000/XP Professional, Vista, Windows 7 or Server 2003. It applies to multi-processor machines and clusters of single or multi-processor machines.

The purpose of Parallel PHOENICS is to enable larger models to run faster therefore the minimum recommended configuration for each processor is a PC running at 2GHz, with 1GB of RAM. When running parallel PHOENICS across a cluster, MPICH.NT requires the ability to make TCP/IP socket connections between all hosts. The network cards and switch used to connect the PCs in the cluster should run at 100Mbps or more. For efficient parallel operation the processors should all be of equal performance: if not, the loads will be unbalanced and the slowest processor will determine the speed of the system.

6.2 Preliminary Considerations

Before starting the installation make sure that each PC in the cluster belongs to the same Workgroup or Domain. To check this, go to the Control Panel and open up the Systems Properties dialog. Then look at the 'Computer Name' (see figure below):



Here the computer name is CHAM-CFD1 and it belongs to the Workgroup PARALL. You may choose the name of the workgroup, but all the PCs which are to be in the cluster must belong to the same one. Use the 'Change...' button to reset the Workgroup of any PCs where necessary.

It is necessary to install MPICH.NT on each PC in the cluster. To this the user will need to be logged in using an account with Administrator permissions. This need not be the account

on which you run PHOENICS.

Since the advent of Service Pack 2 in Windows XP, Windows has had the personal Firewall switched on by default. Experienced users may configure the firewall settings to allow parallel PHOENICS to run successfully, but while installing and until the user is sure that MPICH has been configured correctly, it is recommended that any personal firewalls are turned off. For XP, open the Windows Firewall icon on the Control Panel, and then choose the 'Off (not recommended)' option, then click OK.

After the user has established that MPICH is working correctly then the Firewall should be switched back on.

If the master PC has difficulty seeing one or more of the slave PCs and you are using static IP addresses in your cluster then you should consider defining the IP addresses in the host file on each of the PCs. The host file is normally located as

C:\Windows\system32\drivers\etc\hosts

An example 'hosts' file is:

```
# Copyright (c) 1993-1999 Microsoft Corp.
#
# This is a sample HOSTS file used by Microsoft TCP/IP for Windows.
#
# This file contains the mappings of IP addresses to host names. Each
# entry should be kept on an individual line. The IP address should
# be placed in the first column followed by the corresponding host name.
# The IP address and the host name should be separated by at least one
# space.
#
# Additionally, comments (such as these) may be inserted on individual
# lines or following the machine name denoted by a '#' symbol.
#
# For example:
#
#       102.54.94.97       rhino.acme.com           # source server
#       38.25.63.10      x.acme.com             # x client host

127.0.0.1       localhost
192.168.11.1    cham-cfd1
192.168.11.2    cham-cfd2
192.168.11.3    cham-cfd3
192.168.11.4    cham-cfd4
```

In the following sections, the PC from which parallel PHOENICS is launched is known as the master (process) and the other PCs/processes in the cluster will be termed slaves.

6.3 Installation of MPICH.NT

It will be assumed in what follows that PHOENICS has been successfully installed in accordance with the instructions in the earlier chapters of this document. A full PHOENICS installation need only be made on one machine in a parallel cluster (the one from which jobs will be run); however it is recommended that an installation is made on each PC. If PHOENICS is installed on a single host then it will be necessary to share the \phoenics directory so that all PCs may see it. Each machine in the cluster will also be required to have a valid local licence file 'phoenics.lic' accessible.

On Windows platforms parallel PHOENICS uses MPICH.NT as the message passing interface (MPI) for the communication between the different processes. MPICH.NT is freely

available on the Internet but for compatibility it is important that the installation is made from the MPI provided with PHOENICS package. Installation instructions are as follows:

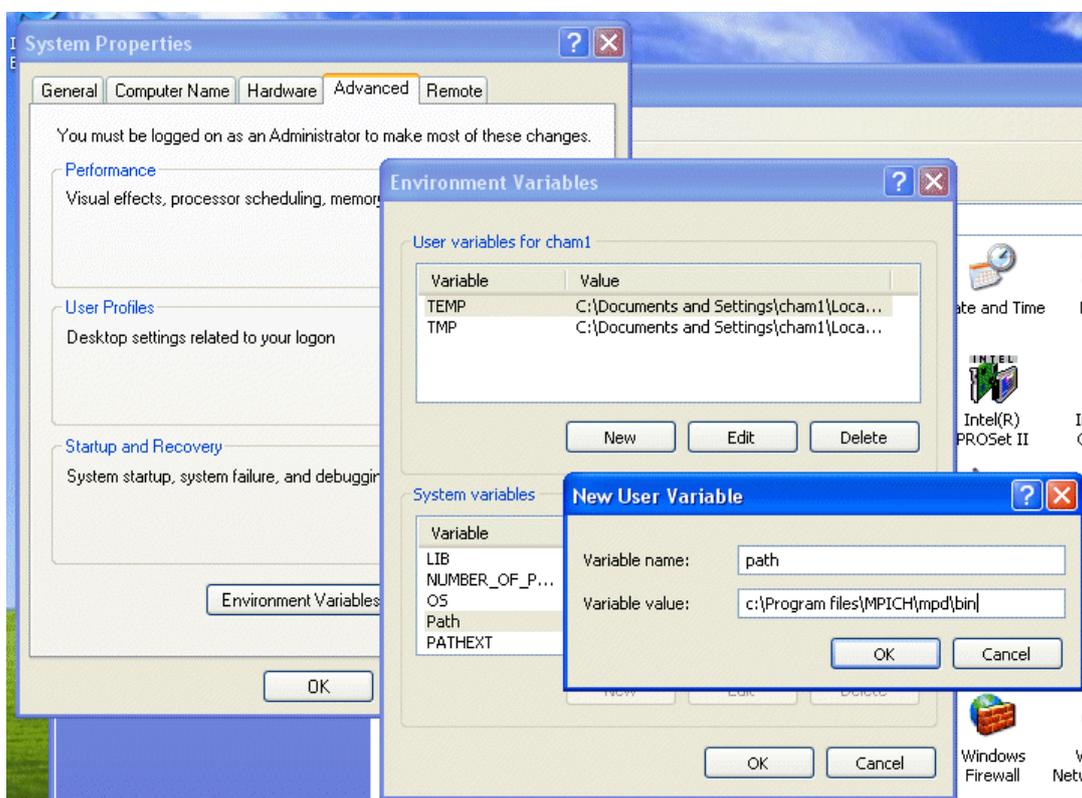
1) In order to run the MPICH.NT installation program you must first be logged onto the PC using an account that has Administrator privileges.

