LETTER TO THE EDITOR

Physics in Medicine and Biology top ten

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LETTER TO THE EDITOR

**Physics in Medicine and Biology top ten**

Received 11 December 2003

The Editor,

Sir,

At the recent meeting of the Editorial Board of this journal there was considerable discussion of citations and impact factors. This piqued my curiosity about the articles published in *Physics in Medicine and Biology* that have been cited most often. In keeping with popular trends I have generated a list of the top ten, shown below with the full abstract (the articles are papers unless otherwise stated). Table 1 lists the total number of citations since publication along with the number in the years 2000–2003. These data were compiled using the Web of Science® (Thomson ISI) on 1 December 2003.

The most striking feature of the list is the diversity of subject matter and the important role that these papers served in the early development of new research areas. While half the articles were submitted from the UK, a total of five countries are represented. All articles received at least one citation in 2003, although some are clearly ‘rising stars’. The list might look quite different in five or ten years’ time.

**Table 1.** Ten most cited papers published in *Physics in Medicine and Biology*.

<table>
<thead>
<tr>
<th>First author</th>
<th>Total citations</th>
<th>Citations 2000–2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matthews (1957)</td>
<td>864</td>
<td>21</td>
</tr>
<tr>
<td>Edelstein (1980)</td>
<td>528</td>
<td>25</td>
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<td>Brooks (1976)</td>
<td>464</td>
<td>33</td>
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<tr>
<td>Sarvas (1987)</td>
<td>378</td>
<td>165</td>
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<td>Delpy (1988)</td>
<td>359</td>
<td>102</td>
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<tr>
<td>Haase (1985)</td>
<td>347</td>
<td>113</td>
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<td>Chadwick (1973)</td>
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<td>12</td>
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<td>Pethig (1987)</td>
<td>212</td>
<td>46</td>
</tr>
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<td>Spinks (1992)</td>
<td>201</td>
<td>47</td>
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<tr>
<td>Hogstrom (1981)</td>
<td>199</td>
<td>35</td>
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</tbody>
</table>


**The Theory of Tracer Experiments with $^{131}$I-Labelled Plasma Proteins**

**Christine M E Matthews**

The National Institute for Medical Research, The Ridgeway, Mill Hill, London, N.W.7, UK

**Abstract.** Using the tracer theory of Rescigno, adapted for an open mammilary system, a method is given of finding (1) metabolic rate, (2) ratios of masses of protein in extravascular compartments to mass of protein in intravascular compartment, (3) capillary permeabilities, when $^{131}$I-labelled protein is injected into the blood stream of animals. Examples are given for human, rabbit and rat.
LETTER TO THE EDITOR

Spin warp NMR imaging and applications to human whole-body imaging

W A Edelstein, J M S Hutchison, G Johnson and T Redpath
Dept. of Bio-Medical Phys. & Bio-Engng, Univ. of Aberdeen, Aberdeen, UK

Abstract. Describes a new nuclear magnetic resonance (NMR) imaging technique which the authors call 'spin warp imaging' and gives examples of its application to human whole-body imaging. The apparatus is based on a four-coil, air cored magnet (made by the Oxford Instrument Company) capable of accepting the whole human body. The magnet produces a static field of 0.04 T giving a proton NMR frequency of 1.7 MHz. The maximum field inhomogeneity is about $6 \times 10^{-4}$ at a radius of 0.23 m, approximately twice the amount theoretically attainable with this configuration. The pulse sequence used is shown.

Principles of computer assisted tomography (CAT) in radiographic and radioisotopic imaging

R A Brooks and G Di Chiro
Section Neuroradiology, Nat. Inst. of Neurological & Communicative Disorders & Stroke, Bethesda, MD, USA

Abstract. Reconstructive tomography is compared with conventional focal plane tomography. Methods of reconstruction-back projection, iterative reconstruction and analytic reconstruction are described. The limitations of present techniques, and new developments and trends are outlined.

Basic mathematical and electromagnetic concepts of the biomagnetic inverse problem

J Sarvas
Low Temp. Lab., Helsinki Univ. of Technol., Espoo, Finland

Abstract. Basic mathematical and physical concepts of the biomagnetic inverse problem are reviewed with some new approaches. The forward problem is discussed for both homogeneous and inhomogeneous media. Geselowitz's formulae and a surface integral equation are presented to handle a piecewise homogeneous conductor. The special cases of a spherically symmetric conductor and a horizontally layered medium are discussed in detail. The non-uniqueness of the solution of the magnetic inverse problem is discussed and the difficulty caused by the contribution of the electric potential to the magnetic field outside the conductor is studied. As practical methods of solving the inverse problem, a weighted least-squares search with confidence limits and the method of minimum norm estimate are discussed.

