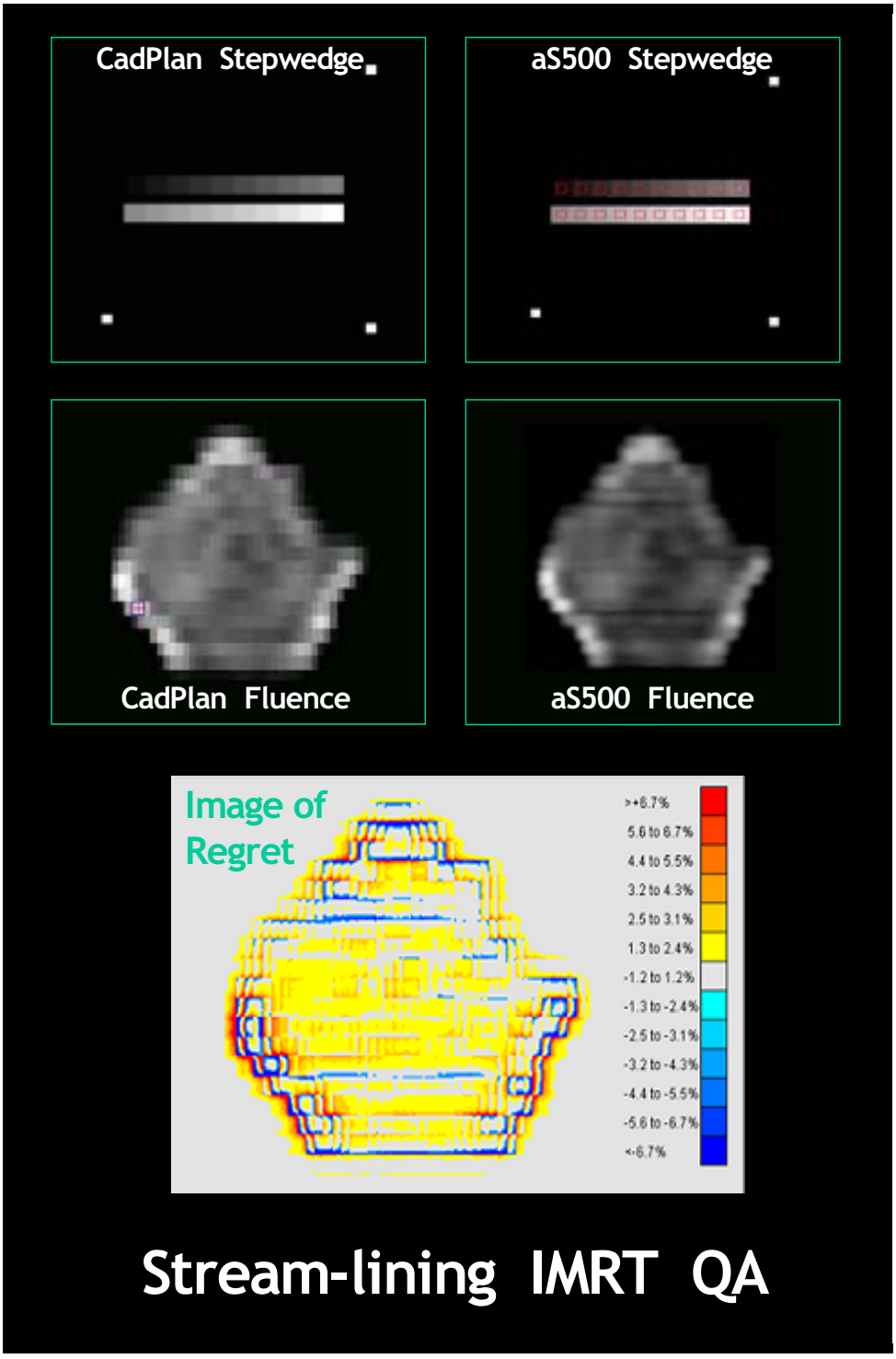
InterACTIONS

CANADIAN MEDICAL PHYSICS NEWSLETTER
Le BULLETIN CANADIEN de PHYSIQUE MÉDICALE



Stream-lining IMRT QA

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LE COLLÈGE CANADIEN DES PHYSICIENS EN MÉDECINE

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About our Cover

Intensity Modulated Radiation Therapy (IMRT) requires large efforts in planning and quality assurance on the part of the medical physicist. Conventionally, film techniques have been implemented to ensure dose accuracy, however, they are inherently time consuming and as patient workload increases, not suitable for use on a routine basis. In an effort to streamline the IMRT quality assurance process, on-line portal imaging has been investigated as a means of reducing workload. The cover page shows the results of a software tool designed to determine the difference between a calculated IMRT fluence map and that which is measured with an on-line imaging system. In this example, fluence images generated with the CadPlan treatment planning system are compared to images acquired with a PortalVision aS500 electronic portal imaging device (EPID). Prior to comparison, pixel intensities in the EPID image are calibrated with a 20 level step wedge synthesised on CadPlan. A pixel intensity to fluence look-up-table (LUT) is generated by comparative analysis of actual fluence (CadPlan Stepwedge) vs. measured step wedge (aS500 Stepwedge) image. Pre-treatment QA images (aS500 Fluence) acquired with the EPID are then passed through the LUT and are subtracted from the actual fluence images (CadPlan Fluence) generated in the treatment planning process. The outcome of the analysis is the display of a difference map or "Image of Regret" and a segmented dose-area-histogram that allows the user to rapidly identify hot and cold spots or areas of interest.

Images provided by Kurt Luchka, BC Cancer Agency, Vancouver Cancer Centre, British Columbia.

The Canadian Medical Physics Newsletter, which is a publication of the Canadian Organization of Medical Physicists (COMP) and the Canadian College of Physicists in Medicine (CCPM) is published four times per year on 1 Jan., 1 April, 1 July, and 1 Oct. The deadline for submissions is one month before the publication date. Enquiries, story ideas, article submissions can be made to:

Dr. Boyd McCurdy
CancerCare Manitoba
675 McDermot Avenue
Winnipeg, Manitoba, R3E 0V9
Email: boyd.mccurdy@cancercare.mb.ca
Phone: (204) 787-1966
Fax: (204) 775-1684

Members of the Editorial Board include:

Peter Munro:	peter.munro@lrcc.on.ca
Pat Cadman:	pcadman@scf.sk.ca
Darcy Mason:	dmason@bccancer.bc.ca

Please submit stories in Publisher 98, Word 6.0, Word 97, or ASCII text format. Hardcopy submissions will be scanned to generate an electronic document for inclusion in the Newsletter. Images in Tiff format at 300 dpi resolution are preferred. Advertising and corporate enquiries can be made to:

Michael Henry
Email: henry@abellshenry.com
Phone: (780) 462-7974
Fax: (780) 466-0731

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CCPM BOARD

COMP/CCPM Office

Ms. Barb Callaghan
COMP Secretariat
COMP/CCPM Office
PO Box 39059
Edmonton, AB T5B 4T8
Telephone: (780) 488-4334
Facsimile: (780) 482-4425
compoffice@shaw.ca

Message from the COMP Chair:

With the new website and its more flexible tools, it is hoped that the information on the website will be updated more frequently since the Chairs of the various COMP and CCPM committees will have direct access to uploading files.

Now that the Holiday Season has come and past and that the turkeys can breathe easier, its time to get back to work for all of us. For the COMP Executive, this means getting ready for our annual meeting.

The Conference Committee, chaired by Peter O'Brien, is continuing its preparation for our 50th Annual Scientific Meeting to be held jointly with the Canadian Association of Physicists in Winnipeg from June 13-16, 2004. This year's CCPM Symposium will be on Scientific Images in the Public Sphere. Several pariticipating organisations will contribute to this symposium, including the CCPM, the Canadian Astronomical Society (CASCA), the Biophysical Society of Canada (BSC) and the CAP.

In this issue, you will also find the Call for Papers for the COMP/CAP/CASCA/BSC meeting. Abstract submission will again be done electronically. However, because of the large number of papers presented at the CAP meetings, only short abstracts are necessary except for the YIS candidates who must submit an additional extended abstract to support their application. As I indicated in my last message, the talks at this conference cover a wide range of topics in Physics. This is a unique opportunity for us that can be quite stimulating and refreshing so I hope you will plan on joining us in Winnipeg in 2004.

At the end of November, the COMP Executive and CCPM Board held their annual mid-year meetings. Several important issues were discussed during these meetings.

The new COMP website is presently being setup by Darcy Mason and the Communications Committee. A preliminary version was made available to the COMP Executive. It looks very professional and promises to be an improvement to the present website. With the new website and its more flexible tools, it is hoped that the information on the website will be updated more frequently since the Chairs of the various COMP and CCPM committees will have direct access to uploading files. First estimates indicate that the new website will go live in February. Stay tuned!

The Radiation Safety and Technical Standards Advisory Committee met during the mid-year meetings to work on Quality Control Standards in Radiation Therapy. A considerable amount of work is involved in writing QC standards for each category of equipment used in radiation therapy. The task group has agreed on a generic format for all documents which should make writing new documents much easier. Peter Dunscombe, the Chair of the RSTSAC, has prepared a summary of our work for this issue of *InterACTIONS* [see page 25].

At the mid-year meetings, the COMP Executive also discussed the process for posting job advertisements. It was felt that the present system whereby job postings are announced every 3 months in InterACTIONS, and then on our website does not fit the needs of those centres who are looking for physicists, nor the needs of the medical physicists looking for work elsewhere. The Executive felt that the website should be the focus for job ads and will allow an immediate update of the available positions. Interactions could still be used as a reminder of which jobs are posted on the web. The Communications Committee will look into implementing these changes.

This is also the time of the year when we renew our Executive Director's contract. I am very happy to announce that Michael Henry has accepted to stay on as Executive Director of COMP and CCPM. Michael has contributed immensely to our organisation and is always looking for ways to increase his role with us. It is always a pleasure working with him.

(Continued on page 27)

Message from the CCPM President:

As I write this message at the beginning of December, I have just returned from the mid-year CCPM board meetings held in Toronto last weekend and will summarise the work done on your behalf.

