TechnicVR

shaderware.com

Student Guide

TechnicVR

shaderware.com

Student Guide

www.shaderware.com

info@shaderware.com

Table of Contents

Introduction

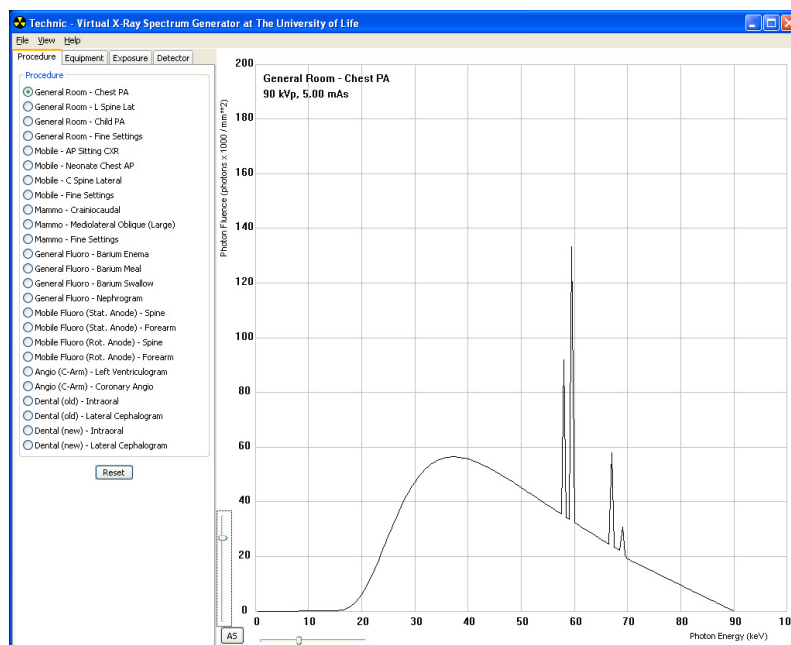*This section will explain what virtual radiography is*

This software is used to support radiography students in learning about the x-ray machines used in projection radiography, mammography and fluoroscopy. TechnicVR is a fully featured simulation of the x-rays created during an exposure. It is important to find out about what the patient is subject to. As a practitioner, your patients might ask you questions about this, and you need to be able to alter the factors sensibly to get the right results every time. All types of projection radiographic procedure are possible to set up using TechnicVR. It can be quite rewarding to quickly experiment with extreme examples (without risking equipment or yourselves!). The main benefit is that you can work through this at your own pace, satisfying your own curiosity, wherever a laptop computer can be located.

Starting TechnicVR

This section will explain how to start TechnicVR from the desktop or start menu and help you identify the initial screen items.
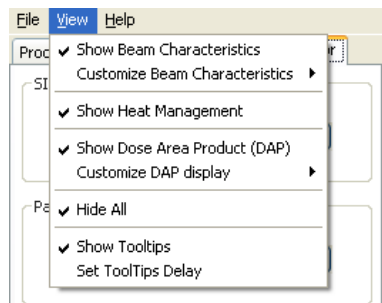
Default start-up screen

TechnicVR initially starts with the 'Procedure' tab open and the spectrum graph prominently displayed. The right hand output panel is deliberately hidden by default.

The view menu

By default, the start-up screen is uncluttered and simple. Any changes to the exposure factors result in a simple outcome – changes to the shape and height of the graph representing the beam spectrum.

It is easy to customise the screen by altering configurations in the 'View' menu

De-select 'Hide All', you can then choose 'Beam Characteristics', 'Heat Management' or 'Dose Area Product'. The screen can display all of these outputs at once if required; the 'Beam Characteristics' and 'Dose Area Product' outputs can be further customised.

The right hand panel displayed with 'Beam Characteristics', 'Heat Management' and 'Dose Area Product' all selected.

