



EMITEL e-Encyclopaedia of Medical Physics and Multilingual Dictionary of Terms



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e-Learning in Medical Physics and EMITEL e-Encyclopaedia with Dictionary

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King's College London; International Organization for Medical Physics (IOMP); University of Florence; University of Lund; Lund University Hospital; King's College Hospital; AM Studio, EMITEL Network of 270+ specialists (for contact: slavik.tabakov@emerald2.co.uk)



The delivery of contemporary healthcare is impossible without medical technology - one of the most advanced technologies of our time.

Education and Training in the field is complex, demanding and difficult to organise.



1. The biggest e-L advantage is the easy explanation of contemporary science. Adding computer simulations, interactive diagrams or just digital images increases enormously the effectiveness of teaching.



2. The easy upgrade of e-L materials is additional advantage, imperative for dynamic profession as Medical Physics and Engineering.

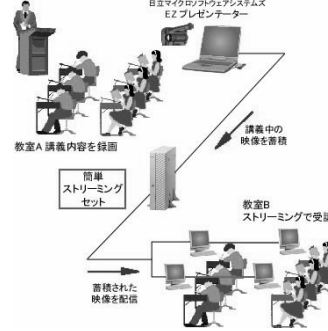
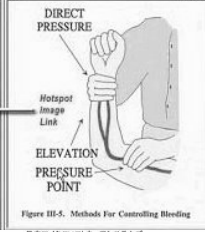


Effectiveness of learning

- Pedagogical effectiveness (better learning)
- Economic efficiency (more students per teacher)

Management of learning (administrator+assessor tools)

Method	Procedures	Examples
Direct local pressure	<ul style="list-style-type: none"> Place direct pressure, pad over the wound and press firmly Wrap firmly with pressure bandage 	
Elevation	<ul style="list-style-type: none"> Elevate the wound above the level of the heart. 	
Pressure Points	<ul style="list-style-type: none"> Femoral point for leg bleeding Brachial point for arm bleeding Others 	
Tourniquet	<ul style="list-style-type: none"> Only as a last resort 	



Main e-Learning layers:

- Building simulations
- Developing modules
- Structuring programs

The screenshot shows a complex e-learning interface. On the left, there are navigation tabs for 'Home', 'Introduction', '5.1', '5.2', '5.3', '5.4', '5.5', '5.6', '5.7', '5.8', '5.9', '5.10', '5.11', '5.12', '5.13', '5.14', '5.15', '5.16', '5.17', '5.18', '5.19', '5.20', '5.21', '5.22', '5.23', '5.24', '5.25', '5.26', '5.27', '5.28', '5.29', '5.30', '5.31', '5.32', '5.33', '5.34', '5.35', '5.36', '5.37', '5.38', '5.39', '5.40', '5.41', '5.42', '5.43', '5.44', '5.45', '5.46', '5.47', '5.48', '5.49', '5.50', '5.51', '5.52', '5.53', '5.54', '5.55', '5.56', '5.57', '5.58', '5.59', '5.60', '5.61', '5.62', '5.63', '5.64', '5.65', '5.66', '5.67', '5.68', '5.69', '5.70', '5.71', '5.72', '5.73', '5.74', '5.75', '5.76', '5.77', '5.78', '5.79', '5.80', '5.81', '5.82', '5.83', '5.84', '5.85', '5.86', '5.87', '5.88', '5.89', '5.90', '5.91', '5.92', '5.93', '5.94', '5.95', '5.96', '5.97', '5.98', '5.99', '6.00'. The main content area displays a text-based module titled '5.3 T1- and T2-maps. Understanding T1-weighting, T2-weighting, PD-weighting'. It includes a table for 'Image weighting' and a small MRI image. On the right, there is a sidebar with 'The Physics of Diagnostic Radiology' and 'The Physics of Radiotherapy'. At the bottom, there are controls for 'Scan percentage', 'Low Pass Filter', 'High Pass Filter', 'Mid scan width', and 'SAR REDUC'.

e-learning production:

- field knowledge
- paedagogical approach
- e-developer

Address: http://www.sprawls.org/resources/RADQU/

SPRAWLS EDUCATIONAL FOUNDATION The Physical Principles of Medical Imaging Online

Radiation Quantities and Units
Perry Sprawls, Ph.D.

Introduction and Overview

SPRAWLS EDUCATIONAL FOUNDATION
Open Resources for Learning and Teaching
The Physical Principles of Medical Imaging

Blur, Resolution, and Visibility of Detail
Perry Sprawls, Ph.D.

Online Textbook
Table of Contents

WHICH RADIATION PATIENT RECEIVE?

