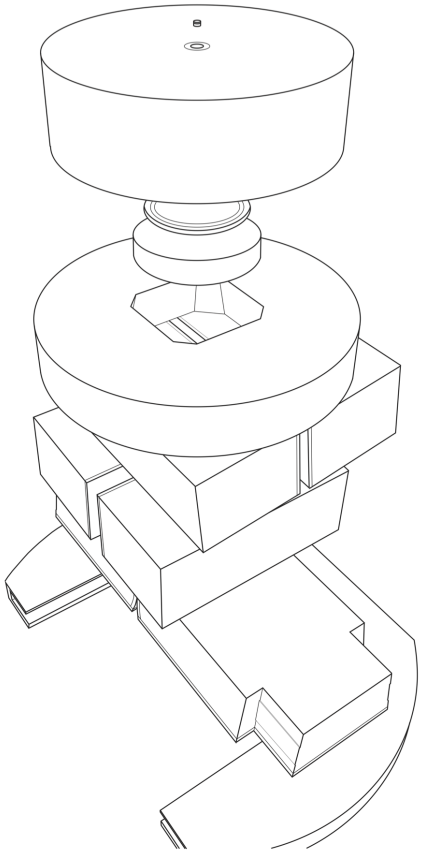
PRIMO
Quick Start Guide



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PRIMO QUICK START GUIDE
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WWW.PRIMOPROJECT.NET

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Important information

Purpose of this guide

The scope of this *Quick Start Guide* is to give users the possibility to quickly get a glimpse of the basic features of PRIMO. However, this guide is not intended as a substitute for the *PRIMO User's Manual*, whose reading is necessary in order to use PRIMO adequately.

What is PRIMO?

PRIMO is an automated, self-contained, fully Monte Carlo-based linac simulator and dose calculator. It features a user-friendly graphical interface. The Monte Carlo engine of PRIMO is PENELOPE 2011. PRIMO can estimate the absorbed dose in water phantoms and computerized tomography studies written in DICOM format. It is possible to delineate structures using the tools provided by the software or, if desired, structures in DICOM-RT STRUCT format can be imported.

Available linacs

The linacs that can be simulated are listed in table 1. PRIMO can import phase-space files written in the International Atomic Energy Agency (IAEA) format. Phase-space files written by PRIMO also comply with the IAEA standard.

Legal matters in a nutshell

PRIMO is free software. However, it is not open-source and reverse-engineering of any distributed or generated file from the software is expressly forbidden.

Although PRIMO is mainly conceived as research software, it finds multiple applications in the routine clinical practice. For example, it can be used as an independent quality assurance tool. However, it must be stressed that PRIMO is not medical software and it does not have any certification or warranty.

[1] For simulating this linac it is necessary to obtain the phase-space files distributed by Varian. These phase-space files are currently only available to TrueBeam owners.

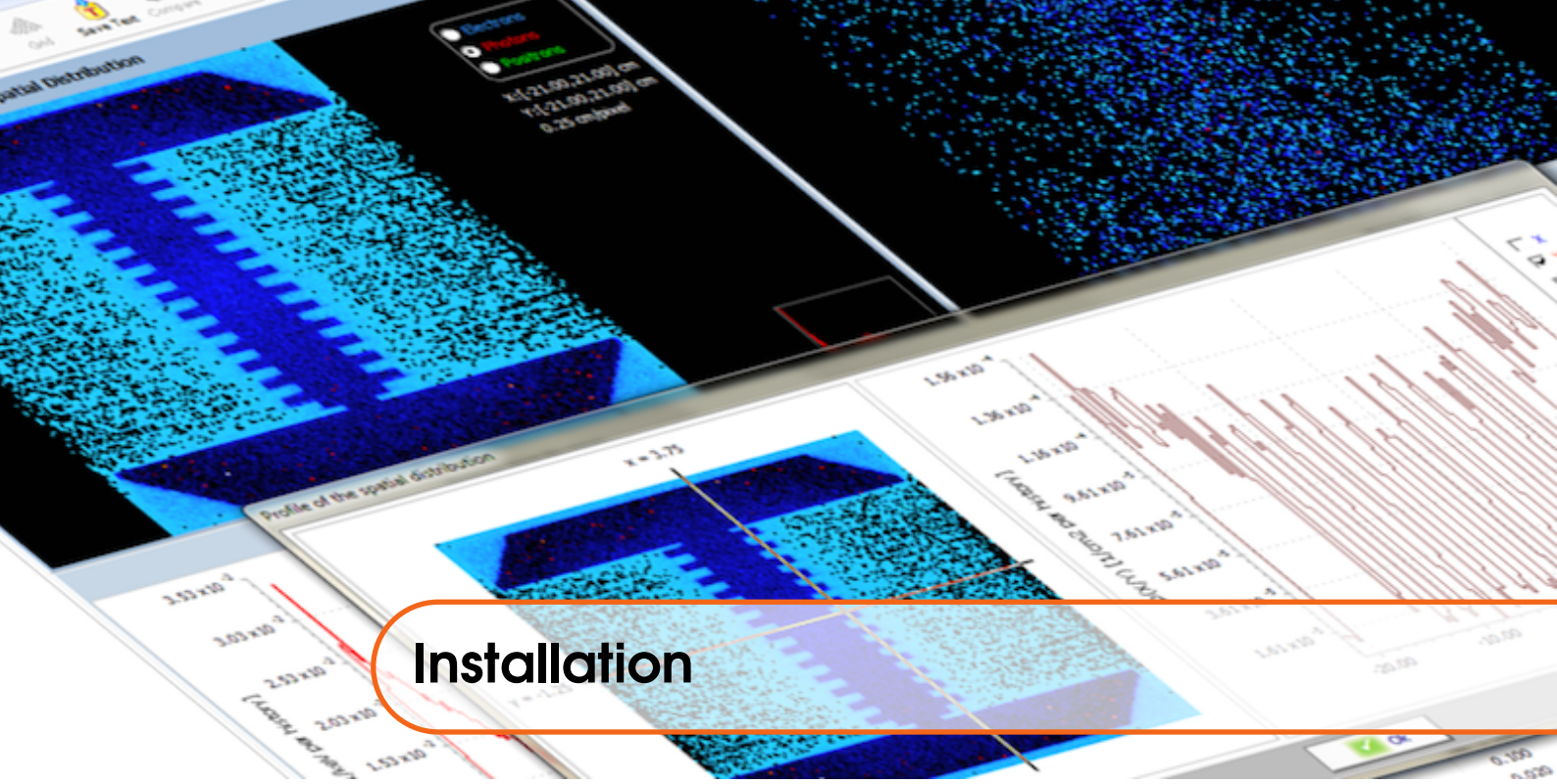
[2] Experimentally based geometry of TrueBeam developed in-house