*If the PC is running **Vista Business** or **Windows 7** you need to ensure that any Command Prompt window you use has **Administrator** privileges. By default, a Command Prompt window opened by a user who has Administrator privileges has those privileges withdrawn from that Command Prompt window. It is thus necessary, when opening a Command Prompt window, to explicitly request "Run as Administrator" from the shortcut menu. This shortcut menu is obtained by right-clicking the icon from which the Command Prompt window is launched. Note: A warning window from User Account Control may appear at this point, respond with 'yes' to allow changes to be made.*

2) Run the mpich installation program provided, *mpich.nt.1.2.5.exe* which is located in the directory `\phoenics\ld_allpro\ld_libs\ld_windf\mpi`. It is recommended that the user choose all the default options. This will install mpich within the `C:\Program Files` directory.

Please note: While it only necessary for PHOENICS to be installed on a single PC in a cluster, it is necessary to install MPICH on all PCs.

3) The PHOENICS parallel run scripts assume that `mpirun.exe` is located on the users PATH on the master and slave PCs. If the default location was chosen, this should be `C:\Program Files\MPICH\mpd\bin`. The PATH should be set through the System Properties dialog [launched from the Control Panel]. The image below shows the stages to set the User variable, *path*. Go to the Advance settings page and click on Environment Variables button. If the User variable *path* does not exist, click on New, otherwise highlight *path* and click on Edit. Add the necessary path entry for mpirun – separate any path entries by semi colons. [To modify the System variable *path*, consult with your network administrator.]



4) You need to register MPICH on the master PC as follows. Open a Command Prompt window [From the Start menu it is located under Accessories], change to the mpd directory,

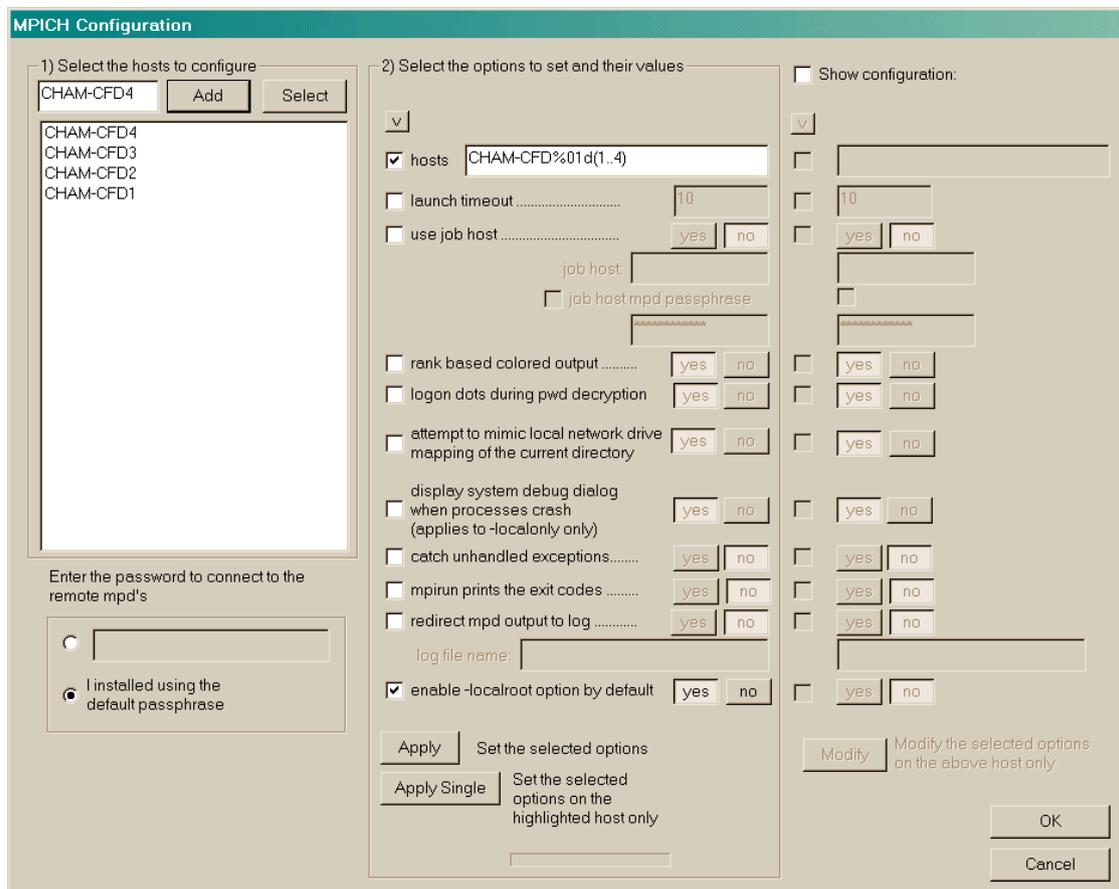
```
> cd c:\Program Files\MPICH\mpd\bin
```