CHAPTER CONTENTS

INTRODUCTION AND OVERVIEW
BLUR
Blur Size
Blur Shape
Blur Profile

VISIBILITY OF DETAIL
UNSHARPNESS
RESOLUTION
Limiting Resolution
Comparing The Imaging Modalities

MODULATION TRANSFER FUNCTION
Spatial Frequency of Anatomical Objects
Composite MTF

INTRODUCTION AND OVERVIEW **CONTENTS**

An important characteristic of any medical imaging method is its ability to show the anatomical detail of the human body. Detail, as used here, refers to the small structures, features, and objects associated with normal anatomy and various pathological conditions. The smallest detail that can be visualized is determined, to a large extent, by the amount of blur produced by the imaging procedure. There is some blur in

www.sprawls.org resources

IPEM – X-ray Spectrum processing tool (independent)

EMIT – MRI simulation (requires IDL Virtual machine)

Spectrum Details

Target Material: Tungsten (W)
Tube Voltage: 10 kVp
Anode Angle: 12 deg
Voltage Ripple: 0.5%
Source File Name: 000120.spc

Materials Used to Attenuate Spectrum

Material Name	Thickness / mm
Aluminum	3.54

Processed Photon Spectrum

Y-Axis Scale: Linear Log 10

Energy / keV	Photons per (nA.s mm ²)
4.0	0.00E+00
1.0	0.00E+00
1.5	0.00E+00
2.0	0.00E+00
2.5	0.00E+00
3.0	0.00E+00
3.5	0.00E+00
4.0	0.00E+00
4.5	0.00E+00
5.0	0.00E+00

Analyze of Processed Spectrum

Mean Photon Energy: 44.8 keV
J/g: 1.259E+02 pGy per nA.s
I_{eff} (W): 3.347E+03 mm²

Diffusion - DEMO:

Select first image:
Advanced loading: extfile:
View images:
View textfile:
Preferences:
Tools

Advanced loading of images:

Image: 1004.dcm
Size: 178
Header: DICOM
Name: Yes

Set threshold in B0 image
Default path: C:\EMERALD_and_EMIT e
Select option: **

Data files in directory:

- 1001.dcm
- 1002.dcm
- 1003.dcm
- 1004.dcm
- 1005.dcm
- 1006.dcm
- 1007.dcm
- 1008.dcm
- 1009.dcm
- 1010.dcm
- 1011.dcm
- 1012.dcm
- 1013.dcm
- 1014.dcm
- 1015.dcm
- 1016.dcm
- 1017.dcm
- 1018.dcm
- 1019.dcm
- 1020.dcm

select first image: 1004.dcm
select gradient: Gradienter.M
View each loaded image for [0] Sec

Load:

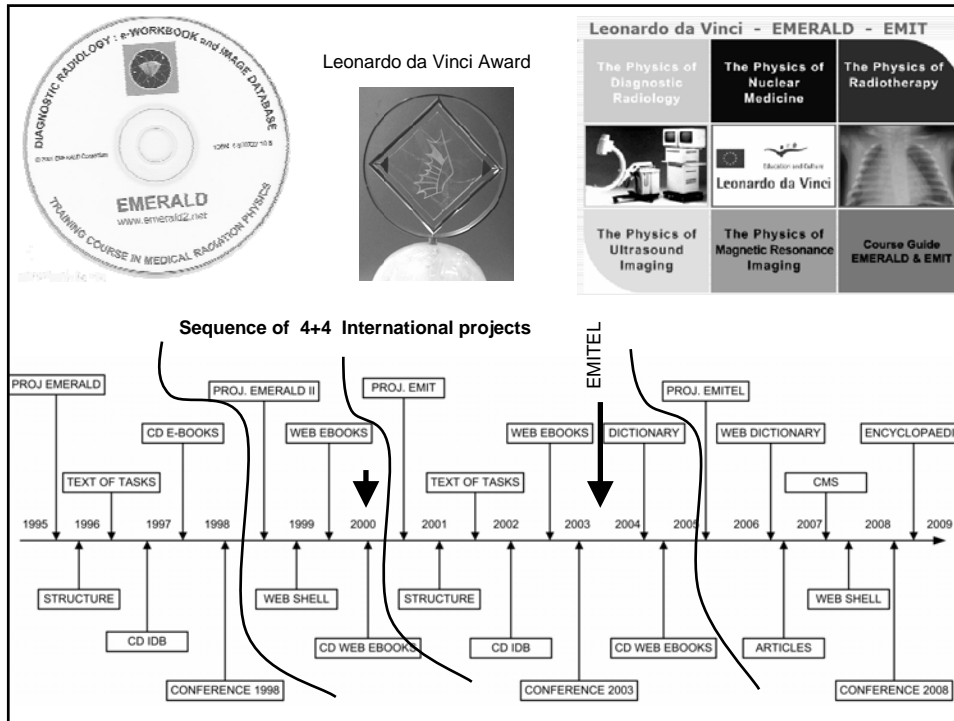
Done Help

Tables Options Function

Sketch Bottom: 21
Sketch Top: 1.00000

Gamma Correction:

- B/W LINEAR
- BLUE/WHITE
- GRN+RED-BLU+WHT
- RED TEMPERATURE
- BLUE/GREEN+RED+YELLOW
- STD GAMMA-II
- PRISM
- RED+PURPLE
- GREEN+WHITE LINEAR
- GRN+WHT EXPONENTIAL
- GREEN+PINK
- BLU+RED
- 16 LEVEL
- RAINBOW
- STEPS
- STERN SPECIAL



EMERALD and EMIT modules (5 volumes)

Text hyperlinked with images + Educational Image Database + Timetables (training)

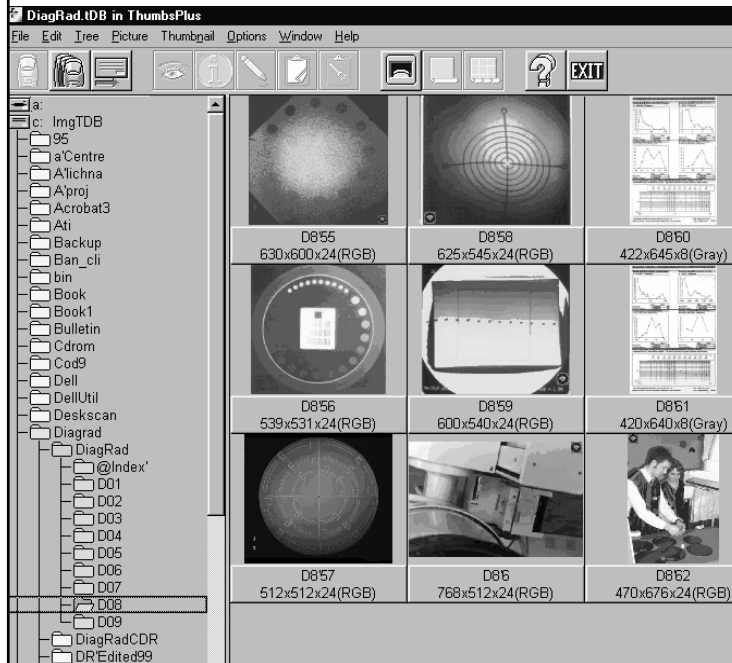
www.emerald2.eu

5.3 ASSESSMENT OF X-RAY TUBE OUTPUT PARAMETERS

5.3.1 Task
Assessment of X-ray Tube Output Consistency; Output variation with mA and with kV; Linearity; Assessment of the Focal spot size and the X-ray/Light beam alignment.

Approximate time for performing the task - 2 days.

Image Database functions



Browsing
 Keywords
 Image Info
 Annotations
 Sorting
 Visualisation
 (full image
 quality)
 Image
 organisation
 follows
 workbook