Planning for next year's **MCCPM oral examinations** was high on the agenda. As

published in the last issue of InterACTIONS, they will be held for the first time next year on 29 May in Toronto. Each examination will last 1.5 hours and full details will be provided to all candidates by our Chief Examiner, Katharina Sixel. For this year only, there will be no additional fee, the CCPM will cover the costs from it's reserves. In keeping with the mandate of the CCPM to hold examinations on a cost neutral basis, we will be presenting a full cost analysis and a proposed fee structure to the members for a vote at the next AGM in Winnipeg. We anticipate that the cost will be set at around the $500 mark.

On the topic of **recertification**, next year will be the third year that this has been done. For the first time this year, the required recertification date was given on your dues renewal form. For those of you recertifying in 2004, you will be contacted by our Registrar, Wayne Beckham, in February with a reminder and instructions on how to proceed.

The **CCPM Emeritus** category was raised with a view to clarifying the criteria and nomination procedure. After some considerable discussion, we came to the realisation that maybe this category was inappropriate for the CCPM. The rationale was that all our other activities have an associated certification process rather than a peer nomination and clearly a certification process for emeritus status would be totally inappropriate. Also, the criteria should probably be defined around contributions made to the CCPM, which may be liable to conflict of interest allegations with the current board appearing to be setting up a system for self-recognition. At present, our thinking is that the COMP Emeritus category should be used to recognise significant contributions to the profession and that the emeritus category in the CCPM should be removed. We will be bringing a proposal on this topic to the membership for vote in Winnipeg and, in the meantime, if you have any thoughts, please get in touch with any of the board members.

As you are all aware, the CCPM published a series of **Guidelines on Dosimetry Training and Assessment** at the end of last year, available from the web site. We have recently received a letter of support and enthusiasm for this document from the Chair of the Radiation Therapy Policy Advisory Committee of CAPCA. At almost the same time, we were contacted by the President of CAMRT, Claire Hatch, to say that the board of the CAMRT have expressed an interest in collaborating with the CCPM on the development of an education program in dosimetry. We have agreed that each of our two organisations will nominate a small number of appropriately qualified representatives to take this initiative further. If you are interested in participating or could recommend a colleague, please contact Wayne Beckham who has agreed to co-ordinate the CCPM efforts.

We are frequently asked about **equivalency** with competency certification from other countries. This is a complex topic as the process varies greatly from country to country. The position of the CCPM board is that all persons requiring competency certification in Canada must go through the MCCPM examination process. Of course, a particular employer may recognise other certifications such that an individual with such a qualification may not be required to re-certify in Canada. In that case, maintenance of clinical competency certification would clearly also be directed to the body granting the original certification. However, with the recent clarification of the membership and fellowship categories of the CCPM, the

(Continued on page 28)

...the board of the CAMRT have expressed an interest in collaborating with the CCPM on the development of an education program in dosimetry.

Message from the Executive Director of COMP/CCPM

...no professional scope of practice that has the potential for impacting medical physics should be considered without adequate consultation with COMP and CCPM.

Professional issues continue to be important for medical physics in Canada and internationally. The executive and board have continued to make the advancement of the profession a high priority.

At the recent mid-year meetings of the Board and Executive, several issues were discussed. The Board and Executive decided to continue its support of CAMPEP (Commission on Accreditation of Medical Physics Education Programs) and nominated Dr. Brenda Clark for an additional term on the CAMPEP Board. Dr. Clark currently serves as Vice-Chair of CAMPEP. We were excited to hear that two graduate medical physics programs in Canada have become accredited and at least one more accreditation is in progress.

The mid-year meeting also heard that the latest publication from the Canadian Institutes for Heath Information entitled *Medical Imaging in Canada* included a section on medical physics. This was seen as a reflection on the efforts of many in the profession to gain increased recognition for the profession as an integral part of the matrix of Canadian health professions.

On the provincial professional recognition level, the medical physicists in British Columbia have formed a society to work toward gaining provincial statutory recognition of the profession and a group of medical physicists in Quebec have formed the Association Québéquoise des Physiciens Médicaux Cliniques with the purpose of furthering provincial recognition of the profession in that province. Provincial initiatives are required to gain statutory recognition of the profession as professional licensure and health are constitutionally under provincial jurisdiction.

Increasingly, there is concern that the medical physics profession should be clear about the professional practice that is within the scope of the profession. It is important to ensure that other professions and occupations that have a potential for overlapping scope of practice understand that no changes in their scope of practice that could impact the scope of practice of medical physics should be contemplated without adequate consultation with the medical physics profession.

Your Board and Executive are clear that COMP and CCPM are the legitimate bodies that represent the medical physics profession in Canada. Your Chair will be communicating this interest to the provincial bodies responsible for health professions and occupations across Canada and will convey our expectation that no professional scope of practice that has the potential for impacting medical physics should be considered without adequate consultation with COMP and CCPM.

At the mid year meetings, the communications committee reported that the website development is progressing and the new full service website should be operational in late February 2004. This new website will be constructed to allow committees and officers to provide regular updates and revisions without an intermediary. This will provide the membership with more accurate and timely updates about COMP and CCPM activity. Many thanks to Darcy Mason and his committee for the valuable work in developing this new website.

Stephen Pistorius, past COMP Treasurer has been working hard with the Local Arrangements Committee in planning the joint annual meeting with CAP and partners coming up in Winnipeg this June. Many thanks to Stephen for his continued contributions.

Best wishes to all for a successful and joyous 2004. As always, your comments, suggestions, and advice are welcome – feel free to call or email.

CALL FOR PAPERS

50th Annual Scientific Meeting of COMP and CCPM Symposium

June 13-16, 2004
Winnipeg, Manitoba

The Canadian Organization of Medical Physicists and the Canadian College of Physicists in Medicine are pleased to invite you to Winnipeg, Manitoba for our **50th Annual Scientific Meeting**. This anniversary year is also a return to our roots. We are meeting with the Canadian Association of Physicists which, before COMP, was the national organization for medical physicists in Canada through its Division of Medical and Biological Physics. Also meeting with us will be the Canadian Astronomical Society and the Biophysical Society of Canada. This is a unique opportunity to hear the latest from our colleagues in these disciplines.

Abstract Submission: A web-based abstract submission process will again be used this year. Details will be available on the CAP website (www.cap.ca) early in January 2004. The deadline for submission is **March 1, 2004**. Contrary to previous years, only a short abstract (**less than 250 words**) is required except for YIS applicants who must also submit an extended abstract for evaluation.

YIS and Poster Awards: Both YIS and Poster competitions will take place during our meeting. During the short abstract submission process, YIS applicants must indicate their participation in this competition by clicking the appropriate box. The submission procedure for the extended abstract will be detailed on the website.

Early-registration:
The Early-registration will begin in January and end on May 1, 2003. Note that, contrary to COMP meetings, the cost of the banquet is not included in the registration fees. Those willing to attend must purchase banquet tickets separately. Information and instructions on how to register will be posted on the CAP website and on the University of Manitoba website (www3.physics.umanitoba.ca/Congress2004).

Please visit the CAP website for all details on registration and abstract submission. A link to the CAP website can also be found on the COMP website (www.medphys.ca).

Report on ASTRO 2003

Submitted by John Lewis,
CancerCare Manitoba, Winnipeg, MB

The 2003 American Society for Therapeutic Radiology and Oncology, held in Salt Lake City October 19-23 (with additional sessions on the 18th) attracted approximately 10,000 attendees. ASTRO was a wide ranging multi-ring circus of educational and scientific sessions, nursing programs, panel presentations, poster discussions, business meetings, and award ceremonies, with posters galore to be viewed.

As an example of the variety, Monday morning, 7:15 a.m., scheduled 10 educational sessions, which ranged from the MD-oriented treatment of several cancers (lymphomas, colon, laryngeal, pediatric, endometrial, and breast), treatment related complications, LDR of the prostate, IMRT (part II of a sequence), to the molecular mechanisms of DNA damage repair. For a physicist, the IMRT course (see below) was an obvious choice, but an MD might have had difficulty choosing. The presentations themselves were usually of high quality, but the presence of 10^4 people in about 2×10^1 sessions meant that some of the sessions were ridiculously large: speakers so far away from most participants as to be a blur, indeed with two large projection screens being used to show the speaker. The argument has been made that meetings could be conducted electronically, the participants staying at home, and some of the larger sessions constituted arguments for such an approach.

For a physicist, the IMRT educational sequence, (I: "Planning and Delivery", II: "Clinical and Radiobiological Aspects, Including Prescription", and "Targets and Doses for IMRT of Head and Neck and Gynecologic Cancer") presented a good and timely description of the state of conventional MLC-based IMRT. My only objection was that IMRT was defined in terms of MLCs, rather then regarding IMRT as basic approach for which MLCs and physical compensators are two realizations. However, perhaps the most interesting consideration of IMRT came in a radiobiological talk by Soren M Bentzen ("Biological Basis for Non-Uniform Dose-Distributions in Radiation Oncology"), whose arguments for evidence-based IMRT were impressive. There appeared, in general, to be a concern that MLC based IMRT might in practice being delivering too low a dose rate to have the desired biological effects. The point that MLC based IMRT is financially driven in the United States was noted, and the question as to the result if or when this financial bias ends was asked but not answered.

Salt Lake City had more to offer then the conference. Of particular note was a performance of Faust by the Utah Opera Company performed at the historic Capital Theatre. The small size of the venue gave an intimacy often lacking in large modern theatres, and the at times radical presentation (the use of a crucified Christ might once have led to the producer being burned at the stake), were a delight. The fact that the sets were from a Montreal presentation was a nice touch. SLC also rebounds in fine restaurants, with the open kitchen at the Bambara providing an especially fine culinary experience.

Report on Image-Guided Radiotherapy Symposium

Submitted by Michael Sharpe,
Princess Margaret Hospital, Toronto, ON

On Sept 12-13, 2003, the University of California - Davis hosted an Image-Guided Radiotherapy Symposium in South Lake Tahoe, California. The symposium was held primarily as a continuing medical education opportunity for the radiation oncology community of Northern California, but was attended by a few peripatetic individuals, including a handful of Canadians.