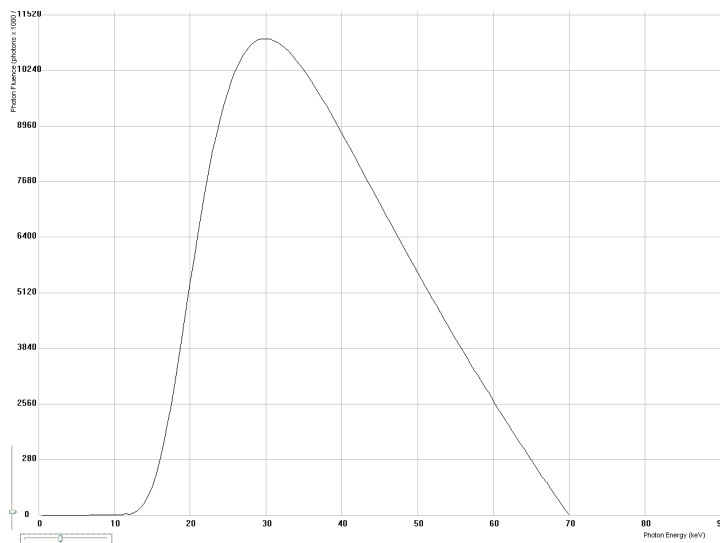In this example all possible options are selected.

The simulated x-ray spectrum

This section will explain the simulated x-ray beam and the quantitative measurements related to the spectrum displayed.

The main graphic output from TechnicVR is the simulated x-ray spectrum. This alters in real time with the exposure factors selected. There are also a range of quantitative values associated with this spectrum that are reported and 'Beam Characteristics'.
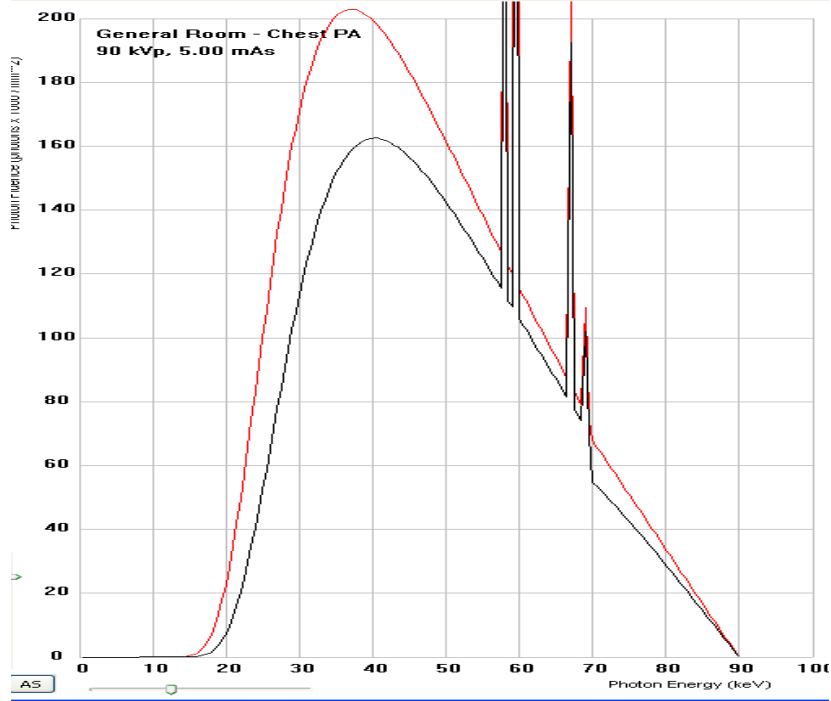
The spectrum graph

The graph responds to all exposure factors. It is always displaying photon fluence (the number of x-ray photons per mm^2) against photon energy (units of keV)
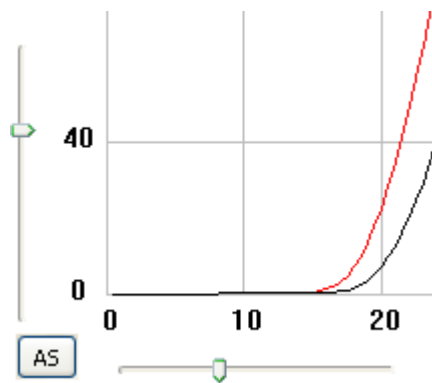

The 'predicted' spectrum is always shown; this allows a dynamic display of any alteration in exposure factor which is a very powerful learning tool.