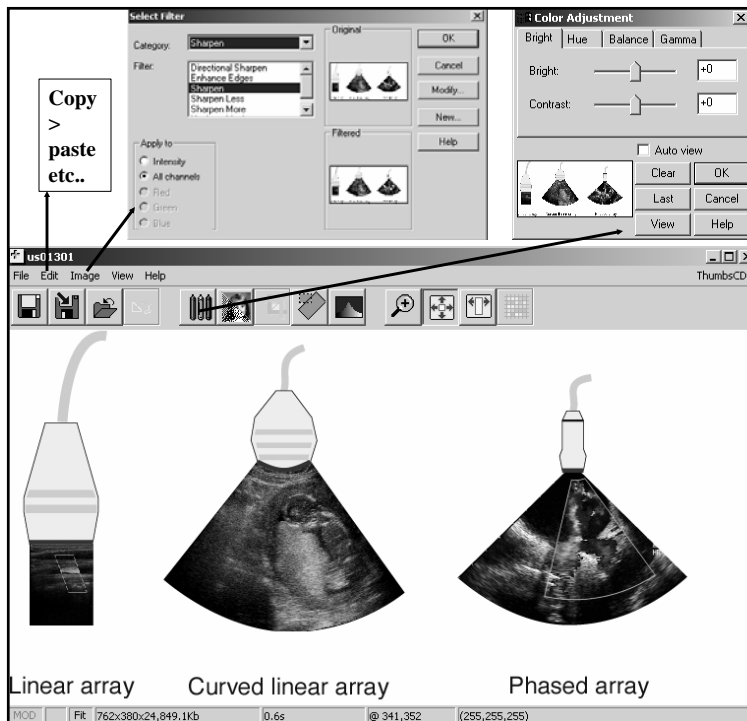
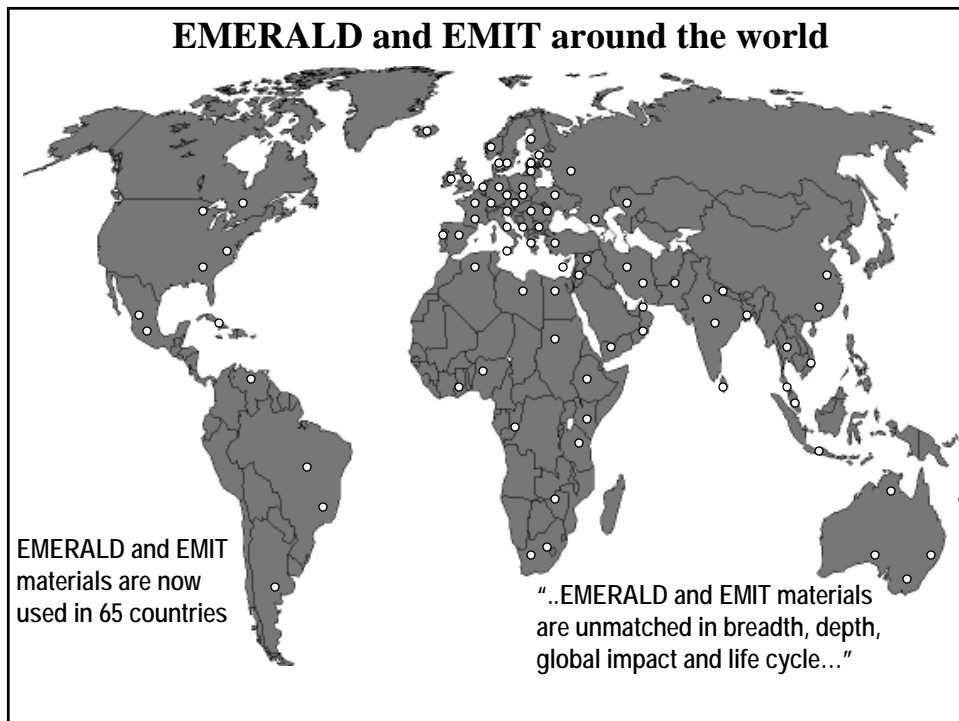
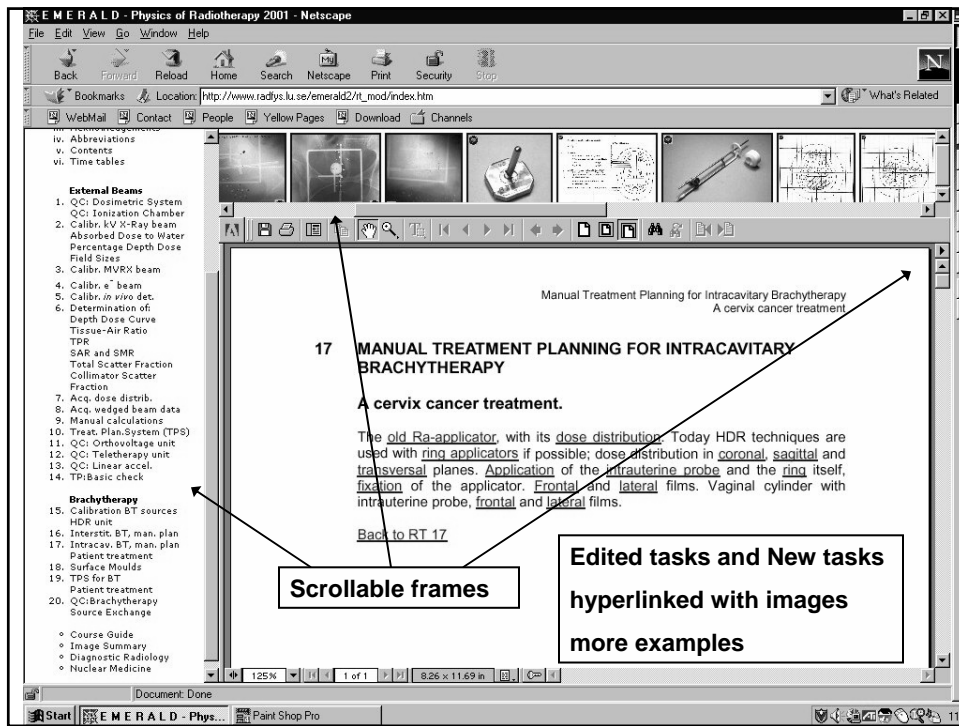