The one and half day program was led by an international faculty, who reviewed the expanding role of imaging technologies in radiation oncology practice. In the morning of the first day, Anthony Seibert reviewed the basic principles of our favourite imaging modalities, while Peter Hoban reviewed the volume delineation principles espoused in ICRU Reports 50 and 62. Later on in the day, Lei Xing reviewed the expanding role of functional imaging studies in IMRT treatment planning. Rock Mackie and yours truly followed by discussions of the convergence of imaging and therapy in the treatment room, in the form of "Tomotherapy and Cone-Beam CT". The first day was rounded out with Randall Holt's review of the expanding application of 3D imaging in brachytherapy, and Mike Herman's TG-58 centred lecture, outlining how to get the most out of your electronic portal imaging equipment. On the second day, Hiroki Shirato and Yoshihiro Takai covered "Real-Time Tumour Tracking" with x-ray fluoroscopy, which was complimented by Martin Murphy's fluoroscopy experience in the development and use of computer-assisted monitoring of patient movement for the Cyberknife system. Stavros Demos finished up the day by leading a review of optical spectroscopy methods for the detection and monitoring of cancers.

South Lake Tahoe straddles the California-Nevada boarder. It is a beautiful location, best known for its alpine skiing and its Casinos. Your reporter regrets that his itinerary did not permit further detailed comment on the extra-curricular activities available in the Lake Tahoe region! On a
personal note, I enjoyed meeting two Radiation therapists during a pleasant coffee-break encounter. When I asked them where they were from, they said, "Princess Margaret Hospital", affirming the almost incomprehensible size of our department!

Report on the 7th Biennial ESTRO Meeting on Physics and Radiation Technology for Clinical Radiotherapy

13-18 September 2003, Geneva, Switzerland

Submitted by
Brenda Clark[a] and Alistair Bailey[b]
[a]Vancouver Cancer Centre, Vancouver, BC
[b]Centre for the Southern Interior, Kelowna, BC

The European Society for Therapeutic Radiology and Oncology (ESTRO) holds several meetings and teaching courses each year, the largest of which is the annual meeting. Every second year, they hold a separate meeting for Physics and Radiation Technology which this year was held in Geneva. This brief review will describe some of the highlights. The abstracts have been published in Radiotherapy & Oncology vol 68 (Supplement 7).

With a participation of ~500, this meeting is larger than the COMP meeting and considerably smaller than the AAPM meeting. Of the total attendees, approximately 10% were radiation technologists (or therapists in North American parlance, in Europe, a therapist is a physician!), another 10% were American and 2% Canadian.

The meeting was organised such that 36% of the presentations were invited speakers with few sessions being comprised entirely of proffered papers. Clearly the advantage of using such a high percentage of invited talks is that the scientific committee have more control over the content. Apparently, this year there was a determined attempt to control the number of sessions devoted to IMRT and certainly this topic did not dominate the meeting as it has done in the past. Of the 32 symposia/proffered paper sessions, only 6 had IMRT in the title. There were also 8 forty-five minute teaching sessions given first thing in the morning, which in Europe is at the relatively civilised hour of 8:30.

There was a strong component of radiation biology in the meeting, with 3 of the teaching sessions and several of the symposia/proffered sessions being devoted to topics in radiation biology and several very entertaining presentations given by radiation oncologists. Alan Nahum suggested that the time is ripe for including biological parameters in treatment planning calculations and his software is available for calculation of tumour local control probability (TLCP) from alan.nahum@rh.dk.

Of the 72 invited symposia speakers, two were Canadians. ***Joanna Cygler*** presented "***Verification of a Commercial Monte Carlo Electron Treatment Planning System***" in the symposium entitled "Dose Computation Methods" and ***Jake Van Dyk*** presented "***Early Experience with Helical Tomotherapy***" in the session on "New Techniques".

There were also three Conference Lectures and three Award Lectures, the latter comprising two for young investigators and a third for an administrator with ESTRO who gave a very lively discussion on "Strategies in Nature as a Paradigm for Problem Solving and Interdisciplinary Co-operation in Radiation Therapy". The Conference Lectures were given by Ben Mijnheer on "Positive Lessons to be learned from Accidents in Radiotherapy", Andrée Dutreix, one of the founding members of ESTRO and the only French medical physicist in the original group of 250, on "Medical Physicists in ESTRO: 22 Years of Co-operation with Radiation Oncologists" and ***David Jaffray*** who gave an excellent presentation entitled "***Image-guided Radiation Therapy Based on Kilovoltage X-ray Imaging***"

Of the "other" sessions, a point-counter-point session entitled "IMRT Should/Should not be Implemented in Small Clinics" was very lively with several references being made to Ferraris. Apparently they are difficult to drive (unfortunately we wouldn't know from experience!) and the message was that just because you can afford to buy one, you still have to learn to drive it properly, the analogy being made of course with IMRT systems. Of the participants, about 66% thought that IMRT should be implemented in small clinics and the take home messages from this discussion were that it's not the size of the clinic that matters, rather the resources, that there has to be a proven patient benefit and that good imaging is a pre-requisite.

Notable quotes:

- "~5% of treatment plans were modified after a Monte Carlo check" – P Keall, #3
- "SPECT shows more promise for tumour imaging than PET" – JD Chapman, #21
- "Suprapubic ultrasound does not distort the prostate" – S McNeeley, #26
- "X-ray positioning for prostate treatments gives a measurable reduction in rectal and bladder toxicity" – D Verellen, #47
- "Ultra-fractionation (i.e., with a dose of <1Gy/fraction) should theoretically be ~3.7 times more effective at cell killing than conventional fractionation" – SM Bentzen, #71
- "Not all computed DVHs for IMRT plans submitted to the QUASIMODO project fulfilled the set objectives" – C De Wagter, #118
- "Scientific services such as Monte Carlo simulation should be available to users throughout the community via access similar to that currently provided by the electricity service, i.e., through a plug in the wall" – Hans Hoffmann, Director of Research at CERN, #131
- "Everything we know about IMRT we have learnt from prostate treatments" – R Price, #155

(Continued on page 10)

ESTRO (Continued from page 9)

- "We give the patient a breathing training tool on a Palm Pilot to take home to practice before treatment" – B Paliwal, #192

Towards the end of the meeting, a pair of Round Table sessions were scheduled on recruitment for physicists and technologists from which it was apparent that the shortage of radiation therapy professionals is not only a North American crisis. In Italy alone, in a current population of ~ 450 physicists there is a shortfall of 275! A review in the UK found that many physicists are performing non-physicist tasks such as dosimetry as there is also a shortage of trained dosimetrists and physics assistants. Unfortunately we were unable to stay for the discussion so don't know if there have been some great solutions proposed!

On the negative side, there were many parallel sessions and frequently the choice between them was difficult. Also, the registration fee is relatively high but includes lunch for the three days of the meeting, croissants and coffee in the morning and fruit and coffee mid-afternoon and also free public transportation throughout the city during the days of the meeting.

The night out was held at the Circus Knie, billed as "The most famous Circus Company and Dynasty in Europe" with a 200 year history. This event was only 4 days after Princess Stephanie of Monaco married one of the acrobats and moved, with her three children, into a giant motorhome parked with the rest of the circus in a large square in the centre of Geneva. The Princess had had a much publicised earlier liaison with one of the elephant trainers, see figure 1. The performance was a lot of fun although the dinner beforehand was disappointing, consisting of sandwiches with an ice cream in the intermission.

Although Geneva is undoubtedly a lovely place to hold a meeting, we were somewhat shocked by the graffiti visible almost everywhere – it seems to clash with the "clean" image that we have of Switzerland. Talking to friends who live and work in Geneva, the story is that most of the graffiti originated from the recent G8 summit held across the lake at Évian. Apparently the security around that meeting was so good that the demonstrators could not get anywhere near their targets so they poured into Switzerland and defaced buildings in both Lausanne and Geneva.

Prior to the main meeting, ESTRO held a two day workshop on "Optimisation of IMRT". The registration for this workshop was 250 which resulted in a predominantly lecture format rather than conventional workshop style discussions. The workshop overall covered a wide range of information related to IMRT, however, there was no 'beginner's guide to implementing IMRT'. A large majority of speakers were from North America, but the workshop had a definite European flavor. This meant that there was more willingness to discuss whether IMRT was necessary, the consensus was that it is. It was also notable that there was only one paper on Tomotherapy (similar weight to the Cyberknife), and this reflects the absence of European activity in this area. Papers covered technical implementation and target delineation. A number discussed the next frontier of biological optimization. There were papers on special systems (Tomotherapy, Cyberknife, protons), and a useful discussion of different commercial planning systems.

In summary, a very good meeting with some different perspectives. Photos [see page 11], courtesy of Kelvin Hiscoke, Palmerston North, New Zealand.

In Brief

Submitted by Dave Rogers,
Ionizing Radiation Standards, National Research Council of Canada, Ottawa, ON

Effective Oct 1, 2003 the NRC primary standard for air kerma in a Co-60 beam has increased by 0.59% as the result of a re-evaluation of the correction factors used to establish the standard. The previous change was in 1990. Air-kerma calibration coefficients determined using the old Co-60 standard can be multiplied by 1.0059 to give calibration coefficients consistent with the new standard. This small change, combined with a somewhat larger change in the standard for the same quantity at NIST, implies that the Canadian and American standards now agree within 0.15%.

The primary standards for air kerma in low-energy x-ray beams and for absorbed dose to water in Co-60 and linac beams are not affected by this change. The change will have no effect on clinical dosimetry for clinics which have switched to using the recommended TG-51 protocol of the AAPM.

For complete information see: "The 2003 revision of the NRC standard for air-kerma in a Co-60 beam", NRC Report PIRS-876 by D. W. O. Rogers and John McCaffrey at http://www.irs.inms.nrc.ca/inms/irs/papers/PIRS876

Figure 1: No, not meeting attendees, some of the entertainment offered at the night out at Circus Knie.

Figure 2: The circus version of inverse planning, an act entirely suspended in the air.

Figure 3: A local specialty, cheese fondue, from left Kelvin Hiscoke (New Zealand), Kati Kuehn (Germany), Emily Vollans and Brad Gill (Vancouver).