assuming the default location was chosen, and run the MPICH program MPIRegister.exe. You will be prompted for an account and password, e.g.

```
> mpiregister.exe
account:  cfd1
password: *****
confirm:  *****
Do you want this action to be persistent (y/n)?  y
```

If the cluster has been set up within a network Domain (rather than a Workgroup) then in the above you should also specify the domain as part of the account name. For example, if 'phoenics' is the domain and 'cfd1' is the user account within that domain, enter `phoenics\cfd1`. The response 'y' ensures that this action is persistent, i.e. this registration process does not have to be repeated for each session on this PC.

5) The user may run the MPICH Configuration tool to identify the PCs in the cluster. From the Start menu, locate the MPICH menu, the MPICH Configuration tool is available under the mpd submenu. First select the hosts in your cluster, on which you have installed MPICH, using the Add or Select buttons. In this example we have four PCs: CHAM-CFD1, CHAM-CFD2, CHAM-CFD3 and CHAM-CFD4. In column two, tick the final option 'enable -localroot option by default', press the yes button on that row and then press 'Apply'. You may now press 'OK' to close the configuration tool.



6.4 Windows Firewall settings

XP Personal Firewall: XP Service Pack 2 now activates the personal firewall by default. If the firewall is activated, then running the PHOENICS solver, earexe, may generate a Windows Firewall Security Alert. When running in parallel mode it is essential that earexe is Unblocked, even if you are only using the processors of the host PC. If mpirun is run with an MPI configuration file instead of the executable program as the argument, then there will be an additional security alert for the mpirun program. Again, it is essential that this program be unblocked.



With the Windows Firewall, the user may choose to unblock the Earexe executable from the security alert dialog above. However, if you are operating across a cluster, this will not be sufficient to enable Parallel Phoenix to run. There are additional settings needed on both the master and slave PCs.

For those using the Windows XP open the Windows Firewall icon from the Control Panel, then go to the Exceptions Page. On the Master PC you will need to use the “Add Program...” button to add the following programs:

C:\Phoenix\d_earth\d_windf\learexe.exe

C:\Program Files\MPICH\mpd\bin\mpiconfig.exe

C:\Program Files\MPICH\mpd\bin\mpirun.exe

You may also use the “Change scope..” button to restrict access to My network (subnet) only.

On each of the slave PCs, you will need to add the programs

C:\Phoenix\d_earth\d_windf\learexe.exe

C:\Program Files\MPICH\mpd\bin\mpd.exe

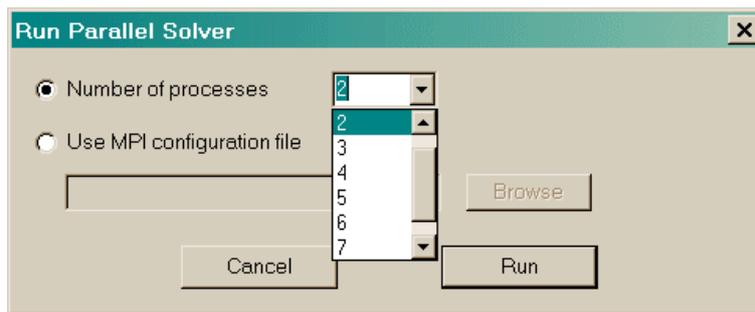
Users of other personal firewall will need to unblock the above programs in a manner suitable for their firewall software.

6.5 Running Parallel PHOENICS

6.5.1 Running the standard parallel Earth

The simplest way to launch parallel EARTH is from the VR-Editor, although it can be run from a DOS window in command mode.

If a parallel PHOENICS licence has been purchased, an additional sub-menu, 'Parallel Solver', will appear under the 'Run' menu option in the VR-Editor. Once the parallel solver is chosen, a dialog box will appear on the screen where the user can either specify the number of processes to use or to specify a MPI configuration file.



The pulldown combo box provides the user with an option to select up to thirty-two processes. Those users who have more than thirty-two processors on their PC cluster may type the appropriate number into the box. This method does have its limitations though, it does require that:

- a) each node in the cluster must have been previously identified using the MPICH Configuration tool (see step 5 in section 6.3),
- b) each node has a local copy of Earth. If a full installation of Phoenics has not been made then there must be a copy of the Earth executable at `\phoenics\d_earth\d_windf\earexe.exe`. If a Private Earth is to be used, then this also should be copied to the working directory for each of the slave processes.