Image resolution

normally up to
 800 horiz. px.
 24 bits JPEG

Image Manipulation

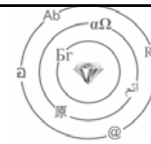
Contrast
 Brightness
 Gamma
 Filtering
 Colour depth
 Zoom +/-
 Captions



European Medical Imaging Technology
e-Encyclopaedia for Lifelong Learning (EMITEL)



EMITEL Encyclopaedia of Medical Physics



The encyclopaedic articles cover:

- Diagnostic Radiology (X-ray)
- Nuclear Medicine
- Radiotherapy
- Ultrasound imaging
- MR imaging
- Radiation Protection



It is planned to extend to other areas of medical physics in the future.

Funding and support:

- Partially funded by the European Union under Leonardo da Vinci Programme
- International Contribution from key professionals
- All previous EMERALD and EMIT project materials included

Project Partners: King's College London and King's College Hospital (UK), University of Lund and Lund University Hospital (Sweden), University of Florence (Italy) and AM Studio, Plovdiv (Bulgaria), IOMP as an international partner, ICTP as supporting partner (Conference 2003).

EMITEL CONCEPTS:

- Filling an educational gap
- Educational value – first priority
- Reliable reference tool
- Allows easy update of the materials
- Minimum learning curve
- Maximum life cycle of the product
- Includes imaging material, diagrams and examples
- Use of simple software without compromising the content
- Useful for a broad audience of colleagues (use of dictionary)
- EU + International collaboration through IOMP
- Supported both for on-line and off-line use

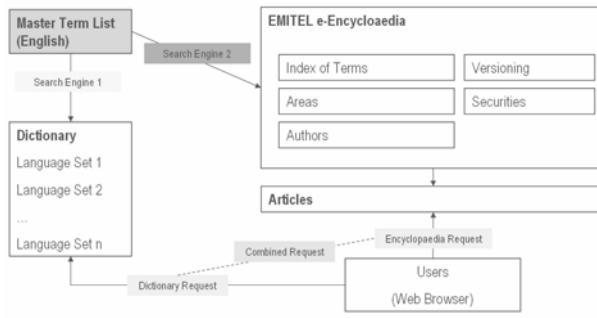


RESULTS Languages in the DICTIONARY:

Dictionary – 27 languages (in 8 alphabets),
each with ~3400 terms:

English, French, German, Italian, Swedish, Spanish,
Portuguese, Bulgarian, Czech, Greek, Hungarian,
Lithuanian, Polish; Estonian, Romanian, Turkish,
Latvian, Russian, Thai, Arabic, Persian, Bengal,
Slovenian, Malay, Chinese, Japanese, Croatian

WEB DATABASE



ENCYCLOPEDIA	DICTIONARY	COMBINED
Choose input Language	English	Output Language
dose		Swedish
Dose		French
Implant dose distribution		English
Incident dose		German
Inhomogeneous dose distribution		Swedish
Integral dose		Italian
Lateral dose distribution		Spanish
Lethal dose		Portuguese
Linear dose response curve		Polish
Linear nonthreshold dose response		Di Czech
Linear-quadratic dose-response curve		Hungarian
Maximum dose		Romanian
Maximum permissible dose (MPD)		Li Latvian
Maximum target dose		Lithuanian
Mean absorbed dose to air		in Estonian
Mean lethal dose		Creek
Mean target absorbed dose		in Turkish
		Arabic
		Thai
		Chinese
		linjär doseresponskurva
		linjär doserespons utan tröskel
		linjär-kvadratisk dose-responskurva
		maximum dos
		Maximal tillåten dos (MDP)
		maximal target dos
		medelabsorberad dos till luft
		Medeldos för dödlighet
		medeltargetdos

DICTIONARY (Translator)

Available both at: www.emitdictionary.co.uk and with the Encyclopaedia

Gratefully acknowledged contributors (details at www.emitel2.eu) :

