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On electromagnetic acoustic transduction in biology and medicine: a speculative review

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Abstract

Some premises of solid state physics in living matter, relevant to this review's subject, are first recalled. Besides the well known microwave auditory effect and the applications of photoacoustic discipline, the electromagnetic acoustic (EMA) transduction in living tissue concerns the entire electromagnetic spectrum, from ELF fields to ionizing radiation.

The frequency of EMA transduction waves can be ultra-acoustic (MHz, GHz) as well as acoustic (kHz), so that cavitation effects and space resonance interactions with subcellular organelles and DNA can ensue.

Considering the large presence in the human body of 'non-hearing high actin-microvilli content cells', with actin bundles arranged as in microvilli in the cochlear hairy cells, and the low levels of microwave radiation sufficient to induce the hearing effect, a plausible *actin-microvilli hypothesis* is presented to explain some of the microwave nonthermal effects.

EMA transduction can also explain some deep therapeutic effects obtained with millimeter waves and offers an interpretation of therapeutic aspecificity, which characterizes both electromagnetic and ultrasound physical therapy.

KEYWORDS: Photoacoustics, laser-ultrasound, microwave-ultrasound, hearing effect, actin-microvilli, energy transduction.

Analysis of Periapical Lesion Using Statistical Textural Features and Neural Networks

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Abstract

Radiographs are the most accurate diagnostic aid for the detection of osseous abnormalities in the maxilla and the mandible. Density and gray-scale changes in radiographs are important visual features the clinicians use to evaluate changes in bone pattern. In this work we present a quantitative study on different regions of periapical images by means of statistical textural features for classification purposes. We employed the Co-occurrence Matrices method for extracting features, and a multilayer perceptron as classifier. Our analysis has been performed on a database of 54 images; from every image two Regions Of Interest (ROIs) were selected, corresponding to regions where the periapical lesion was visible or not. Two different combinations of learning and testing sets were used; classification performance has been evaluated with ROC analysis. The obtained results show the effectiveness and robustness of this representation and, at the same time, encourage the development of this approach in order to obtain a follow-up system for supporting the decision-making process by clinicians.

KEYWORDS: Computer-aided diagnosis, texture classification, image analysis, neural networks.

The Application of Biological Models to Clinical Data*

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Abstract

This paper presents a methodology for applying biological models to clinical data with the goal of being able to estimate the probability of complication in an organ or normal tissue when exposed to a non-uniform irradiation. For purposes of illustration, and in order to provide information which may be useful in clinical practice, the discussion is presented for the particular case of the population averaged critical volume model applied to the set of dose-volume tolerances published by Emami et al. [5] and to the data on radiation hepatitis from the University of Michigan Medical Center [9].

The paper includes pseudo-code allowing the assessment of the probability of complication for an inhomogeneous dose distribution using the standard critical volume model for normal tissue complication probability (NTCP). The model has four parameters. In order to obtain estimates of the model parameters for different organs, the model is fitted to the data using the maximum likelihood method. As a result, the best-fit parameter values for a variety of organs are obtained with their errors. Graphs illustrating the goodness of the fit are also presented as well as the formalism for estimating goodness of fit.

KEYWORDS: Biological modeling, NTCP, Critical volume, model fitting.

A comparison of glomerular filtration rate values determined using four radionuclide techniques in healthy volunteers

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Abstract

Glomerular filtration rate (GFR) is widely regarded as a reliable method of determining renal function. Very little information is available on normal GFR values, especially on methods using ^{99m}Tc. The purpose of this study was firstly to obtain GFR values in healthy volunteers to compare three different ^{99m}Tc-DTPA renal clearance methods. Secondly, the ^{99m}Tc-DTPA values were compared to corresponding values obtained from ⁵¹Cr-EDTA renal clearance. Finally a normal range for GFR in our department was established.

Forty healthy volunteers were recruited and divided into two age groups. The first ranged from 18 to 50 years and the second between 51 and 70 years. Four methods of determining GFR were applied simultaneously i.e. (i) a *two blood sample method with ⁵¹Cr-EDTA* (used as the reference method), (ii) a *single sample imaging and urine collection* method, (iii) a *single sample imaging and urine quantification* method and (iv) a *two blood sample method with ^{99m}Tc-DTPA*.