6.5.2 Configuration File

The MPI configuration file option gives a more flexible way of launching the parallel solver. Assuming we have PHOENICS installed on **each PC** in the cluster, the following config file will use the local earexe.exe to run a single process on each of the four PCs.

```
exe c:\phoenics\d_earth\d_windf\earexe.exe
hosts
cham-cfd1 1
cham-cfd2 1
cham-cfd3 1
cham-cfd4 1
```

Example configuration files, config2 and config4, are provided as part of the PHOENICS installation (in directory `\phoenics\d_utils\d_windf`). The following file 'config4' is for use on a cluster where PHOENICS is installed only on the **master PC**:

```
exe \\cham-cfd1\phoenics\d_earth\d_windf\earexe.exe
hosts
cham-cfd1 2
cham-cfd2 2
```

This file is for use with a run command (such as runcl4) issued on cham-cfd1, with cham-cfd2 as the other machine in the cluster. The first line specifies the executable program 'earexe', and the text 'phoenics' on that line is the **shared** name of the actual phoenics folder (e.g. c:\phoenics). The lines following the 'hosts' line list the machines that are to be used and the number of processes to be used on each - in this case 2. If the executable program is to be different on each host, then this line may take an optional third parameter, indicating the executable program, as it will be seen from the machine in question. Note that the first host machine should be the one on which the executable program is located. If cham-cfd1 and cham-cfd2 were single processor machines, runcl2, which uses config2, would be used.

Users should create their own configuration and 'run' files, based on the examples provided, tailored to their own installation. These can either be located in \phoenics\d_utils\d_windf or the local working directory.

6.5.3 Cluster Operation

All Nodes in the cluster should belong to the same Workgroup or Domain, and the user should be logged into each Node on the Cluster using the same Workgroup/Domain User account.

PHOENICS must be installed on the Master PC, but installation on the other Nodes (Slave PCs) is optional.

a) If PHOENICS is only installed on the **Master** PC then the phoenics folder will need to be shared, with at least Read permissions, for the other Slave PCs in the cluster. The Shared name which is chosen when the folder is shared is used in the configuration file, and in the example file 'config4' above the shared name is 'phoenics'. In addition, on each Slave PC there must be a folder with the same pathname as that on the Master PC from which PHOENICS has been launched. For example, if, on the Master PC the program is run from C:\phoenics\d_priv1 then there must be a folder C:\phoenics\d_priv1 on each of the Slave PCs. This folder must contain a copy of the FLEXIm licence file 'phoenics.lic', (which can be found in C:\phoenics\d_allpro on the Master PC). The Workgroup/Domain User account used to log into each Slave PC must allow write access to this folder C:\phoenics\d_priv1.

b) If PHOENICS is installed on each **Slave** PC (in addition to the Master PC) then the Workgroup/Domain User account used to log into each Slave PC must allow read access to all PHOENICS folders, and write access to the folder C:\phoenics\d_priv1.

For cluster operation it is necessary for MPICH to know which processors to use for the run. This is achieved by means of a configuration file (see chapter 6.5.2), or by using the MPICH Configuration Tool.

- A configuration file specifies precisely which nodes on the cluster to use. No account is taken of what the load on those processors may be at run time
- The MPICH configuration tool specifies a 'pool' of nodes which can be used. At run time the system decides which of those processors to use based on the load on each one

6.5.4 Automatic domain decomposition

When using the default automatic domain decomposition, parallel PHOENICS only differs from sequential when Earth is run: problem set-up and post-processing of results can be done in exactly the same way as for the sequential version. A case that has been run in sequential mode can be run in parallel without any changes being made. The output from a parallel PHOENICS simulation will be result and phi files, having the same format as for sequential simulations.

6.5.5 User-specified sub-domains

It is also possible to by-pass the automatic domain decomposition algorithm, and to specify how you want to decompose the calculation domain into sub-domains. This can be done by setting the appropriate date-for-solver arrays in the Q1 file.

For example, to split the domain into 8 sub-domains (2 in each direction), the following arrays must be set in the Q1 file:

```
LG(2)=T  
IG(1)=2  
IG(2)=2  
IG(3)=2
```

The logical LG(2) will instruct the splitter to by-pass the automatic domain decomposition, and split the domain according to the settings defined in the IG array as follows.

IG(1) specifies the number of sub-domains in the x-direction;
IG(2) specifies the number of sub-domains in the y-direction;
IG(3) specifies the number of sub-domains in the z-direction;

In this case, the domain has been divided into sub-domains according to the settings made in the Q1 file.

6.5.6 Command mode operation

In a Command Prompt window, if the EARTH executable is launched directly, then the sequential solver will be used; to run the parallel solver, the program name 'earexe' is used as an argument to mpirun.

A script RUNPAR.BAT [nnodes] is provided. The optional argument [nnodes] indicates the number of processes to be launched on the current PC. The default is to launch two processes.

For example, RUNPAR 2 will execute the MPI command:

```
mpirun -localroot -np 2 \phoenics\d_earth\d_windf\earexe
```

If a cluster has been defined by the MPICH configuration tool then, the command will execute on two processors in the cluster, otherwise it will launch multiple processes on the local machine

There are also 'run' commands which can be used in conjunction with configuration files, for example 'runcl4' uses the configuration file 'config4'. Config4 lists the PCs and processors to be used (see above Configuration file section above).

6.5.7 Testing Parallel PHOENICS

The parallel installation should be tested by loading a library case.

The different solver used for parallel operation requires a slight modification to the numerical controls. For example, the user may use main 'Menu' in the VR-Editor, and select 'Numerics' and then 'Iteration control': change the number of iterations for TEM1 (temperature) from 20 to 300. (Increasing the relaxation for the velocity components, U1 and W1, from 1.0 to 10.0 will also improve performance.)