Dictionary: Slavik Tabakov (Coordinator); Farida Bentayeb; Rachida El Meliani; Nagi Hussein; Ibrahim Elyasseery; Golam Abu Zakaria; Hasin Azhari Anupama; Md Akhtaruzzaman; Safayet Zaman; Jenia Vassileva; Venceslav Todorov; Petar Trindev; Slavik Tabakov; Borislav Konstantinov; Anastas Litchev; Andy Zhu; Dai Liyan; Dai Xiangkun; Fu Guishan; Geng Hui; Wang Jianhua; Wang Yunlai; He Zhengzhong; Xu Xiao; Xu Zhiyong; Yin Yong; Zhang Jiutang; Zhang Yue; Ivana Horakova; Anna Kindlova; Simona Trampotova; Daniela Kotalova; Vaclav Husak; Jaroslav Ptacek; Josef Pacholik; Pavel Dvorak; Libor Judas; Irena Novotna; Kalle Kepler; Sigrid Kivimae; Kalju Meigas; Juri Vedru; Alain Noel; Jean-Yves Giraud; Helene Bouscayrol; Louis Blache; Markus Buchgeister; Gunther Helms; Stefan Delorme; Stelios Christofides; Prodromos Kaplanis; George Christodoulides; Charalambos Yiannakaras; Nicolaos Papadopoulos; Demetrios Kaolis; Georgiana Kokona; Georgios Menikou; Christos Papaefstathiou; Yiannis Gerogiannis; Demetra Constantinou; Spyros Spyrou; Andreas Mikelides; Anastasia Sissou; Christodoulos Christodoulou; Pal Zarand; Istvan Polgar; Tamas Porubszky; Janos Martos; Geza Safrany; Tamas Daboczi; Jozsef Varga; Franco Milano; Yuri Dekhtyar; Alexei Katashev; Marite Chaikovska; Emzinsih Dzintars; Sergei Popov; Lada Bumbure; Juris Rauzins; Plaude Sandija; Arunas Lukosevicius; Algidas Basevicius; Dovile Serenaitė; Diana Adliene; David Bradley; Alireza Binesh; Ali Asghar Mowlavi; Azam Niroomand-Rad; Marta Wasilewska-Radwanska; Zenon Matuszak; Katarzyna Matusiak; Aleksandra Jung; Ana Pascoal; Nuno Teixeira; Paulo Ferreira; Nuno Machado; Daniela Andrei; Cristina Petroiu; Aurel Popescu; Octavian Dului; Raducu Popa; Constantin Milu; Valery Kostylev; Nina Lutova; Boris Narkevich; Tatiana Ratner; Ervin Podgorsak; Bozidar Casar; Vili Kovac; Damijan Skrk; Petra Tomse; Ana Millan; Ignacio Hernando; Alejandro Garcia Romero; Inger-Lena Lamm; Monica Almquist; Ronnie Wirestam; Sven-Erik Strand; Bo-Anders Jonsson; Michael Ljungberg; Freddy Stahlberg; Thomas Jansson; Anchali Krisanachinda; Sivalee Suriyapee; Tanawat Sontropornpol; Panya Pasawang; Chotika Jumpangern; Taweap Sanghangthum; Isra Na Ayuthaya; Sonjarod Oonsiri; Perihan Unak; Turgay Karali; Serap Teksoz; Zumrut Biber Muftuler; Fatma Yurt Lambrecht.



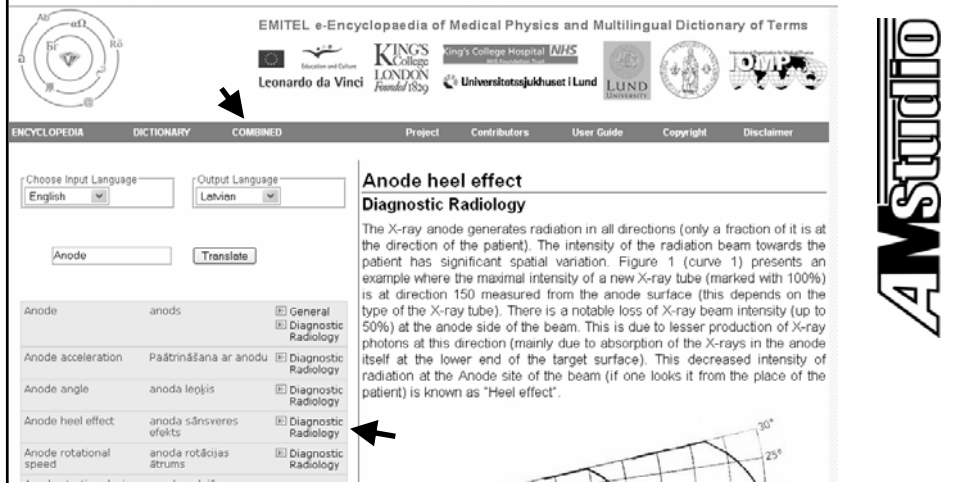
RESULTS Web Software: WWW.EMITEL2.EU

Web site – Database + Encyclopaedia web site with 2 Search engines (fully open)