Report on AAPM 2003

10-14 August 2003, San Diego, USA

Submitted by Kyle Malkoske,
CancerCare Manitoba, Winnipeg, MB

This past August, the annual AAPM meeting was held in beautiful San Diego, California. The massive San Diego Convention Centre, provided ample space for the sessions, vendor exhibition, and the 467 posters in the poster display area. This year's meeting attracted 3176 delegates.

The conference opened on Sunday, August 10, with professional and educational councilling symposia in the morning, followed by the highly anticipated Young Investigator's Symposium. The competition included 10 excellent presentations. Congratulations to Steven Steciw of the Cross Cancer Institute in Edmonton, who was awarded first place in the competition for his presentation: A Monte Carlo Based Method for Accurate IMRT Verification Using the AS500 EPID – S. Steciw, B. Warkentin, S. Rathee, and B. Fallone. Sunday also included a new function at the AAPM meeting, the poster discussion session. Approximately 100 posters were sectioned off into groups of 8-12 dedicated to a specific topic. The 45 minute sessions in which either the moderator or the authors themselves gave a brief overview of the poster, provided the conference delegates the opportunity to ask the authors questions directly, often stirring up lively discussions. The format for the rest of the week included refresher and continuing education courses from 7:30 to 9:30 a. m., followed by scientific sessions, panel discussions, and hands-on workshops running until 5:30 p.m.

What was the "hot topic" of this year's conference you ask, well let's just say that IMRT was more popular than Tickle-me Elmo dolls at Christmas. During each session one was hard pressed not to find at least one room discussing IMRT optimization, delivery, or QA. Image guided therapy and methods of quantifying and compensating for target motion during treatment were also a few of the more popular topics on the agenda. With seven parallel sessions going on at any one time there was a little bit of everything covered at the meeting. To try and cover it all in such a short report would be impossible, so I'll skip right to some the highlights:

A special thanks goes out to Sherry Connors of the Cross Cancer Institute, who organized a great Canadian luncheon on Wednesday, August 13th. Approximately 50 hungry Canucks stormed Dick's Last Resort in San Diego's Gas Lamp district to indulge in hearty pails of deep fried delight! [See pictures on page 13, courtesy of Sherry Connors]

Canadians also cleaned up at the annual APPM awards ceremony held on Monday night! Here some of the highlights:

1st Place Young Investigator's Symposium

- Stephen Steciw, University of Alberta

Sylvia Sorkin Greenfield Award (best paper in *Medical Physics* (other than Radiation Dosimetry))

- Mia Skarpathiotakis, Martin Yaffe, Aili Bloomquist, Dan Rico from U of T and Sunnybrook in Toronto, and Serge Muller, Andreas Rick, Fanny Jeunehomme of GE Medical Systems (France) for their paper entitled, "Development of contrast digital mamography", *MP* **29** (10) 2419-2426 (2002)

Farrington Daniels Award (best paper on Radiation Dosimetry in *Medical Physics*)

- Daryoush Sheikh-Bagheri, and Dave Rogers, of the NRC in Ottawa, for their paper entitled, "Sensitivity of megavoltage photon beam Monte Carlo simulations to electron beam and other parameters", *MP* 29 (3) 379-390 (2002)

Newly Elected Fellows of the AAPM (Canadians and former Canadians)

- Sherry Connors, Cross Cancer Institute, Edmonton, Alberta.
- Aaron Fenster, Robart's Research Institute, London, Ontario.
- Ellen E. Grein, St. Francis Hospital, Hartford, Conneticut
- Terence Peters, Robart's Research Institute, London, Ontario.
- Marc Sontag, St. Jude Children's Hospital, Memphis, Tennessee
- Robert Nishikawa, University of Chicago, Illinois.

Ken Hogstrom was awarded the William D. Coolidge award, the AAPM's highest honor for *exhibiting a distinguished career in medical physics, and exerting a significant impact on the practice of medical physics*. The presentation of the award included some not-so-distinguished photos of Dr. Hogstrom that you probably won't find on the MD Anderson website!

According to the Radiological Physics Centre, approximately 35% of all US radiation therapy facilities have converted to the TG-51 protocol for external beam calibrations, and a few refresher courses were aimed at helping (and urging) physicists to implement the protocol.

Rationale for quartering the annual effective dose limit for the general public to 0.25 mSv for shielding considerations in diagnostic and therapeutic radiation rooms was debated in a special panel session covering the science, policy, regulation,

(Continued on page 13)

AAPM (Continued from page 12)

and consequences of the exposure limits. Evidently, the economical burden of converting existing bunkers designed to 1 mSv/year exposure to the general public could be quite significant. In some examples presented, the upgrade costs rivaled those of a brand new bunker installation.

The night out was held on Tuesday evening at the Embarcadero Park on the San Diego harbour front. In addition to beautiful weather, the delegates were treated to buffet style food stations and a host of entertainment including magicians, balloon twisters, caricature artists, and live music. All the makings of great circus, without the circus clowns…ignoring some of the conference delegates, that is!

The conference closed at noon on Thursday, Aug 14, with just enough time to shuttle us out, clean up, and prepare for the presidential dinner later that evening. At $5000 per plate, I'm sure that none of the delegates hung around to rub elbows with Mr. Bush!

Overall, as a first time AAPM AGM attendee, I must say that the organizers did a fantastic job. Even though I personally prefer a smaller conference setting, the fact that the sessions were generally kept on schedule allowed one to navigate through the parallel sessions to try and cover all interests without too much trouble. The 2004 meeting will be held July 25 - 29 in Pittsburgh, PA.

Modeling Geometric Uncertainties in Radiation Therapy

By Tim Craig[a] and Jake Van Dyk[b]
[a]Princess Margaret Hospital, Toronto, ON
[b]London Regional Cancer Centre and University of Western Ontario, London, ON

1. INTRODUCTION

1.1 Geometric Uncertainties in Radiation Therapy

Recent advances in radiation therapy have provided improved definition of the target and healthy tissues, more accurate dose calculation, and the ability to create high dose volumes that conform to the target while avoiding healthy organs. However, as dose distributions become more conformal, other inaccuracies become more apparent. Some of the most significant inaccuracies can be due to geometric uncertainty.

Geometric uncertainty is detrimental because radiation therapy attempts to create a high dose region that conforms to the tumour. If the tumour moves out of this high dose region, it will receive a lower dose than prescribed. This reduces the probability of controlling the tumour. Similarly, if this high dose region is incorrectly targeted, and irradiates adjacent healthy tissue, this could increase the probability of treatment complications.

We define geometric uncertainty as a variation in the patient anatomy relative to the incident radiation beams. The two main sources of geometric uncertainty are daily positioning of the patient for treatment and mobility of the tumour or internal organs within the patient.

Patient repositioning uncertainty exists because the patient is treated using multiple treatment fractions over several weeks. Despite efforts to be as accurate as possible, the patient's position will vary from day to day. The location of the patient's bony anatomy is generally accepted as the best measure of patient positioning. Thus, a distribution of bony anatomy position measurements can be used to quantify patient repositioning uncertainty. Several investigators have quantified positioning uncertainty for a variety of sites (1, 2).

The second substantial source of geometric uncertainty is organ motion. We define organ motion as the variation in the location of an organ or tumour relative to the bony anatomy. Thus, patient repositioning uncertainty represents the uncertainty in the alignment of the bony anatomy with the treatment beam, while organ motion represents uncertainty in the position of an organ relative to the bony anatomy. Organ motion has also been quantified for several sites (2-6).

Patient repositioning and organ motion uncertainties can have both random and systematic components. The random uncertainties change in magnitude and direction every treatment fraction, while systematic uncertainties are constant throughout the treatment. Separation of random and systematic uncertainties is important because they alter the delivered dose in different ways. Random uncertainties will tend to 'blur' the dose distribution relative to that which was intended, while systematic uncertainties will result in a 'shifted' dose distribution.

1.2 Accounting for Geometric Uncertainties through Target Volumes

The International Commission on Radiological Units and Measurements (ICRU) reports 50 and 62 aim to ensure accurate radiation therapy through rigorous specification of the target volumes and the prescribed dose (7, 8). Three fundamental target volumes are defined: the gross tumour volume (GTV), clinical target volume (CTV), and the planning target volume (PTV). The GTV is the gross demonstrable malignant growth, and is usually the tumour as observed on x-ray computed tomography (CT) images and/or other imaging modalities. The CTV is defined by adding a margin to the GTV to account for subclinical spread of disease. Finally, an additional margin is added to the CTV to generate the PTV. This margin is intended to account for changes in the position of the CTV. The PTV is "a geometrical concept used for treatment planning, and it is defined to select appropriate beam sizes and beam arrangements, to ensure that the prescribed dose is actually delivered to the CTV" (7). Therefore, uncertainties due to patient repositioning and organ motion are accounted for in the margin that defines the PTV. A schematic example illustrates these concepts in Figure 1.

A variety of methods have been employed for determining appropriate margins to define a PTV. These range from unqualified estimates, to simple statistics-based geometric margins (e.g., two times the standard deviation of the uncertainty), to 'margin recipes' (6).

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Figure 1: ICRU report 50 defines three target volumes for radiation therapy planning.

Modeling Geometric Uncertainties... (Continued from page 14)

1.3 Accounting for Geometric Uncertainties through Modeling

While the PTV is a widely accepted method for accounting for uncertainty in the CTV position, it does have limitations. These limitations include the fact that the required PTV size depends on the shape and dose gradients of the dose distribution, and that the dose to the PTV will not necessarily be the same as the dose to the CTV. This adds complexity to the process of designing the PTV, as well as the process of interpreting the clinical significance of the dose distribution within the PTV.

An alternate method is to calculate the impact of geometric uncertainties on the dose distribution. This method allows the treatment planner to see the dose distribution that is expected to be delivered in the presence of geometric uncertainty. This is in contrast to conventional treatment planning, where the treatment is evaluated using the intended dose, which is not the same as the delivered dose. An interesting aspect of this method is that if all of the geometric uncertainties that the PTV accounts for are incorporated in the dose distribution, the PTV concept becomes redundant. In this case, the modeled CTV dose is indicative of the dose that will actually be delivered. This may be a significant improvement over conventional treatment planning, which requires that the dose to the PTV be used for plan evaluation, since it cannot be assumed that the planned CTV dose represents the received dose.