For parallel operation it is recommended that velocities should be solved whole-field (rather than slab-by-slab); this can be achieved from the VR Editor (under 'Models', 'Solution control/extra variables') or by direct editing of the q1 file (by setting 'Y' as the third logical in a SOLUTN command).

6.6 Further Information

A MPICH user guide is installed as part of the installation in PDF format; it is accessible from the MPICH menu item on the Start menu. Online documentation is available at

<http://www-unix.mcs.anl.gov/mpi/mpich1/>

Appendix A. Unlocking PHOENICS

FLEXIm

PHOENICS is normally unlocked using the FLEXIm system, and the delivery CDROM contains a FLEXIm licence file which allows use of PHOENICS for an initial period of one month.

The batch file /phoenics/d_allpro/get_hostid.bat will create a text file lmhostid.txt, which contains the FLEXIm HOSTID of that PC. Alternatively, the program /phoenics/d_allpro/lmhostid.exe, when run in a DOS window, displays the required FLEXIm HOSTID. This HOSTID should be sent to CHAM's Installation Section (see Contacting CHAM details below) in order to obtain a longterm licence file. The FLEXIm licence file 'phoenics.lic' supplied by CHAM in response to such a request should be placed in /phoenics/d_allpro, and the existing phoenics.lic file deleted.

USB dongle

A USB dongle may be supplied with the delivery, and the unique USB FLEXID will normally be known by CHAM. This FLEXID is printed on the USB dongle itself, and is of the form 9-abcd1234. When requesting a FLEXIm licence file the FLEXID value should be sent to CHAM's Installation Section (see Contacting CHAM details below).

Rainbow Dongle

Existing PHOENICS users may have a Rainbow dongle, and in this case PHOENICS is locked/unlocked using a dongle-based unlocking string present in the CONFIG file in the directory \phoenics\d_allpro, and is initially supplied with a temporary unlocking string

A permanent unlocking string may be supplied with the PHOENICS delivery, or may be requested from CHAM's Installation Section (see Contacting CHAM details below). The dongle number is currently 10793.

An example of a dongle unlocking string and its location in the CONFIG file is shown below (the example is not currently valid). The unlocking string consists of the line starting with the text 'ID='

```
* ----- The configuration file CONFIG for PHOENICS version 3.5.1 -----
ID=: 9 (L8P3Y) P5ABG1AIOA/2D: SF                               dongle March 2010
*-----
SITE= CHAM
*-----
SATPRE=\phoenics\d_satell\
EARPRE=\phoenics\d_earth\
PHOPRE=\phoenics\d_photon\
AUTPRE=\phoenics\d_photon\
```

Parallel

PHOENICS is unlocked using the FLEXIm system, and the delivery CDROM contains a FLEXIm licence file which allows use of Parallel PHOENICS for an initial period of two months.

The FLEXIm HOSTID can be obtained as detailed under the paragraph 'FLEXIm' above.

Unlocking for a multi-processor machine is exactly the same whether parallel or sequential PHOENICS is being used on that PC.

For a Parallel cluster installation the HOSTID of all the machines in the cluster is required (because, although PHOENICS need only be installed on one machine, parallel Earth will run on each machine). This is the case for multi-processor installations and clusters of fewer than 16 nodes - alternative unlocking will be arranged for larger clusters.

AC3D

AC3D can be obtained directly from Inivis (www.inivis.com).

The folder `phoenics\d_ac3d\plugins` contains files which allow AC3D to be used in conjunction with PHOENICS, and AC3D should be installed on your PC such that it is in the folder `\phoenics\d_ac3d`.

Contacting CHAM

The FLEXIm HOSTID or USB FLEXID should be recorded on the unlocking request form provided and returned to:

Installation Section

Tel: 020 8947 7651, Fax: 020 8879 3497

CHAM,

e-mail: js@cham.co.uk

Bakery House

40 High Street,

Wimbledon

London SW19 5AU

Appendix B. Frequently Asked Questions and Troubleshooting

B.1 FAQ

1. What is the PHOENICS directory structure?

A brief description of the first level subdirectories under `\phoenics` is given below.

d_ac3d contains a stand-alone program AC3D (obtainable from Inivis) which can be used (among other things) to create objects for use in the VR Editor.

d_allpro contains the binary code for the PHOENICS service routines shared by SATELLITE and EARTH, the program libraries for all modules and the graphics drivers used by SATELLITE, EARTH and PHOTON;

d_cosp contains a new "goal-seeker" for the purpose of solving so-called "inverse problems". (to be purchased separately)

d_chmkin containing files for the CHEMKIN interface.

d_earth contains the binary code and some source files of the PHOENICS main solver program EARTH, together with the PHOENICS case libraries;

d_includ contains the Fortran common blocks required for recompilation;

d_intfacs contains the interfaces between PHOENICS and other codes;

d_pc contains the PHOENICS Commander.

d_photon contains the binary code of the PHOENICS post-processor program PHOTON, which now incorporates AUTO PLOT;

d_polis contains all files for the PHOENICS On-Line Information System;

d_priv1 is referred to as a "private" working directory from which the user may run all the PHOENICS programs, or use the PHOENICS-VR Environment;

d_satell contains the binary code of the PHOENICS pre-processor program SATELLITE, and the menu libraries;

d_shapem contains the executable of Shapemaker, a geometry generator;

d_utils contains utility batch files, such as run scripts, link scripts, and compiler option scripts. Also included are directories which contain many utility programs, such as Facetfixer.