Once the settings have been finalised for any given procedure, the exposure button can be depressed and the spectrum is fixed (if 'persist' option is selected). Changes to the exposure factors will now create a new 'predicted' spectrum; this makes it easy to compare and changes to the original exposure.

General Room - Chest PA
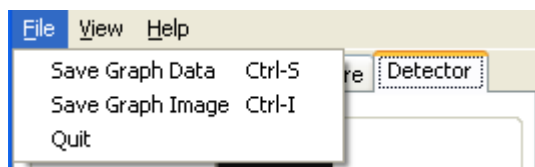90 kVp, 5.00 mAs

Resizing the graph

The axes are fixed, which allows direct comparison between the spectra. If the new spectrum is too large or too small to be displayed, the axes can be rescaled using the sliders manually or the 'Autoscale' button (AS)

Exporting the graph or spectrum data

TechnicVR makes it easy to create copyright free content for your PowerPoint presentations, essays or projects. The graph, or the data behind it can be exported from the file menu.

TIP: To quickly save a graph, right click on the plot area and a 'save file' dialogue will appear.

The data table used to create the graph is saved (File\Save) as a comma separated variable file (.csv) which is compatible with most spreadsheet programmes, e.g. Microsoft Excel. All the beam characteristics (even those that are not currently displayed) and the current exposure parameters are saved to this file alongside the individual photon energy data.

The detector(s)

This section will explain the TechnicVR detectors and the controls available on the 'Detector' tab
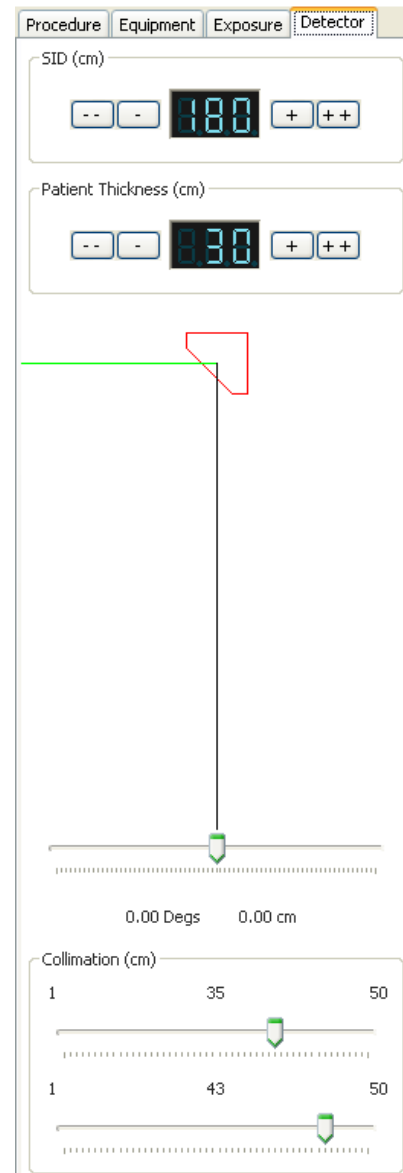
Types of Detector

Chapter 2 described how the outputs from the detectors modelled by TechnicVR can be displayed to the user. The 'Detector' tab has options to select the entrance surface detector position and to alter collimation of the beam (which will alter the Dose Area Product reading.
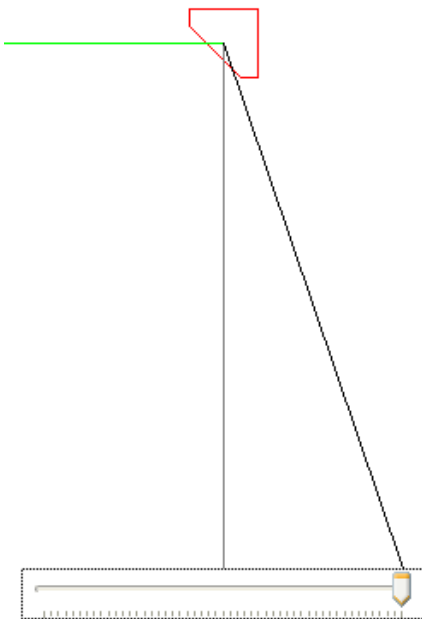
The entrance surface detector