All GFR values were normalized to body surface area. 95% confidence intervals indicated no significant differences between GFR calculated with the different methods. The distribution of the GFR values for both age groups was done and normal ranges for the different age groups calculated. GFR decreased with age from an average of 85.5 ml/min (18 - 30 years) to 71.7 ml/min (61 - 70 years).

The GFR values obtained using the four different renal clearance methods showed no significant differences and thus one range of normal values for different age groups is suggested.

KEYWORDS: Glomerular filtration rate, Tc-99m-DTPA, Cr-51-EDTA, gamma camera quantitation.

Quality Control of Viewing Boxes at the University Hospital of the Universidade Federal do Rio de Janeiro

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Abstract

At the University Hospital of the Universidade Federal do Rio de Janeiro, a survey was performed to analyze the working conditions of viewing boxes. The survey consisted in checking the illuminance of the rooms, the luminance levels of the viewing boxes and their uniformity. Results show that the luminance levels are all below the recommended levels, that the uniformity is generally inadequate, and that the room illuminance is adequate in only 19% of the rooms when compared to recommendations contained in international quality control protocols. Cleaning and minor repairs showed that an improvement of around 50% in luminance levels can be achieved at extremely low cost.

KEYWORDS: Viewing box, diagnostic radiology, quality control, luminance levels.

Dose reference levels for examinations using Computed Radiography*

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Abstract

During recent years conventional film-screen radiography is being more and more replaced by digital techniques like digital storage phosphor radiography. Digital techniques allow dose variations over a wide range without appreciable change in diagnostic information. On the one hand this could lead, under appropriate conditions, to a reduction of dose in comparison with film-screen radiography, as suggested by several authors [1, 2], but, on the other hand, an inadequate technique could also increase the dose in a significant way. Therefore specific reference doses have to be established and monitored during routine clinical practice. Dose reference levels are introduced by the Council of the European Communities [3] as an instrument to achieve optimisation of radiation protection in radiology. Considering the need for all the Member States to implement the new EU Medical Exposure Directive [4], a study was undertaken at the University Hospital of Careggi in Florence to evaluate the entrance skin dose in computed radiography for different examinations: thorax, pelvis and spine. ESD were directly measured for CR using thermoluminescent dosimeters and compared with the corresponding DRL values for screen-film detectors. The measured values for different examinations are reported and the third quartile has been chosen as a local dose reference value for the specific radiology department. The possibility of dose reduction has also been investigated.

KEYWORDS: Diagnostic Reference Level, Computed Radiography, dosimetry.

Recommended Guidelines on National Schemes for Continuing Professional Development of Medical Physicists*

The European Federation of Organisations for Medical Physics

EFOMP Policy Statement No. 10

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Abstract

Modern Health Care Services are met with ever-increasing demands on competence, specialisation and cost effectiveness. The Medical Physics Services in hospitals face the same demands. Continuing Professional Development (CPD) is vital to the Medical Physics Profession in order to: embrace the pace of change occurring in medical practice; promote excellence within the Profession; and assist in the protection of the Public against incompetence. Furthermore, CPD is a prerequisite of some statutory registration schemes, and is a requirement of the Medical Exposure Directive. The European Federation of Organisations for Medical Physics (EFOMP) commends National Member Organisations to encourage participation in CPD.

In order to assist in the harmonisation and promotion of this best practice EFOMP presents a set of general requirements for use as a template in the design of a CPD scheme. It uses a credit point system and recommends that CPD should be assessed on the basis of a 5-year cycle with a total of 250 credit points being earned during that period. Two major categories of CPD activities are recognised. Firstly attendance at pre-assessed courses, with one credit point allocated per full course hour. Secondly self-directed learning split into 8 subgroups: formal local hospital education activities, reading of textbooks and articles, lecturing, training visits, publications, congress contributions, implementation of new technologies and active membership in task groups.

KEYWORDS: Continuing Professional Development, CPD scheme, EFOMP, Medical Exposure Directive, Qualified Medical Physicist.

Abstracts

40th Annual Meeting of the South African Association of Physicists in Medicine and Biology Durban, South Africa, June 6-8, 2000

ABSTRACTS

40th Annual Meeting of the Soci t  Fran aise de Physique M dicale Nantes, France, June 6-8, 2001

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