2. How do I create a working directory?

Under Windows

A working directory, `\phoenics\d_priv1`, is provided with the installation. New working directories may also be created anywhere on the system. The following steps should be performed in order to create a working directory, such as **d_work**. After the new directory has been created copy the file '**mpich.dll**' from `d_priv1` to this new folder.

To create the new folder, click the right mouse button on an empty part of the Windows desktop then select New, and Folder. Type in a name for the new folder, e.g. **d_work**, then press <return>. Drag this **d_work** folder to any convenient location.

Start the PHOENICS-VR Environment and click on Options, Change working directory. Use the browser to locate the new folder.

Note that the desktop icon created by the installation process is set to start PHOENICS with `\phoenics\d_priv1` as the working directory. This can be changed by bringing up the properties dialog box for the PHOENICS icon, and changing the 'Working' directory on the program tab. Many copies of the icon can be made, each with a different 'Working' folder.

In a Command Prompt (MS-DOS) window

It is recommended that a new working directory is created under the **\phoenics** directory although the new directory can be anywhere. To create the new working directory, type: `md d_work`

3. Why the PHOENICS On-line Information System (POLIS) did not run correctly?

POLIS can be run from the PHOENICS-VR Editor or PHOENICS Commander by clicking on the appropriate button under HELP in the top tool bar. It can also be started on Windows systems from the CHAM-logo icon labelled 'POLIS' on the Desktop.

All the POLIS documents are in HTML format, and can be accessed directly through the Microsoft Internet Explorer. The address of the POLIS home page is usually **\phoenics\d_polis\polis.htm**.

Normally, the POLIS files will be copied to the drive on which PHOENICS has been installed. The Desktop icon and Start-menu item will be set to this drive automatically by the installation program

The drive letter used by the HELP button is stored in the file **\phoenics\d_allpro\cham.ini**. At installation time, it is set to C. If PHOENICS is installed on another drive, say D, the **cham.ini** file must be edited (with Notepad or any other file editor) and the entry 'drive = ' in the [POLIS] section must be set to the correct drive letter.

A consequence of this is that it is possible to keep all the POLIS files on the CDROM if there is a shortage of disk space. The POLIS drive letter should then be set to that of the CDROM drive. The directory **\phoenics\d_polis** can now be deleted from the hard-drive. The properties of the Desktop icon and Start menu item should be changed accordingly.

4. Why the POLIS links don't work in Firefox

POLIS uses absolute pathnames in its HTML links; unfortunately Firefox is unable to translate these links correctly from the file system. It is possible to get over this limitation by installing and using the IE Tab add-on. The IE Tab can be downloaded from the Firefox website, <http://www.mozilla.com>, then follow the link to popular Add-ons. Just scroll down until you find the IE Tab, click on the 'Add to Firefox' button and install. The Tab will appear as a small icon to the left of the address bar, just click on it when you need to activate it.

5. Can I open a new Command Prompt window to run PHOENICS?

PHOENICS can be run from a Command Prompt window opened by users, using individual commands such as:

- sat (to run SATELLITE)
- vre (to run the PHOENICS-VR Environment)
- ear (to run EARTH)
- pho (to run PHOTON)

providing that the PATH for that window has been suitably modified. The batch file **\phoenics\d_utils\phoepath** will modify the PATH correctly.

Users should check this file to ensure that the drive letters and paths for PHOENICS and the INTEL Visual Fortran Compiler are both correct.

6. What compiler options should I use?

For the 32bit Intel Visual Fortran version, the PHOENICS code has been compiled using the compiler options

```
ifort /iface:cvf /threads /libs:static /winapp /compile_only /assume:byterecl
```

/debug:none /optimize:3 /include:\phoenics\d_allpro\d_libs\d_windf

as specified in the batch file COMPILE.BAT in the directory **\phoenics\d_utils\d_windf**.

For the 64bit Intel Visual Fortran version the compiler options are

ifort /iface:cvf /define:_X64_ /threads /libs:static /winapp /compile_only /assume:byterecl /debug:none /optimize:3 /include:\phoenics\d_allpro\d_libs\d_windf

B.2 Troubleshooting

Somehow the CHAM icon, PHOENICS-VR disappears from my desktop. How do I recreate this icon.

Should the PHOENICS-VR Environment Icon be deleted in error it can be recreated thus:

Select the following by clicking, using the left button of the mouse

- Start, then point to Programs
- Windows Explorer

Then, in 'All folders', double click on

- Phoenics
- d_satell
- d_windf

Finally, in the 'contents of d_windf ' box, click right button of the mouse on

- satexe.exe
- Create Shortcut

A Shortcut to satexe.exe is now created. Drag this Shortcut, using the left mouse button, onto a suitable part of the Windows screen. Rename the icon, using the right button, to 'PHOENICS-VR'. Right-click on the icon and select 'Properties'. Add the argument vre after SATEXE.EXE. Set the 'Start in' folder to a suitable location, e.g. \phoenics\d_priv1.

When I click on the PHOENICS-VR Environment icon, I get an error message that Windows cannot find C:\PHOENICS\D_SATELL\D_WINDF\SATEXE.EXE'.

The desktop shortcut created by Install assumes that PHOENICS has been copied to drive C:. If you have copied it to another drive, you will have to modify the 'Cmd line' and 'Working' entries on the Program tab of Properties to reflect the correct drive letter. Click on the Commander icon with the right mouse button to bring up the Properties dialog box.