This is notionally a small device that can be positioned on the entrance surface of a patient or phantom. It might be envisaged as a thermoluminescent material or a solid state device, however it is considered it is of a small size.

By altering the Source Image Distance (SID) and the patient thickness, the Source Detector Distance (SDD) can be calculated (remember to add 8-12cm to the patient thickness for Bucky examinations)

By default the detector is positioned at the central ray. But its location across the radiation field from cathode to anode can be altered. This will affect the spectrum and beam characteristics reported.

The range the detector can be moved is determined by the collimated area, and is reported in degrees.

This allows demonstration of the Anode Heel Effect dynamically to students.

The 'Dose Area Product' (DAP) meter

Modern radiography equipment often has a DAP meter attached to the light beam diaphragm (LBD). This provides a measure of both the ionisation of air due to the intensity of the radiation AND the area irradiated. Two readouts are possible, a predicted value and an accumulated DAP, for fluoroscopy systems.
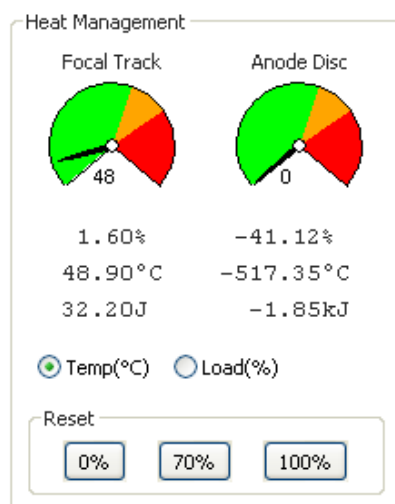

Two sliders are available to alter the collimated area for most procedures; the intra oral dental equipment has a circular collimator with only one slider.

The tube loadings

The x-ray spectrum generated by a set of technical factors is only half the story and TechnicVR also simulates the effects the Radiographers settings have on the tube.

Heat management

Only a small fraction of the electrical energy supplied by the generator is converted into x-rays; the majority heats up the anode target. The type of exposure and tube design all affect the rating of the tube. All these factors are used in the simulation, to achieve very realistic temperature values. These are put into the context of the tube heat capacity and are also shown as % tube loadings or temperatures on degrees Celsius.
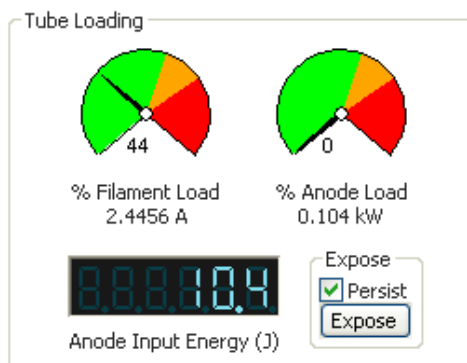

Once the exposure button is depressed (on the 'Exposure' tab) the heat is applied to the anode and dynamic cooling occurs, in real time, showing the effect of repeat exposures.

If a new simulation is required, the tube can be reset to either 'cold' (0%) 'warm' (70%) or 'hot' (100%) by clicking on the appropriate button

Predicted filament and anode loadings

Most x-ray tubes fail due to filament breakage. Even a small increase in filament temperature can shorten the life of the x-ray tube. TechnicVR will allow overload conditions to be simulated, and the effects are shown.

The filament and anode predicted loadings are only displayed on the 'exposure' tab.