Three modes: Encyclopaedia / Dictionary / Combined

Tested to work with all major Internet browsers

Materials tested by project members and by MSc students



The screenshot shows the EMITEL e-Encyclopaedia of Medical Physics and Multilingual Dictionary of Terms website. It features a navigation bar with 'ENCYCLOPEDIA', 'DICTIONARY', and 'COMBINED' modes. Below the navigation bar, there are dropdown menus for 'Choose Input Language' (set to English) and 'Output Language' (set to Latvian), along with a 'Translate' button. A search box contains the word 'Anode'. The search results table lists terms like 'Anode', 'Anode acceleration', 'Anode angle', 'Anode heel effect', and 'Anode rotational speed'. The 'Anode heel effect' entry is highlighted, and its detailed description is shown on the right. The description explains that the X-ray anode generates radiation in all directions, but with significant spatial variation, leading to a 'Heel effect' where intensity is lower at the lower end of the target surface. A diagram of an X-ray tube is visible at the bottom right of the page.

AMStudio

RESULTS Articles (Encyclopaedic entries) :

Completed c. 3400 articles - with c. 2500 images and diagrams

Volume approx. 2100 A4 pages (size of articles varies, median 300 words)

Language: English

Largest Work Pack – developed by 7 Groups working in parallel
Diagnostic Radiology (X-ray); Nuclear Medicine; Radiotherapy;
Ultrasound imaging; MR imaging; Radiation Protection; General

- Includes: synonyms, acronyms and abbreviations;**
- Some articles written by 2 parallel Groups;**
- Articles' content and use tested (by experts and students);**
- System for editing and updating applied to each article;**
- Search for part of the word (in case of misspelling)**

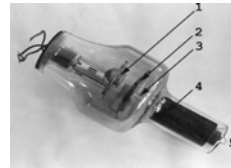


Types of articles:

1. Very Short (not many) - example

Unsharpness

Unsharpness is a characteristic of an image resulting from blurring. In such an image structures, objects, and edges appear to be "unsharp".



2. Short articles (often related to other articles) - example

Line focus principle

The line focus principle, first described by Dr. O. Goetze, in 1918, is found in most x-ray tubes. The usual cathode consists of a helical heated filament mounted in a focusing electrode. The resulting electron beam focused on the anode surface forms a focal spot that is an image of the elongated (line shaped) heated filament. The length is generally the largest dimension of the focal spot and is highly dependent on the angle of the anode surface and the direction from which the focal spot is being observed. For more information see article on Stationary anode.

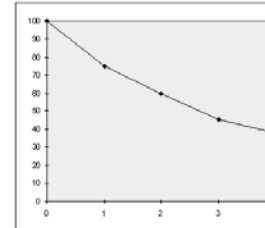
3. Typical articles (majority)

200-400 words plus one diagram or image

4. Very long articles (not many)

3-4 pages with 4-6 diagrams/images

5. Internally linked (no text at all) < 10%



Full text search - (inside article text in English – only in Encyclopaedia mode)

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attenuat Search

Search in: Title Full Text

Area: All

- Block transmission factor
 - Diamond detector
 - Secondary collimator
 - Treatment head
 - Multileaf collimator
 - Time-distance-shielding (TDS) rules
 - Neutron therapy
 - Grid efficiency
 - MRI (Magnetic Resonance Imaging)
 - Flat panel detector
 - Apparent diffusion coefficient (ADC)
 - Image artefact
- Radiotherapy
 - Radiation Protection
 - Radiotherapy
 - Radiotherapy
 - Radiotherapy
 - Radiation Protection
 - Radiotherapy
 - Diagnostic Radiology
 - Magnetic Resonance Imaging
 - Diagnostic Radiology
 - Diagnostic Radiology
 - Magnetic Resonance Imaging
 - Ultrasound Imaging
 - Diagnostic Radiology

Grid efficiency

Diagnostic Radiology

Grid efficiency is the combination of two factors. One is the ability to attenuate scattered radiation, which is its purpose, and the other is the undesirable attenuation of the primary radiation. Both of these are related to several factors but the predominant factor affecting grid efficiency is grid ratio as illustrated on Figure 1.