I can't run any PHOENICS modules from a Command Prompt window with the 'runsat', 'runear' commands - I get 'bad command or file name' error messages.

You should check if the path is correct by typing 'PATH' on the Command Prompt window. The correct path should point to \phoenics\d_windf\d_utils; \phoenics\d_winsd\d_utils and \phoenics\d_utils. If it does not, you must run the batch file <drive>:\PHOENICS\D_UTILS\PHOEPATH.BAT in the DOS window before running any PHOENICS modules. Check that this file contains the correct drive letter for PHOENICS, and the correct path to the INTEL Fortran compiler.

PHOENICS and the INTEL Fortran compiler are installed on different drives, and I can't compile my ground file.

The batch file <drive>:\PHOENICS\D_UTILS\PHOEPATH.BAT must be modified, so that all references to **c:\Program Files\Intel\Compiler\Fortran\V.V\IA32\....** are changed to **<drive2>:\Program Files\Intel\Compiler\Fortran\V.V\IA32 \...**, where <drive2> is the drive containing

the Intel Fortran Compiler (Note, V.V represents the compiler version, e.g. 9.1 or 10.0)

For the 64bit Intel Fortran compiler all references to C:\Program Files (x86)\Intel\Compiler\Fortran\V.V\em64t should be changed to <drive2>\Program Files (x86)\Intel\Compiler\Fortran\V.V\em64t .

My windows open and close too quickly for me to be able to see the messages.

Edit the file \phoenics\d_allpro\cham.ini ('Files', 'Open file for editing','cham.ini' from environment top menu bar) and replace the line

```
pause = off
```

by

```
pause = on
```

My compile window opens and closes too quickly for me to be able to see the error messages.

Edit the file \phoenics\d_utils\d_windf\compile.bat, and add /list to the argument list as follows:

```
@echo off
```

```
ifort /compile_only /debug:none /optimize:3 /list %1
```

You will now generate listing files for each file compiled.

The INTEL Visual Fortran compiler version does not appear to be accessible when I try to compile a program.

The file \phoenics\d_utils\phoepath.bat expects the 32bit Intel compiler to be in the folder c:\Program Files\Intel\Compiler\Fortran\V.V\IA32 (where V.V is the version of the compiler, e.g. 9.1 or 10.0) This folder is specified by the command:

```
Set DFDIR = c:\Program Files\Intel\Compiler\Fortran\V.V\IA32
```

Search for the IA32 folder with Windows Explorer, and then modify phoepath.bat to point to the correct location.

The 64bit Intel Fortran compiler is expected to be in C:\Program Files (x86)\Intel\Compiler\Fortran\V.V\em64t, so change phoepath.bat in a similar manner to above.

When I click on 'compile' from the VR Environment I encounter the error message 'Bad command'. How do I cure the problem?

This problem is usually because the path name for the script ifortvars.bat is incorrect in the file \phoenics\d_utils\phoepath.bat. The relevant part of the phoepath.bat file looks like:

```
set DFDIR= c:\Program Files\Intel\Compiler\Fortran\V.V\IA32
```

```
rem
```

```
echo Adding INTEL PHOENICS to path
```

```
path=\phoenics\d_utils\d_windf;\phoenics\d_utils;%path%
```

```
call %DFDIR%\bin\ifortvars.bat
```

(where V.V is the version of the compiler, e.g. 9.1 or 10.0)

When the INTEL compiler was installed in the user's computer, it may not have been placed in the usual directory, but in some other directory or even on a different drive

The compiler should be in c:\Program Files\Intel\Compiler\Fortran\V.V\IA32 (the path to

ifortvars.bat will be c:\Program Files\Intel\Compiler\Fortran\V.V\IA32\bin\ifortvars.bat).

If the user adopts the non-standard practice of installing the compiler on a drive other than C:, or in a directory other than one of those shown in above, then he must modify his phoepath.bat file accordingly.

In summary, the solution to the 'Bad Command' problem is to determine the location of the ifortvars.bat file on your computer and then correct the path name in the phoepath.bat file in /phoenics/d_utils.

When I click on 'compile' from the VR Environment I encounter the error message 'Too many parameters'. How do I cure the problem?

This error message may be cured by modifying the file /phoenics/d_utils/phoepath.bat so that the path statement:

```
echo Adding INTEL PHOENICS to pathpath = \phoenics\d_utils\d_windf;\phoenics\d_utils;%path%
```

is replaced by

```
echo Adding INTEL PHOENICS to path
path = \phoenics\d_utils\d_windf;\phoenics\d_utils;c:\windows\system32
```

This means the path is set explicitly, rather than adding to an existing path by the use of %path%.

I wish to see an EARTH window with variables, not the graphics window with spot values and residuals.

You must turn the graphical convergence monitor off. Either:

in VR 'Main menu', 'Output', toggle 'Monitor display mode' from 'Graphics' to 'ASCII';

or

edit Q1 ('File', 'Open file for editing', 'Q1') and delete the reference to TSTSWP.

PHOENICS starts but immediately stops. When I click on the PHOENICS icon, the PHOENICS-VR window appears and disappears almost immediately.

Check in the working directory for the file **luout**. If it exists, open it with Notepad or some other file editor. It may contain an error message - usually indicating that unlocking is incorrect.

I have put my unlocking string in the file phoenics/d_allpro/config, but still get the message 'illegal or absent id string'.