Selecting procedures and equipment

This section will explain how to select a procedure and make changes to the default exposure parameters

Selecting procedures

Projection radiography includes a wide range of practice. The equipment used can vary enormously form one procedure to the next. To allow comparisons and accurate simulation, TechnicVR includes the following procedure types to be selected.

Dental Intraoral

Mobile

Chest

General room

Bariums

Angiography

Mobile II

Mammography

The procedure choices will only be displayed when the 'procedure' tab is selected.

When a procedure is selected, default exposure factors populate all the fields. These can then be altered individually

.

Equipment Choice

Radiographers have to be flexible enough to carry out procedures on a variety of different equipment. There are often both modern and older x-ray rooms in use at a particular clinic, for example. Different manufacturer's equipment may also have some characteristics that affect the x-ray spectrum. In TechnicVR you can make changes to equipment to show how these affect the x-ray spectrum. These factors are not normally in the control of the radiographer in day to day operation (unless they select to use a particular room).

Control of exposure factors can either be by kVp and mAs (2 point) or kVp, mA and time (3 point). Changes here will affect the 'exposure' tab layout

The equipment choices will only be displayed when the 'equipment' tab is selected.
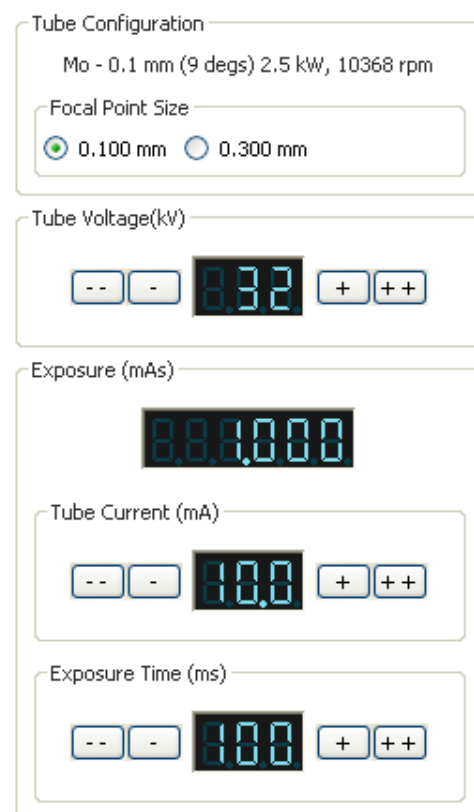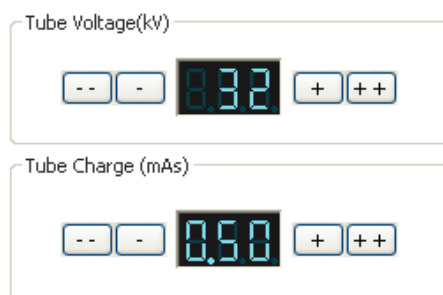
Altering common exposure factors

This is an everyday activity. Although the use of automatically programmed radiography factors (APR) is increasing with modern generator control panels, it is important to optimise exposure factors fr each and every patient. These controls are found on the 'Exposure' tab

Filament size

A smaller filament size is desirable for improved image quality. But this puts a strain on the equipment, and can involve a reduction of image quality if the exposure time increases enough to allow movement blur. The focal spot can be selected from those available in the 'exposure' tab.
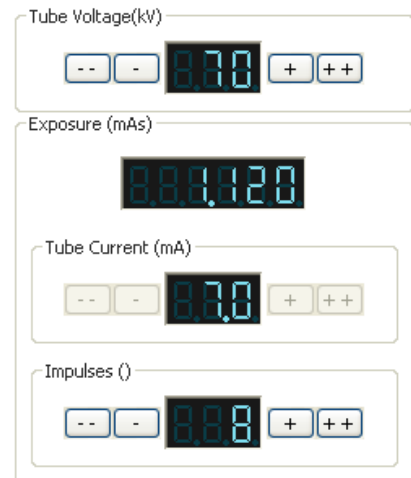
Two or three point control

For most procedures, there is a choice of selecting tube potential difference (kV) and tube charge (mAs) [two point] or selecting tube current (mA) and time (s) separately [three point].