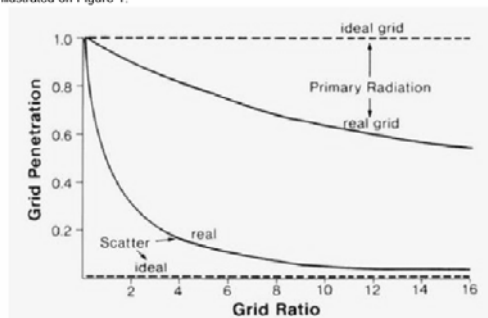
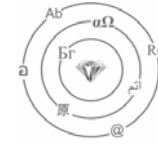


Figure 1. Illustration of Grid efficiency

Grid ratio (usually with values from 5:1 to 16:1) is a ratio between height (thickness) of the strips and width of the interspace. In general, the efficiency of a grid increases with grid ratio because the attenuation of the scattered radiation increases more than the attenuation of the primary

ENCYCLOPAEDIA

Gratefully acknowledged contributors (details at www.emitel2.eu) :



Encyclopaedia: Slavik Tabakov (Coordinator); Perry Sprawls; Graeme Taylor; Maria Lewis; Elizabeth Morris; Magdalena Stoeva; Asen Cvetkov; Mario Dedenaro; Niko-las Pallikarakis; Kalle Kepler; George D Frey; William Hendee; Ratko Magjarevic; Vassilka Tabakova; Alain Noel; Paola Bregant; Justine Calvert; Tracy Underwood; Stephen Wastling; Michelle Footman; Hannu Escola; James Clinch; Hamish Richardson; Navneet Dulai; Sven-Erik Strand; Bo-Anders Jonsson; Mikael Peterson; Michael Ljungberg; Gillian Clarke; George Mawko; Anchali Krisanachinda; David Bradley; Ana Millan; Franco Milano; Inger-Lena Lamm; Fridtjof Nuesslin; Phil Evans; Charles Deehan; Joan Coward; Mark Grattan; Brendan McClean; Ruth McLauch-lan; Paul Zarand; Barry Allen; Markus Buchgeister; Ivana Horakova; Ervin Podgorsak; Jean-Yves Giraud; Freddy Stahlberg; Ronnie Wirestam; Andy Simmons; Stephen Keevil; Gerard Boyle; Nicola Harris; Emil Nordh; Adnan Bibic; Anders Nilsson; Anna Rydhog; Jimmy Latt; Johan Olsrud; Linda Knutsson; Peter Mannfolk; Sarah Brockstedt; Jonathan Siikanen; Mattias Nickel; Karlin Bloch; Markus Nilsson; Martin Leach; Mario Secca; Tobias Schaeffter; Ewald Moser; Gunter Helms; Jacques Bittoun; Cornelius Lewis; Jim Thurston; Peter Smith; Elizabeth Chaloner; Marta Radwanska; Anna Benini; Stelios Christophides; Cari Borrás; Kjeld Olsen; David Platten; Ignacio Hernando; Bruce Walmsley; Colin Deane; David Goss; Tomas Jansson; Monica Almqvist; Victoria Aitken; Lorna Sweetman; Fernando Schindwein; Crispian Oates; Tony Evans; Heikki Terio; Luciano Bertocchi; Colin Roberts.



Dedicated Content Management System (CMS) for upload to the Database

CMS web site for regular updates and editing of content (open for Editorial Board)

The screenshot displays the Emitel CMS interface. On the left is a sidebar with navigation links: 'Browse Terms', 'Documents', 'Help', and 'Logout'. The main content area is titled 'Echocardiography' and includes a sub-section 'Ultrasound Imaging' with a 'Clinical' tag. Below this is a detailed text description of echocardiography, accompanied by two small images: one showing an ultrasound scan and another showing a person's chest with a probe. A table below the text lists various terms related to echocardiography, such as 'DESS (Dual echo steady state)', 'Echo planar imaging', 'Echo spacing', 'Echo time, TE', 'Echo train length', 'Echocardiography', 'Echoes, definition of, in ultrasonography', 'Echo Enhancing Agent', 'Echo ranging', 'Echogenic', 'Effective echo time', 'Fast spin echo (FSE)', and 'FFE (fast field echo)'. Each term has a 'Create Article' link next to it. The interface also shows a search bar and a 'Done' button.

Included in 2010 through CMS – 2 languages and 100+ new and updated articles

EMITEL summary and future:

- The largest International project in the profession developed the first dedicated Medical Physics e-Encyclopaedia with Multilingual Dictionary
- Incremental build-up methodology (*iterations*):
 - Initial articles > Refereeing > Editing > Web publishing > Web update > Print
- Parallel Web update and paper print preparation (final pre-print editing by 2011)
- Web site will continue to be updated in future with the Network support
- Additional future international support (IOMP, IFMBE)
- Expanding the articles and including new articles and themes (CMS)
- Expanding EMITEL Network



EMITEL International Network

- Objective: Regular update and support of EMITEL
- Coordination from King's College London (with dedicated administrator)
- Currently 250+ specialists from 35 countries (expected to grow in future)



All members are professional experts, the majority officers of their National Societies (of those 21 are Current and Past Presidents);

Many thanks to all supporters and contributors!