Check that you have entered the string correctly, paying particular attention to possible confusion between the upper-case letter O and the number 0.

Furthermore, the character string 'ID=:' must start in column 1. If a leading space is left in the string, it will not be recognised.

The message sent to you containing your unlocking string also contains your dongle id as a check, in the form:

```
NODEID=10793          for a dongle
```

This line should not be entered in the config file.

I have put PHOENICS on to a PC server, but could not run from another PC on my network.

You will need to have local copies of some files and directories on each machine. You will also need to modify the config and prefix files. Please contact CHAM for detailed information.

PHOENICS has been working satisfactorily, but today it fails with a Microsoft error window reporting an error in 'satexe'. I have made no changes since yesterday, and my computer has not been upgraded or modified since PHOENICS last worked.

If no changes have been made on your PC it is just possible that the length of the FLEXIm licence path list in the Registry has become too long. Run the program 'FlushLic.exe', which is to be found in the folder \phoenics\d_utils to clear this FLEXIm licence path list.

When I run the Sequential Solver (EARTH) nothing happens on the screen and no error messages are displayed, and no result file is created.

Sequential EARTH requires the dummy library mpich.dll to be accessible. This library file is located in d_utils/d_windf and can be copied from there to your working folder. Alternatively, you can add the folder pathname '\phoenics\d_utils\d_windf' to your PATH.

I get a message indicating there is insufficient Virtual Memory when I run a PHOENICS module

The F-arrays for all the modules are now allocated dynamically at run-time, in the file CHAM.INI.

Sometimes, when running large cases, the Earth Solver will display a dialog complaining that there is insufficient virtual memory, and give the size of the F array it is trying to allocate. In many cases, changing the CHAM.INI setting to allocate that much memory initially will allow the case to run.

In some cases, it will result in another error dialog - **'Insufficient virtual memory to allocate array'**. This means that Windows cannot allocate a contiguous piece of memory of the requested size.

By default, Windows can address a total of 4 gigabytes (GB) of virtual address space. By default, 2 GB of this is reserved for the kernel (operating system), and 2 GB is reserved for User mode programs such as PHOENICS.

The 2GB user space also has to hold all the DLLs of programs such as virus checkers, graphics drivers and whatever else is running. The maximum available space seems to be around 1.75GB.

Furthermore, the DLLs of these other programs may load into memory at inconvenient locations, thus fragmenting the contiguous memory and reducing further the maximum single allocation.

By placing a **/3GB** switch into the Boot.ini file of the operating system, the virtual address space distribution is changed to give User mode programs 3 GB of space and limit the kernel to 1 GB.

This parameter is fully functional on:

- Microsoft Windows NT Server 4.0,
- Microsoft Windows Enterprise Edition with Service Pack 3,
- Microsoft Windows 2000 Advanced Server,
- Microsoft Windows 2000 Datacenter Server,
- Microsoft Windows XP (with SP2), and
- Microsoft Windows Server 2003.

On other versions of Windows NT and Windows 2000, the **/3GB** parameter restricts the kernel to addresses above the 3 GB boundary. However, user-mode applications cannot access more than 2 GB of address space - 1GB is effectively lost.

Windows 95, 98 and ME cannot use this parameter at all.

To add the **/3GB** switch to a Windows XP machine, go to Start - Settings - Control Panel - System. Select the Advanced page, and click Startup and Recovery Settings. Click Edit to manually edit the startup options file. The bottom of the file will look somewhat like:

```
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\WINDOWS="Microsoft      Windows      XP
Professional" /fastdetect /NoExecute=OptIn
```

Copy and paste the last line to make a duplicate. On the duplicate line add /3GB to the end of the line, and change the name of the operating system, e.g.

```
multi(0)disk(0)rdisk(0)partition(1)\WINDOWS="Microsoft      Windows      XP
Professional 3GB" /fastdetect /NoExecute=OptIn /3GB
```

Make sure the 'Time to display list of operating systems' is ticked, with at least a 10 second wait.

Save the boot.ini file, exit from all the dialogs and reboot the computer. When it starts, it will offer a choice of operating systems. Choose the new one, e.g. **"Microsoft Windows XP Professional 3GB"** with the /3GB switch. There should be no obvious difference in the operation of the computer. If there are any problems, reboot and select the original OS.

On Windows XP, some drivers, especially video adapter drivers with onboard RAM, cannot run with the /3GB parameter because they require more address space than the 1 GB kernel address space permits.

Only make this modification if you feel confident, or ask the system administrator if they are prepared to make the change for you. More information about the /3GB switch can be found by searching at www.microsoft.com.

When I attempt to compile from within VR Editor, an error in the Command Prompt window indicates that the wrong compiler has been accessed

This can happen if you have more than one Fortran compiler installed. The solution is to set up an Environment Variable PHOENICS_COMPILER with a value which is the pathname to the correct compiler. The pathname would be similar to this

```
C:\Program Files\Intel\Compiler\Fortran\9.1\IA32
```

Under the VISTA Operating System I get grey rectangles when running the VR Viewer

There are two ways of accomplishing this :

- a) Click on Start, Computer, System properties, Performance, Adjust visual effects, and remove the tick from 'Enable desktop composition'. Click OK and close the remaining dialogs
- b) You can also clear the gray rectangles by setting 'HardwareAccel = off' in CHAM.INI, but that disables all acceleration. Changing the Windows Theme to 'Windows Classic' also removes the gray rectangles, but also removes the Vista 'look and feel'.