Several methods for incorporating geometric uncertainties in the dose distribution have been explored. Although others will be discussed later, the most commonly employed technique is the 'convolution' method. This approach was first proposed by Leong (9) and subsequently applied by many investigators (6, 10-18). This method requires a probability density function (PDF) that describes the geometric uncertainty. The conventionally calculated 'static' dose distribution is then convolved with this PDF to produce the expected dose distribution. Mathematically, this procedure may be expressed as:

$$\overline{D}(x,y,z) = \iiint_{\infty} D_0(x',y',z')P(x-x',y-y',z-z')dx'dy'dz'$$

where D_0 is the static dose distribution, P is the PDF, and $\overline{D}$ is the expectation dose distribution.

2. MODELING GEOMETRIC UNCERTAINTIES WITH CONVOLUTION

2.1. Limitations

Before methods like convolution can be used routinely, the impact of assumptions in the model must be investigated. Convolution is simply a mathematical operation that does not properly model the physics of radiation interactions. We will discuss two significant assumptions in a convolution model: shift invariance and an infinite number of treatment fractions. Shift invariance implies that a positioning error results in delivering the planned dose distribution exactly, but shifted the same distance in the opposite direction. The assumption of an infinite number of fractions is important because the distribution of uncertainties is modeled as a continuous PDF that would only be properly reproduced for a treatment of an infinite number of fractions, each delivering an infinitesimally small dose. These two assumptions are both violated in practice.

2.1.1 Shift Invariance

Shift invariance may reduce the accuracy of convolution when internal inhomogeneities or surface curvature are present (19). Shift invariance is also violated because dose is not typically calculated outside the patient; therefore, errors may occur at the patient's surface because there is no dose outside to be 'shifted' into the patient. Errors due to shift invariance have been noted in the past (12-15, 18), but have only recently been quantified (19-21).

These issues are demonstrated with a sinus cancer example. This example contains tissues of inhomogeneous density and significant surface curvature. Thus, it is expected to violate the shift invariance assumptions. We compare the static dose calculation and convolution calculation to the expected result.

We also compare a 'corrected convolution' model (19). This model is designed to address issues resulting from the lack of dose outside of the patient. A simple method of reducing these errors is to use an algorithm that assigns 'artificial' dose values to points outside the patient.

Figure 2 illustrates the error in calculating dose for this patient using the conventional static method, convolution, and the corrected convolution. The static calculation demonstrates errors in regions corresponding to the beam edges. This is expected, since the greatest change will be for points that are just inside the beam, but are moved out by geometric uncertainty (or for points just outside the beam that are moved in). Convolution shows a different distribution of errors with a greater magnitude. Errors deep within the patient are due to violation of shift invariance caused by inhomogeneous tissues (i.e., bone and air cavities). These errors do not exceed a few percent. However, very large magnitude errors are observed at the patient surface. This is because dose is not calculated outside the patient. In this respect, the corrected convolution dramatically improves the accuracy of the convolution method.

Additional work has demonstrated that shift invariance errors are small for deep-seated organs, and errors due to internal inhomogeneities are usually negligible (19). However, as this example illustrates, the effect of surface curvature may be important if targets or critical organs are near the surface. This deficiency is addressed by the corrected convolution method.

2.1.2 Finite Fractionation

As discussed above, the convolution integral also implies an infinite number of treatment fractions. Typical treatments employ 15-50 fractions that deliver approximately 2 Gy each. Each fraction can be considered a discrete sample from a PDF describing the uncertainty, and these multiple samples will not reproduce the PDF exactly. This leads to multiple possible delivered dose distributions, while the convolution result is

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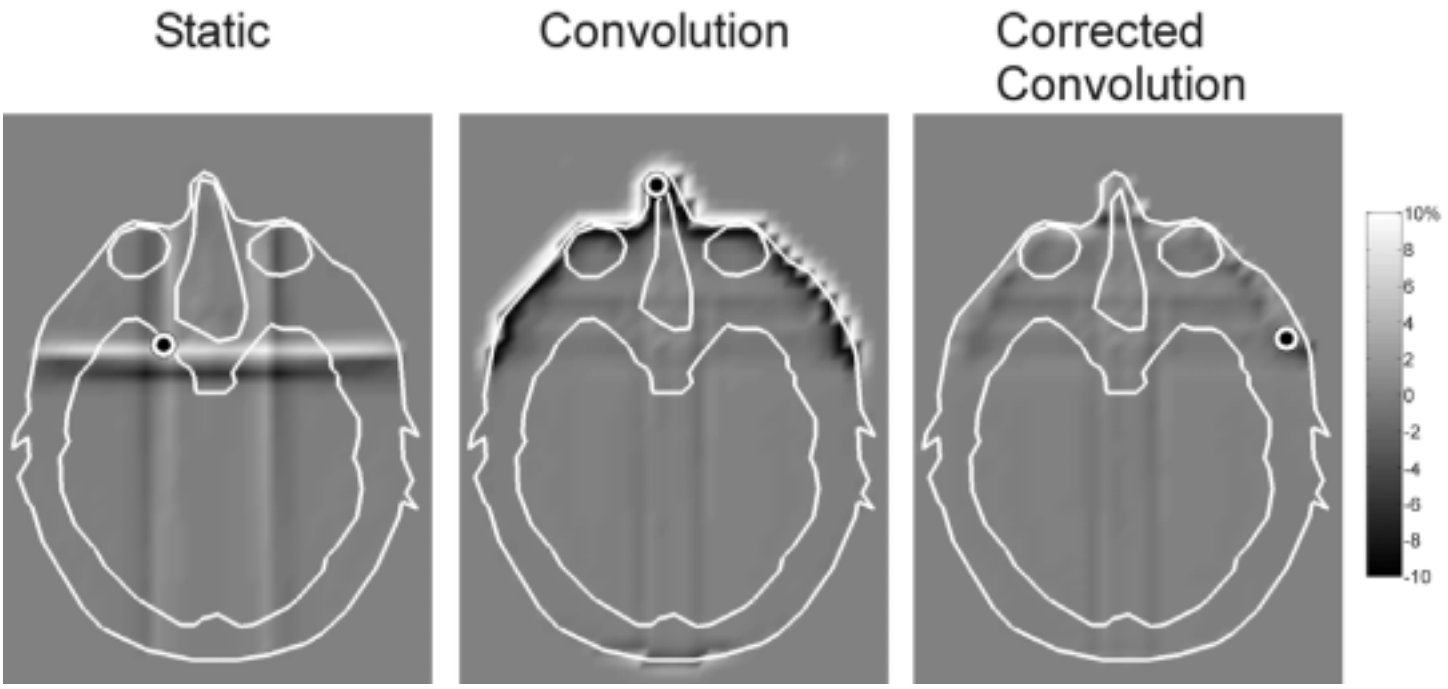

Figure 2: Dose difference maps demonstrating errors in the static dose calculation, convolution, and corrected convolution. The white lines are contours of the patient surface, PTV (static image), CTV (convolution and corrected convolution), left and right eyes, and brain. The dots indicate the maximum error (averaged over nearest neighbours). The dose errors corresponding to the dots are: (a) 7%, (b) 25%, and (c) 3%.

deterministic. Therefore, convolution will not reproduce the delivered treatment exactly (22). Few investigators have noted these errors due to finite fractionation (10, 13, 15, 18).

We demonstrate this issue with a schematic anatomy composed of a spherical CTV with a cylindrical critical organ, irradiated with a four-field box technique. The PTV was designed by adding a uniform 6 mm margin to the CTV. The dose distribution produced by convolution is compared to random simulations of treatments with various numbers of fractions.

The error in estimating the dose and outcome parameters for treatments of various numbers of fractions is shown in Table 1. The error in all parameters decreases as the number of fractions increases. However, the greatest dosimetric error anywhere in the anatomy is substantial, even for large numbers of fractions. Despite this fact, convolution produces excellent estimates of the minimum CTV dose, maximum critical organ dose, tumour control probability (TCP) and normal tissue complication probability (NTCP) for clinically realistic numbers of fractions. Only treatments of very few fractions show a substantial error in the estimation of any of these parameters.

This example illustrates that the accuracy of convolution will vary with the metric used to assess the plan. Nonetheless, treatments of greater than 20 fractions are generally in good agreement. In general, random uncertainty may lead to substantial uncertainty in the predicted dose distributions; however, convolution methods allow accurate calculation of dosimetric parameters for target volumes and critical organs (22).

2.2. Utility of Modeling Geometric Uncertainties

Once the limitations of convolution are understood, the utility of this method can be explored. We present an example where convolution provides more accurate treatment planning information than conventional methods (23).

The London Regional Cancer Centre has implemented simplified intensity modulated arc therapy (SIMAT) to deliver intensity modulated radiation therapy to prostate patients (24, 25). Despite the apparent superiority of SIMAT to conventional treatments, it is commonly expected that treatments with such steep dose gradients may exhibit increased sensitivity to geometric uncertainties. We use convolution to compare the impact of geometric uncertainties on SIMAT, four-field and six-field conformal prostate treatments (23).

A representative prostate patient is analyzed. The CTV is the prostate, and a 10 mm margin is added to define the PTV. Four-field, six-field and SIMAT plans were generated with prescription doses of 68 Gy, 74 Gy, and 81 Gy, respectively. The prescription doses are based on each technique's ability to avoid healthy tissues. Rectal shielding was used in all plans. Since the prostate PTV often overlaps the rectum, this results in the posterior PTV receiving a lower dose than prescribed. A convolution is performed for each technique to model patient repositioning and prostate motion.

Figure 3 shows dose-volume histograms (DVHs) for each of the techniques with and without uncertainty. When the static plans are evaluated (considering the PTV as the target volume)

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Number of Fractions	Dose Anywhere in Volume (%)	Minimum CTV Dose (%)	Tumour Control Probability (%)	Critical Organ Maximum Dose (%)	Normal Tissue Complication Probability (%)
1	40	8	6	4	5
5	16	3	1	2	2
20	9	1	0	1	1
40	7	1	0	1	1
100	3	0	0	1	0

Table 1: Mean error in plan evaluation parameters calculated using convolution as a function of the number of treatment fractions.

the minimum dose is similar for all techniques, despite the different prescription doses. However, once the effect of uncertainties is incorporated into the dose distribution, the minimum CTV doses are quite different and SIMAT is clearly superior. In addition, it appears that with uncertainty, each technique delivers a superior dose distribution compared to what was intuitively expected.