Estimation of optical pathlength through tissue from direct time of flight measurement

D T Delpy, M Cope, P van der Zee, S Arridge, S Wray and J Wyatt
Abstract. Quantitation of near infrared spectroscopic data in a scattering medium such as tissue requires knowledge of the optical pathlength in the medium. This can now be estimated directly from the time of flight of picosecond length light pulses. Monte Carlo modelling of light pulses in tissue has shown that the mean value of the time dispersed light pulse correlates with the pathlength used in quantitative spectroscopic calculations. This result has been verified in a phantom material. Time of flight measurements of pathlength across the rat head give a pathlength of $5.3 \pm 0.3$ times the head diameter.


TECHNICAL NOTE

$^1$H NMR chemical shift selective (CHESS) imaging

A Haase, J Frahm, W Haniecke and D Matthaei
Max-Planck-Inst. für Biophys. Chem., Göttingen, West Germany

Abstract. $^1$H NMR images of human or animal tissues reflect the spatial distribution of both water ($H_2O$) and methylene ($CH_2$) proton resonance signals. There are several reasons for a separation of these contributions: (i) the large chemical shift dispersion in high magnetic fields ($\geq 1.5$ T) which leads to an apparent spatial shift in ‘composite’ images between the superimposed $H_2O$ and $CH_2$ images; (ii) the evaluation and interpretation of proton $H_2O$ and $CH_2$ relaxation times from NMR images; and (iii) the physiological implications of ‘water’ and ‘fat’ distributions for medical diagnosis. The authors describe a chemical shift selective (CHESS) imaging technique which destroys the unwanted signal component by means of a selective 90 degrees excitation pulse and a subsequent magnetic field gradient (‘homogeneity spoiling gradient’) prior to imaging of the wanted component. The new method allows the creation of either a pure ‘water’ or ‘fat’ image.


A molecular theory of cell survival

K H Chadwick and H P Leenhouts
Eurational ITAL, Wageningen, The Netherlands

Abstract. A theory is presented to explain the effect of radiation on cell survival.


REVIEW ARTICLE

The passive electrical properties of biological systems: their significance in physiology, biophysics and biotechnology

R Pethig and D B Kell
Inst. of Molecular & Biomolecular Electron., Univ. Coll. of North Wales, Bangor, UK

Abstract. The following topics are discussed: a summary of dielectric theory; amino acids, peptides, proteins and DNA; bound water in biological systems; biological electrolytes; membranes and cells; tissues.
Physical performance of a positron tomograph for brain imaging with retractable septa

T J Spinks, T Jones, D L Bailey, D W Townsend, S Grootoonk, P M Bloomfield, M-C Gilardi, M E Casey, B Sipe and J Reed

MRC Cyclotron Univ., Hammersmith Hosp., London, UK

Abstract. Performance characteristics of a new design of positron tomograph with automatically retractable septa for brain imaging have been studied. The device, consisting of block BGO detectors (8 × 8 elements per block), has a ring diameter of 76 cm and an axial FOV of 106.5 mm. The in-plane resolution is on average 5.8 mm and 5.0 mm (FWHM) for stationary and wobble sampling, respectively, over the central 18 cm of the transaxial FOV. Its unique feature is the capability of data acquisition both in the ‘conventional’ 2D mode (with septa) or 3D mode (septa retracted) where coincidences between any of the 16 detector rings are acquired. In spite of the increase in scatter when septa are retracted, the increased efficiency in the 3D mode of acquisition yields distinct advantages, particularly in the many studies where tracer concentration is low and consequently where dead time and random rates are less important.

Electron beam dose calculations

K R Hogstrom, M D Mills and P R Almond

Dept. of Phys., Univ. of Texas System Cancer Center, Houston, TX, USA

Abstract. Electron beam dose distributions in the presence of inhomogeneous tissue are calculated by an algorithm that sums the dose distribution of individual pencil beams. The off-axis dependence of the pencil beam dose distribution is described by the Fermi–Eyges theory of thick-target multiple Coulomb scattering. Measured square-field depth-dose data serve as input for the calculations. Air gap corrections are incorporated and use data from ‘in-air’ measurements in the penumbra of the beam. The effective depth, used to evaluate depth-dose, and the sigma of the off-axis Gaussian spread against depth are calculated by recursion relations from a CT data matrix for the material underlying individual pencil beams. The correlation of CT number with relative linear stopping power and relative linear scattering power for various tissues is shown. The results of calculations are verified by comparison with measurements in a 17 MeV electron beam from the Therac 20 linear accelerator. Calculated isodose lines agree nominally to within 2 mm of measurements in a water phantom. Similar agreement is observed in cork slabs simulating lung. Calculations beneath a bone substitute illustrate a weakness in the calculation. Finally a case of carcinoma in the maxillary antrum is studied. The theory suggests an alternative method for the calculation of depth-dose of rectangular fields.