Tube Configuration

Mo - 0.1 mm (9 degs) 2.5 kW, 10368 rpm

Focal Point Size
○ 0.100 mm   ○ 0.300 mm

Tube Voltage(kV)

[--] [-] **32** [+] [++]

Exposure (mAs)

1.000

Tube Current (mA)

[--] [-] **10.0** [+] [++]

Exposure Time (ms)

[--] [-] **100** [+] [++]

Tube Voltage(kV)

[--] [-] **32** [+] [++]

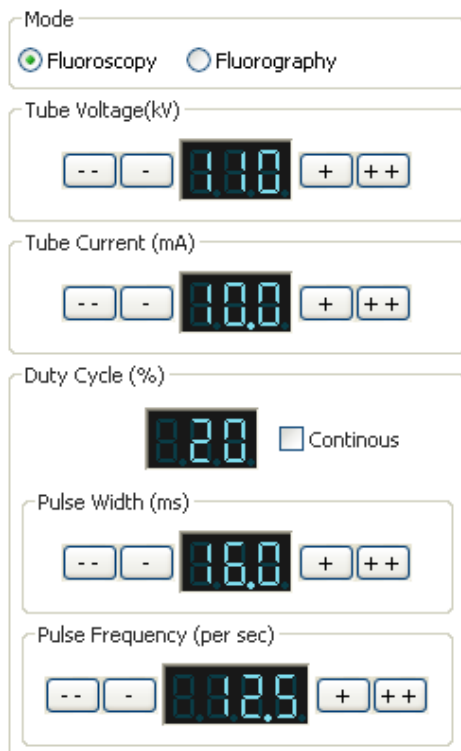Tube Charge (mAs)

[--] [-] **0.50** [+] [++]

Dental

Older intra-oral machines don't set exposure time in conventional units, but set the number of 'impulses'. Each impulse is a single mains voltage cycle. In the UK this is 0.02 seconds long, or 1/50th of a second. In the USA it is 0.016666 seconds, 1/60th of a second.

Tube Voltage(kV)
`- -` `-` **70** `+` `+ +`

Exposure (mAs)
1.120

Tube Current (mA)
`- -` `-` **7.0** `+` `+ +`

Impulses ()
`- -` `-` **8** `+` `+ +`

Fluoroscopy and fluorography

Mode
◉ Fluoroscopy   ○ Fluorography

Tube Voltage(kV)
`- -` `-` **110** `+` `+ +`

Tube Current (mA)
`- -` `-` **10.0** `+` `+ +`

Duty Cycle (%)
20 ☐ Continous

Pulse Width (ms)
`- -` `-` **16.0** `+` `+ +`

Pulse Frequency (per sec)
`- -` `-` **12.5** `+` `+ +`

There are separate settings for fluoroscopic kVp and mA on most fluoroscopy equipment to allow high quality 'spot imaging' or 'acquisition' and low quality 'scout' imaging that is not archived, but is used to position the instruments or fluoroscope. Older systems have continuous fluoroscopy, but modern systems can pulse the fluoroscopy for considerable radiation dose savings to both patients and operators. The rate of 'acquisition' is often just a single exposure, but for some procedures, such as angiography, the rate can be between 6 and 50 images per second.

Bibliography

SOR (2007) **Virtual education: A reality for radiography?,** The Society of Radiographers, [SYNERGY NEWS]

BBC (2006) **Gamers' skills aid X-ray students,** BBC News, 8 July 2006, [Online]

[url: http://news.bbc.co.uk/go/pr/fr/-/1/hi/england/tees/5161058.stm

[Accessed 08/07/2006]

SOR (2006) **Students use virtual reality to train as radiographers**, The society of Radiographers, [Online]

[url: http://www.sor.org/public/students/news/news2.htm

[Accessed 10/07/2006]

Index