These results are contrary to the common belief that geometric uncertainty results in the delivery of a dose distribution that is inferior to the planned dose distribution. This unexpected result is observed in this example because: (a) rectal shielding produces an inhomogeneous PTV dose, and (b) the large 10 mm PTV margin keeps the CTV within the high dose region. Therefore, the differences result from variable CTV position within an inhomogeneously irradiated PTV, not lack of containment. These effects can only be quantified by modeling the effects of geometric uncertainties, and would not be observed by conventional treatment planning (23).

3. ALTERNATE METHODS OF MODELING GEOMETRIC UNCERTAINTIES

While we have focused on convolution up to this point, it is only one of several methods that may be used to model the effect of geometric uncertainties in radiation therapy. Other methods exist, and each has strengths that are ideal for certain situations.

3.1. Fluence Convolution

The convolution method presented above is designed to be generic and easily implemented using any radiation treatment planning system. However, specific implementations of convolution may be useful for certain dose calculation algorithms. A variation on the convolution method presented above is to convolve the x-ray 'fluence', and to account for scatter and dose deposition after the convolution (20, 21, 26, 27). To distinguish between these methods, we will refer to the convolution method we have previously discussed as 'dose convolution', while convolution of the fluence is termed 'fluence convolution'. The advantage of fluence convolution is that shift invariance issues may be minimized or eliminated since radiation scatter and other factors may be properly calculated following the convolution operation. A potential limitation of fluence convolution is increased calculation time. While dose convolution is a fast post-processing calculation performed after the static dose calculation, fluence convolution can require two full dose calculations if both the static and expectation dose are to be assessed.

The implementation of a fluence convolution method depends upon the dose calculation algorithm that is used. Pencil beam models have used convolved beam modeling data (26, 27). Convolution/superposition algorithms convolve the TERMA with the geometric uncertainty PDF, and then proceed with a

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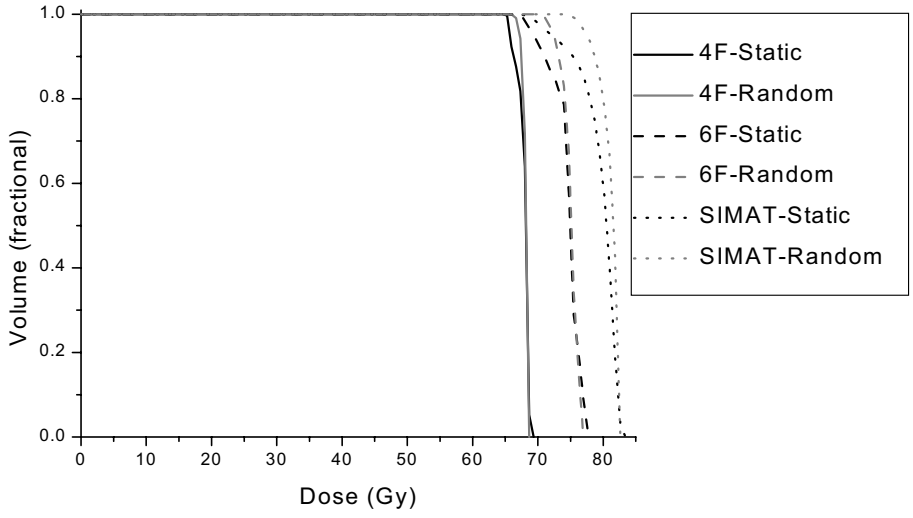

Figure 3: DVHs for each treatment with and without random uncertainty. Static indicates the planned dose distribution, while Random indicates the dose distribution with the effect of random uncertainties incorporated. The PTV is used to assess the static plans, while the CTV is used for the convolution plans.

scatter integration (28). Monte Carlo methods perform the convolution by randomly displacing particles in the phase space (20) or fluence distribution (21).

3.2. Monte Carlo Simulations of Geometric Uncertainty

Several investigators have used Monte Carlo simulations of geometric uncertainty (6, 15, 17, 18, 29). The advantage of this method is that every treatment fraction can be simulated. This is useful for determining quantities such as the distribution of possible outcomes in a population when random uncertainty exists. The chief limitation of Monte Carlo simulations is that the calculation time can be very long.

An ideal application for these methods is modeling the effect of geometric uncertainties on hypofractionated treatments (30). As seen in the 'Limitations' section, as the number of treatment fractions decreases, it becomes more difficult to model accurately the effect of geometric uncertainties using the convolution method.

This is of particular interest at a time when hypofractionation for prostate cancer is being considered by many investigators (31, 32). This interest is due to recent publications that indicate that α/β for prostate carcinoma appears to be lower than assumed for most tumours or normal tissues (33), although the exact value remains a topic of ongoing investigation (34, 35). If this is the case, hypofractionation would be expected to optimally exploit this situation (31).

As an example, we note the results of a Monte Carlo simulation of geometric uncertainty for conventional prostate treatment that delivers 74 Gy in 37 fractions, compared with a hypofractionated treatment delivering the exact dose distribution using 44 Gy in 10 fractions. Using an assumed α/β of 1.5 Gy, these treatments would lead to equivalent tumour control if there were no uncertainties. If a 10 mm PTV margin (corresponding to excellent CTV containment) is used, the difference in TCP between 37 and 10 fractions is <1%. If only a 2 mm PTV margin (corresponding to poor CTV containment) is used, this difference increases to a 3%. Therefore, although the differences are relatively small in this example, geometric uncertainties have a greater impact as fewer fractions are used. Convolution-based methods cannot easily incorporate this dependence on fractionation. Thus, Monte Carlo simulations can yield information that deterministic methods cannot.

3.3. Deformable Models

The convolution modeling that we have presented assumes that the patient anatomy is a rigid body experiencing displacements that can be described by translations. Convolution can be extended to model rotations (6); however, some geometric uncertainties are much more complex, such as the changes in the shape of the lung during respiration. These uncertainties may not be easily incorporated into convolution methods and may require more sophisticated organ deformation models.

Current models of organ deformation require the acquisition of two or more image data sets for a patient (e.g. x-ray computed tomography or magnetic resonance images). A representation of the patient's anatomy (e.g., control points or contours of anatomical volumes) is matched on each data set. One of several models may then be used to deform one instance of the patient to a reference instance (36-43). These models range from relatively simple interpolating models to complex biomechanical simulations, and allow the displacement of any point in the patient anatomy to be described. The cumulative dose can then be estimated from the knowledge of the displacement. These methods hold a great deal of promise, since they allow a complete description of the displacement of any point in the patient. Analyses using these models may provide guidance on techniques and criteria for adapting radiation treatments to the anatomy 'of the day'. Barriers to their implementation are the time-consuming deformation calculations, the difficulty of acquiring accurate biomechanical data, and the large quantity of patient data required. Indeed, since each treatment site requires data from a patient cohort, this raises the possibility that 'patient commissioning' may become an important medical physics task in the future.

4. CONCLUSION

It is obvious that the ability to model geometric uncertainties will play an important role in the future of radiation therapy. These models are already widely used as research tools, and may soon be incorporated into clinical treatment planning. It would be easy to incorporate such models into the plan evaluation phase of treatment planning. If the conventional static plan appears satisfactory, a convolution (for example) could be performed, and the plan re-evaluated using the dose distribution expected due to geometric uncertainties. If the expectation dose distribution reveals that geometric uncertainties will result in an unsatisfactory treatment, the plan can be adjusted to account for this. A similar process could be easily and transparently incorporated into inverse treatment planning methods.

In summary, methods such as convolution can be used to estimate the dose distribution that is expected when geometric uncertainties are present. The accuracy of the convolution model is well characterized, and areas of substantial error can be improved. Modeling geometric uncertainties can produce accurate estimates of the delivered dose distribution. Furthermore, these models produce more useful information for treatment planning decisions than the use of a PTV alone.

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APPEL POUR MISES EN CANDIDATURE

Candidature comme vice-président(e)
(Terme: De la réunion générale annuelle de 2004 jusqu'à la RGA de 2006, devient président(e) en 2006, ancien(ne) président(e) en 2008, fin en 2010)

La mise en candidature doit être signée par deux membres actifs et par le ou la candidat(e) qui indique par sa signature qu'il ou elle accepte la mise en candidature.

Envoyez vos mises en candidature à:

Dr. B. Gino Fallone
COMP Past-Chair
Cross Cancer Institute
11560 University Ave.
Edmonton, AB. T6G 1Z2
Tel: (780) 432 8750
Fax: (780) 432 8615
E-mail: gfallone@phys.ualberta.ca

An election by mail ballot will be conducted in the spring. The results will be reported at the Annual General Meeting in Winnipeg in July 2004.

Les résultats seront rapportés à la réunion générale annuelle à Winnipeg en juillet 2004.

Nominee :

Accepted by nominee :

Sponsor: 1)

2)

Candidat(e) :

Acceptée par le(la) candidat(e):

Parrains: 1)

2)

CALL FOR NOMINATIONS

The CAP-COMP Peter Kirkby Memorial Medal for Outstanding Service to Canadian Physics

The CAP-COMP Peter Kirkby Memorial Medal recognizes outstanding service to Canadian physics. The medal is intended to recognize service to the physics community by strengthening the Canadian physics community, by enhancing the profession of physical scientists, by effectively communicating physics to the non-scientific community, or by making physics more attractive as a career. It is intended to provide a lasting memorial to Peter Kirkby and to recognize in others the qualities for which he is remembered best: a vision of a strong Canadian physics community, dedicated efforts to support that vision and, in all things, fairness and honesty.

The Peter Kirkby Memorial Medal was introduced in 1996 and is awarded biennially. The previous winners were:

2002 - Dr. John R. (Jack) Cunningham, Camrose, Alberta
2000 - Dr. Paul Vincett, FairCopy Services Inc.
1998 - Dr. J.S.C. (Jasper) McKee, University of Manitoba
1996 - Dr. Donald D. Betts, Dalhousie University

The next medal will be awarded in the year 2004. The deadline for nominations has been extended to March 1, 2004.