PRIMO	commercial
Elekta SL	SL series
Elekta MLCi	SLi Plus, Axesse, Affinity, Synergy, Precise
Varian Clinac 600C	Clinac 600 C
Varian Clinac 600CD	Clinac 600 C/D
Varian Unique	Unique
Varian Clinac 2100	Clinac C series, TrueBeam[1]
Varian Clinac 2300	Clinac 2300 C/D
FakeBeam	TrueBeam 6- and 10-FFF beams[2]

Table 1: The column 'PRIMO' indicates the name given to the available linacs in the program. The column 'commercial' indicates the different commercial names that the same linac in PRIMO might have.

PRIMO can be downloaded from the project webpage `http://www.primoproject.net`. It is forbidden to redistribute copies of this software.

Please refer to the disclaimer and copyright statements for further details.



Installation

Tested hardware and software configurations

We have tested and successfully run the code in the following hardware and software configurations:

- Computer with Intel 64 bits processor
- Windows 64 bits[3] operating system[4]
- Administrator rights
- Recommended 1 GB RAM per computing core. For example, a computer with 2 CPUs each with 4 computing cores requires about 8 GB RAM.[5]
- The hard drive must be either local or accessible through a high speed connection (at least 6 GB/s).
- PRIMO occupies less than 100 MB of disk space. Owing to the fact that large files might be generated during execution a minimum of 100 GB of free disk space is recommended for a normal usage of the software.
- Minimum screen resolution 1280×960 pixels
- The default font size in Windows (smaller size) must be used.

Whence to obtain PRIMO

1. Visit the webpage `http://www.primoproject.net`.
2. Enter the section 'Download' and enter your name, email address and affiliation. You will receive an email with a link for downloading the software. PRIMO is distributed as a Windows installer `msi` file.
3. With the same link sent for downloading PRIMO it is possible to download already simulated examples. Each example is distributed as a compressed `zip` file.

[3] PRIMO has been successfully tested on Windows XP, Windows 7, Windows 8, Windows Server 2008 and Windows Server 2012. The classical view of the Windows desktop does not permit to see the full graphical quality of the program's icons.

[4] PRIMO may give problems on virtual machines (Parallels, VirtualBox, VMWare, etc.) and it does not run on Windows emulators (Wine, CrossOver, etc.)

[5] This 1 GB RAM rule also applies to logical computing cores in case of using hyper-threading. However, use of hyper-threading is not recommended.

How to install/uninstall PRIMO

Installer `msi` file

1. Execute the `msi` file.
2. The installation program will guide you through the installation process. The default installation folder is `c:\PRIMO` but it can be changed during the installation process.

R Errors during simulation execution could occur when PRIMO is installed in the `Program Files` folder of a server computer running Windows Server 2012. In that case it is advisable to select a different installation folder, such as `c:\PRIMO`.