Because of the required support material, online nominations are not a viable option. Please download the Nomination Form from the CAP website: http://www.cap.ca/awards/kirkby2004-frm.pdf

Print and complete the nomination form accordingly, and then mail to the CAP with the required documentation.

2004 Sylvia Fedoruk Prize in Medical Physics

The Saskatchewan Cancer Agency is pleased to sponsor a competition for the 2004 Sylvia Fedoruk Prize in Medical Physics. This award is offered annually to honour the distinguished career of Sylvia Fedoruk, former Lieutenant-Governor of Saskatchewan and previously physicist at the Saskatoon Cancer Centre.

The prize will comprise a cash award of five hundred dollars ($500), an engraved plaque and travel expenses to enable the winner to attend the annual meeting of the Canadian Organization of Medical Physicists (COMP) and the Canadian College of Physicists in Medicine (CCPM), which will be held on June 13-16, 2004 in Winnipeg.

The 2004 Prize will be awarded for the best paper on a subject falling within the field of medical physics, relating to work carried out wholly or mainly within a Canadian institution and published during the 2003 calendar year. The selection will be made by a panel of judges appointed by COMP.

Papers published in *Physics in Medicine and Biology* and *Medical Physics*, which conform to the conditions of the preceding paragraph, will automatically be entered in the competition and no further action by the author(s) is required. All other papers must be submitted individually. Four (4) copies of each paper being entered must be sent to:

Clément Arsenault, Ph.D., MCCPM
COMP Chair
Centre d'oncologie Dr Léon-Richard
Hôpital régional Dr Georges-L. Dumont
37 rue Providence
Moncton, NB E1C 8X3
Tel: (506) 862-4151
Fax: (506) 862-4222
E-mail: carsenault@health.nb.ca

Each paper must be clearly marked: "Entry for 2004 Sylvia Fedoruk Prize" and must reach the above address no later than **Friday, February 27, 2004**.

The award winners from the last five years were:

J.H. Siewerdsen, I.A. Cunningham and D.A. Jaffray, "A framework for noise-power spectrum analysis of multidimensional images", *Medical Physics,* **29**, 2655-2671(2002).

B. McCurdy, K. Luchka and S. Pistorius, "Dosimetric investigation and portal dose image prediction using an amorphous silicon electronic portal imaging device", *Medical Physics,* **28**, 911-24 (2001).

M. Lachaine and B. Gino Fallone, "Monte Carlo simulations of x-ray induced recombination in amorphous selenium", *J. Phys. D: Appl. Phys.,* **33**, 1417-23 (2000).

P.Busono and E. Hussein, "Algorithms for density and composition-discrimination imaging for fourth-generation CT systems", *Physics in Medicine and Biology,* **44**, 1455-1477 (1999).

R.G. Kelly, K.J. Jordan, and J.J. Battista, "Optical CT reconstruction of 3D dose distributions using the ferrous-benzoic-xylenol (FBX) gel dosimeter", *Medical Physics* **25**, 1741-1750 (1998).

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40. Hoogeman MS, van Herk M, Yan D, et al. A model to simulate day-to-day variations in rectum shape. Int J Radiat Oncol Biol Phys 2002;54:615-625.
41. Brock KK, McShan DL, Ten Haken RK, et al. Inclusion of organ deformation in dose calculations. Med Phys 2003;30:290-295.
42. Brock KK, Balter JM, Dawson LA, et al. Automated generation of a four-dimensional model of the liver using warping and mutual information. Med Phys 2003;30:1128-1133.
43. Schaly B, Kempe J, Bauman G, et al. Accounting for variable anatomy in radiation therapy dose distributions. Med Phys 2003;30:1428.

The Development of National Quality Control Standards for Use in Canadian Radiation

Submitted by Peter Dunscombe,
Tom Baker Cancer Centre, Calgary, AB

The Canadian Association of Provincial Cancer Agencies (CAPCA) has recently initiated the process of standardisation of radiotherapy treatment quality in Canada through its draft document "Standards for Quality Assurance at Canadian Radiation Treatment Centres". The Canadian Organisation of Medical Physicists and the Canadian College of Physicists in Medicine are contributing to this standardisation initiative through their sponsorship of the development of a series of Appendices to the main document. These appendices detail national quality control standards for the major classes of equipment used in radiotherapy. Appropriately, the Radiation Safety and Technical Standards Advisory Committee (RSTSAC) of COMP/CCPM was identified as the committee to oversee the project on behalf of COMP/CCPM. The RSTAC has, in turn, established a task group to carry out the significant amount of work entailed in this unique endeavour.

Members of the task group have been in electronic contact for the last few months preparing for their first meeting which was held recently in Toronto, in conjunction with the COMP and CCPM mid-winter meetings. During the two days of discussion considerable progress was made. A generic format for all the quality control appendices was finalised. Seven of the nine protocols currently under development were discussed in detail and the tests, frequencies and performance objectives and criteria agreed upon by the task group. The next phase is to fine tune these seven appendices and then submit them to COMP/CCPM. This phase should be complete by the end of January 2004. It will be up to Joint Executive how the process is handled from there. However, wider consultation will be an essential component of whichever process is selected.

The purpose of this brief note is not only to provide a progress report on the project but also to alert the Canadian medical physics community of the potential significance of the standards that are finally approved by CAPCA. In the opinion of the task group, these standards are likely to find their way into both regulatory and accreditation requirements. Should this happen, the performance of those primarily responsible for quality control of equipment, i.e. medical physicists, will be easy to assess in any review process. This, of course, is not necessarily a bad thing as it will provide an additional layer of security for patients treated in Canadian radiotherapy centres. However, there will be clear implications for medical physics resource distribution and local organisational structures that should not be ignored.

The process of developing national quality control standards will continue and will be completed. It is the responsibility of the Canadian medical physics community, in conjunction with others, to ensure that the standards are appropriate and implementable in practice. We hope you will take the time to review the documents as they become available and to provide constructive feedback to the task group, on behalf of our national medical physics organisations, on their further refinement.

The CAPCA Document Review Task Group
Clement Arsenault, Jean-Pierre Bissonnette, Peter Dunscombe (Chair), Harry Johnson, George Mawko, Jan Seuntjens

BLACKOUT in KINGSTON: Something to be said for Cobalt-60 and the CNSC

Submitted by John Schreiner and Andrew Kerr, Kingston Regional Cancer Centre, Kingston, ON

After reading Peter O'Brien's report of the Sunnybrook's experiences of the "Big Blackout of August 14, 2003" we thought we would submit an anecdotal report of Kingston's experience.

Kingston was towards the eastern side of the grid that experienced the cascading power shutdown: our lights and linacs went out just a little after 4:10 pm. Usually when the power goes out in Kingston it flickers momentarily and returns quickly. It was very strange to lose all power without a flicker on a clear calm warm day, since the rare serious blackouts are typically heralded by bad weather. So at first we expected a short local outage. After about 10 minutes, reports from hospital maintenance indicated that the blackout went as far as Toronto, so Andrew Kerr phoned his brother in California (as far away from our geographical area as possible) to obtain some news on how far the outage had spread. The Californian Kerr was able to connect to the CBC web site (still operating) and reported that the power outages were covering most of Ontario and several states in the US and were expanding. With this news we realized that the blackout could be of long duration, and that we could not rely on the power coming on again that evening.

While a power outage has considerable clinical impact, as noted by Peter in the last issue of InterActions, our main clinical challenge was a lymphoma patient from the host hospital's Intensive Care Unit who was on our x-ray simulator in preparation for emergency treatment to relieve a life threatening airway blockage resulting from his disease. We were unable to lower the simulator couch manually, but therapy staff managed with effort to bring the patient down onto the stretcher. Once he was off the simulator, we reviewed the situation with the treating physician and together decided that radiation treatment had to be given as soon as possible to relieve breathing. But all linacs were inoperable.

Fortunately we had a T780 Cobalt-60 unit that could function fully on only emergency power. But there was one dilemma. When the operating licence for the KRCC Co-60 unit was renewed in June 2003, the status changed from a medical teletherapy facility licence to that for an irradiator facility. Our T780 is presently dedicated to research investigating the use of Co-60 as a radiation source for tomotherapy and we had indicated that the unit would be used for non-patient use in our renewal application (form C-120 rev.1) and in the accompanying appendix describing the clinical research Cobalt unit. While we had anticipated that we might have to use the T780 in an extreme emergency, as in the ice storm in 1997, this was deemed unlikely. Thus the CNSC suggested that the Co-60 unit was most appropriately designated an irradiator facility.

Therefore, on August 14 we had a fully functional Cobalt unit that was not to be used for patient treatment. We decided to contact the Canadian Nuclear Safety Commission (CNSC) to waive the treatment restriction. At the same time we prepared the Co-60 unit for treatment. Of course in the power outage we could not connect with the CNSC and could only leave messages. Since treatment was required to maintain this man's life, we proceeded as planned. Physics staff cleared the unit for patient treatment (dismantling the research benchtop), performed required quality assurance, and verified that all the data required (e.g., output factor, etc) for safe treatment were available. The patient was moved to the room within one hour of the power outage and was treated by radiation therapists trained and familiar with the cobalt unit (using parallel-opposed anterior and posterior fields for approximately 8 minutes each). The treatment proceeded without any complications, and the patient returned to the Intensive Care Unit at the Kingston General Hospital.

The next day we had separate replies from both Mike James and Ramzi Jammal of the CNSC; surprising, since Ottawa had shut down all government services and workers had been directed to stay at home in expectation of further power failures. Both CNSC officers expressed understanding of our situation but requested a short written report for review. As Jean Robins our RSO was away, John Schreiner prepared the report with the request that it be included as an appendix in a revised licence so that emergency treatments (such as spinal cord compressions, air way obstructions, and severe gastrointestinal, gynecological or airway bleeding associated with tumours) would be permitted in the future. The CNSC was very supportive and an amended licence arrived soon afterwards.

There are two purposes to this little story. The first is to reiterate the robust character of Cobalt-60 units, which keep on ticking when other radiation sources cannot. This is of course a major motivation for our ongoing research with Co-60 tomotherapy. The second is to commend the support from the CNSC, which continues to assist our clinical function and is very willing to cooperate closely with cancer clinics to advance the safe application of radiation in medicine.