Unistall

Use the Windows Start Menu –> Control Panel –> Programs and Features to uninstall any version of PRIMO that was installed from an `msi` file.

R Uninstall any previous version before installing a new one.

How to install the examples

1. Create a directory called `PRIMOexamples` under `c:\`.
2. Unpack the downloaded files inside the just created directory `c:\PRIMOexamples`. The unpacked files will each one create a directory called `Example`*mn*, with *mn* a two digits number.

List of examples

Example01 Photon reference field from a Varian Clinac 2100 C/D. Nominal energy 6 MV. Field size 10×10 cm^2. Tallied results: phase-space files and dose distribution.

Example02 Electron reference field from an Elekta SL15. Nominal energy 15 MeV. Electron applicator 20×20 cm^2. Tallied results: phase-space file and dose distribution.

Example03 Photon reference field from a TrueBeam STx. Nominal energy 6 MV (free flattening filter). Field size 40×40 cm^2. Tallied result: dose distribution.

Example04 Brain irradiation with two fields from a Varian Clinac 2100 C/D conformed with a MLC 120 High Definition. Nominal energy 6 MV. Tallied results: phase-space files and dose distribution.

Please notice the following remark:

R Examples 01, 02 and 03 contain subdirectories named `Experiment` where experimental data files are stored for comparison with simulated results.

Running PRIMO

PRIMO has been designed with an intuitive graphical user interface. It is assumed that the user has the basic operating knowledge of a medical physicist experienced with treatment planning systems. For the correct interpretation of the simulated results some basic knowledge of the Monte Carlo method is useful. Although the program is flexible enough to satisfy the requirements of advanced users, it always provides reasonable default parameters and hints.

R To launch PRIMO double-click on the PRIMO.exe file icon.

Using the examples

Before launching your own simulation it is recommended to load the examples and touring through the screens of PRIMO. Each of the distributed examples exploits different features of the software. The following instructions are valid for any of the examples.

1. Launch PRIMO
2. Go to File → Open
3. Open the project file (`*.ppj`) stored inside the chosen example directory. Immediately after opening a project PRIMO shows its main screen with the Simulation Setup tab selected.
4. All examples but number 03 contain phase-space files. If a phase-space file is available, this can be analyzed by clicking the Phase Space Analysis tab, then dragging the desired phase-space file icon on the left logical tree and dropping it in the blank screen area. Alternatively, right click on the icon and select the option *Analyze* in the appearing pop-up menu.
5. Similarly to phase-space files, dose distributions can be analyzed by clicking the Dose Analysis tab and then dragging the desired dose icon on the left logical tree and dropping it in the blank screen area. Alternatively, right click on the dose icon and select the option *Analyze* in the appearing pop-up menu.
6. Simulation properties of both phase-space files and dose distributions can be viewed by right-clicking the corresponding icons on the logical tree.

R Most of the screens showing plots give further options if the right mouse button is clicked over the plot.

It is recommended to navigate through all the screens of the examples and to click all buttons to familiarize with the available features. In case of inadvertently damaging any example, it can be restored by erasing its directory and installing it again.

Simulating a linac in photon mode

This section covers how to simulate a reference field of a Varian Clinac 2100 C/D in photon mode. It is a summary of the steps presented in section 5.1 of the *PRIMO User's Manual*.

1. Launch PRIMO
2. Go to File → New or click the button.
3. In the New Project window enter a name for your simulation project. Then from the drop-down menu choose Clinac 2100 and click the radio button Photon to choose photon mode.
4. Click the s2 tab from the Segment Setup panel in the main PRIMO screen. Click the button. In this window the field size can be defined. For the purpose of this example it will be left as 10×10 cm^2. Click *Ok*.
5. Click the s3 tab from the Segment Setup panel in the main PRIMO screen. Click the button. Enter in the Source to phantom surface distance (SSD) field the value of 95 cm. Click *Ok*.
6. Click the button. Select the Splitting-Roulette radio button. Click *Ok*.
7. Click the button. Check the Time checkbox. Uncheck the Histories checkbox. Enter the value 1800 seconds in the Time field for a 30 minutes simulation. In the Number of parallel processes field enter the maximum number of computing cores available in your computer. Click *Ok*.
8. Click the button. Click the button.
9. Once the simulation has finalized the open door button in the execution window will become active. Click it and the main PRIMO window will resume. Then check the Active checkbox next to s2 in order to simulate the second segment of the linac (jaws).
10. Click the and buttons in order to simulate the second segment.
11. Once the simulation has finalized click the button in the execution window will become active. The main PRIMO window will resume. Then check the Active checkbox next to s3 in order to simulate the third segment of the linac (dose distribution).
12. Click the and buttons in order to simulate the third segment.
13. Once the simulation has finalized click the button. The main PRIMO window will resume.

At this point a full simulation of the linac and the dose distribution obtained in water is completed. To analyze the obtained results proceed as described previously for the examples.