The T780C Cobalt-60 unit in the KRCC tomotherapy benchtop configuration when not treating emergency patients.

Physics, Quality Assurance and the NCIC Clinical Trials Group

Submitted by
Peter Dunscombe[a] and Colin Field[b]
[a]Tom Baker Cancer Centre, Calgary, AB
[b]Cross Cancer Institute, Edmonton, AB

At some time in the 1980s, now long forgotten, one of us (PD) was invited to join the Radiation Oncology Quality Assurance Committee (ROQAC) of the Clinical Trials Group (CTG) of the National Cancer Institute of Canada. The primary role undertaken was to review the physics and dosimetry aspects of NCIC sponsored clinical trials involving radiotherapy. Over the years this role expanded somewhat to include providing the occasional talk at the CTG Spring Meeting, surveying physics related quality assurance activities in Canada (which has been published in "Interactions"), helping developing a template for the construction of new clinical trials protocols and various other odd jobs.

One of the issues which ROQAC has been dealing with for some time is that of "real time review". Considerable effort is involved in enrolling a patient in a clinical trial. If the protocol is not precisely followed for each patient, the conclusions from the study may be impacted by therapy noncompliance rather than true treatment differences. Real time review entails all the pertinent documentation, including films and dose distributions, relating to the patient being independently reviewed for compliance by a Radiation Oncologist familiar with the protocol. The review clearly has to happen in close temporal proximity to the start of treatment so that modifications can be made if necessary. Until fairly recently real time review has meant sending all the information by courier to the reviewer for comment. In the age of the internet and electronic data this method of information transfer is archaic, delays and complicates the review and is expensive. Three years ago the ROQAC began investigating electronic data transfer for real time review. At this time the second author (CF) was appointed to the ROQAC in view of his expertise in this area. In October 2001, a pilot project involving the Vancouver Island Cancer Centre, Cross Cancer Institute, and Hamilton Regional Cancer Centre was conducted to evaluate the feasibility of using electronic data transfer to support rapid real-time reviews for the NCIC CTG MA.20 breast protocol using NetSys software developed by the Resource Center for Emerging Technology (RCET, University of Florida, Gainsville, FL). This pilot project proved successful using screen captured and scanned images (e.g. 3D datasets are NOT being used for MA.20). With the success of the pilot project, electronic data transfer is being implemented at all centres accruing patients to MA.20.

A second issue of interest to ROQAC and the Canadian radiation oncology community in general is the development of trials involving the latest techniques in radiotherapy, specifically Intensity Modulated Radiation Therapy. It is recognised that quality assurance for such advanced techniques is critical for their successful application as well as being both complex and resource intensive. Clinical implementation and quality assurance of IMRT, for example, implies a far heavier involvement per patient than conventional treatment approaches.

And now to get to the point. With these developments in radiotherapy clinical trials, physics involvement will have to increase both at the clinic and national levels. Firstly, ROQAC will be looking for assistance in installing and and configuring the RCET software, and performing technical reviews of Dry Runs and initial clinical submissions. Secondly, more direct involvement in clinical trial protocol development will become necessary as planning and delivery complexity increase. For such trials, it is proposed to add a physicist to the writing committee to ensure that the physics and technical aspects of planning and treatment are adequately addressed.

Our request to you on behalf of the ROQAC is three-fold. Please consider assisting the Canadian clinical trials effort by

1. responding positively to any local calls for assistance with electronic data transfer.
2. assisting the NCIC CTG ROQAC to establish electronic data transfer capabilities in your centre for NCIC sponsored clinical trials.
3. participating in the development of national radiotherapy trial protocols if requested

The incremental workload is not expected to be major and these will be three more ways in which the unique expertise of the Canadian medical physicist can be employed to the benefit of future patients. Please forward any questions or indications of interest to either:
cfield@ualberta.ca or peterdun@cancerboard.ab.ca.

COMP Chair... (Continued from page 4)

Finally, I would like to reiterate my regular request for participation in COMP. We are always looking for new blood. As you are probably aware, there are two positions on the Executive that need to be filed in June, i.e. Chair-Elect and Secretary. The Call for Nominations has gone out but we have yet to receive candidates. For those of you who are thinking of stepping forward but are not sure, please contact a member of the Executive to get more information on these positions. These positions do require some time but provide us with a unique opportunity to shape the future of our organisation.

Linac Service Groups seek Organization

Submitted by Tom Feuerstake, Kingston Regional Cancer Centre, Kingston, ON, on behalf of the CAREST group

In-house service groups in Canada are developing an organization to represent their professional interests. The service groups, composed of electronics technologists, mechanical technologists and machinists, have agreed to work together to develop standards for servicing radiation therapy equipment. The standards would describe the training needed to service high-energy Linear Accelerators and other equipment used in radiation therapy departments.

The training for this type of work is quite demanding, yet there is no formal education available. Service technologists are usually hired with a college diploma in a related core technology, such as engineering, electronics or mechanics, and are provided with in-house training by their institution. Most service personnel, but not all, attend training courses at the manufacturer's training centre at some point. These short and intensive courses are directed towards the specific type of equipment, and the majority of their specialized education comes through on-the-job training, often taking years to complete.

"There's a great expectation of self- teaching and on-the-job training in our work," says Bruce Gillies, Manager of Engineering at Toronto Sunnybrook Regional Cancer Centre. "When new people join the group, it takes a long time before we feel comfortable with them working on a Linear Accelerator without direct supervision. We try to send new employees for factory training in the first year, but that's not always possible, so the person's performance is largely dependent on their ability to learn on the job. The biggest thing lacking is credentialing for service engineers. We have an informal peer review system in place at TSRCC where we observe and work with new people and get feedback on how they are doing from the veterans on the team. I think a more formalized system could be set up which would credential people and provide them with the confidence to assume individual responsibility." Bruce points out that service personnel's training does not end there. "Since the working life of a major piece of equipment might be only ten years, people can find themselves expert on a piece of equipment that becomes obsolete and gets replaced with something very different. So the demand for learning on the job never ends."

Credentials and training for these groups has come under scrutiny in the past. Radiation treatment machines are licensed by the Canadian Nuclear Safety Commission, the government agency that regulates the use of nuclear substances and equipment in Canada. Under the CNSC's new requirements, cancer centres must provide information about service personnel's training before they are permitted to work on the equipment. Repairs that involve activated materials are restricted to qualified personnel, and there are requirements for documenting service procedures such as bypassing and restoring safety interlocks. These requirements have left some centres hastening to provide a response in developing new policies and procedures for their workers.

A group of service technologists met at the WesCan conference in Thunder Bay last year to discuss these issues and formed a committee to work towards defining the organization. The group has drafted a mission statement and by-laws, and discussed methods of training. Because of the strong link between service technologists and medical physicists, who oversee technical operations in cancer centres, the group is looking toward the physics community as a model for its own organization. The group has written to the Canadian Organization of Medical Physicists for their support.

With several new cancer centres opening up, the workforce is continually growing, further validating the need for an organization. "The lack of formal training has raised questions about our credentials," says Tom Feuerstake at the Kingston Regional Cancer Centre. "We want to do everything we can to ensure that new workers are competent, and that safety and licensing issues are well understood. A resource such as an association could do that for us. We're aware that similar activities are taking place in other countries, such as in the United States, with the AAPM and the service personnel there. We feel that we need a Canadian solution, particularly because of our regulatory requirements. The response we received from COMP was very supportive. We look forward to working together with them in the coming year."

One of the discussions at the conference focussed on choosing a name for the organization. "If we choose to call ourselves the 'Association of Radiotherapy Equipment Service Technologists' we will be under 'AREST'", said Bruce Gillies, "but if we choose the 'Canadian Association of Radiotherapy Equipment Service Technologists', then we will be 'CAREST'". The group eventually settled on CAREST. More information can be found on their web site at: http://ca.geocities.com/carestgroup/index.html.

CCPM President... (Continued from page 5)

CCPM may accept applications for Fellowship from suitably qualified candidates who have current competency certification from elsewhere.

Finally, it seems appropriate to wish you all a happy holiday season. However, by the time you read this it will be January already so I extend my wishes for a happy and healthy 2004.

What's Wrong with the Sylvia Fedoruk Award and How Can It Be Fixed?

Submitted by Michael S. Patterson, Juravinski Cancer Centre, Hamilton, ON

1. The Award

Most COMP members are familiar with the Sylvia Fedoruk Award (SFA). It was established by the Saskatchewan Cancer Foundation to honor Sylvia Fedoruk, a medical physicist who later served as Lieutenant Governor of that province. The award is intended to recognize the authors who have published the best paper in the field of medical physics in a given year. The work must have been performed mainly at a Canadian institution. The winner is selected by an anonymous committee reporting to the Chair of COMP and announced at the annual COMP meeting. In principle, I think the award is a good idea. It raises the profile of publications in our field and attempts to reward excellence in our scientific community. However, the selection process has always been surrounded by a certain amount of controversy and mystery. In this article I will outline what I think is wrong with the current process and suggest a new method.

2. What's the Problem?

The current process was devised by COMP and works like this. All eligible papers published in Physics in Medicine and Biology or Medical Physics are automatically entered in the competition. Papers published in other journals must be nominated. Papers are grouped into six categories: radiation therapy, dosimetry and Monte Carlo, MRI, CT, ultrasound, and "other". An expert in each field on the committee reviews the papers and selects the best. The whole committee picks the winner from these six. Usually one or two papers receive "honorable mention". It sounds good, but there are a number of problems:

a) No matter how you slice it, this is a subjective process. Each judge applies his or her own judgement in evaluating the papers. No objective or uniform criteria are applied to select the "best" paper.
b) For obvious reasons, the process is secret. Despite the best intentions of the committee, there will inevitably be speculation about how the winner was chosen and what criteria were applied.
c) Conflict-of-interest is unavoidable. The committee members are reading papers written by their friends and colleagues. To avoid this, a judge may have to declare a conflict, and hence disadvantage a paper.
d) Only a limited range of journals and subject matter can be evaluated. Just to get through PMB and Med. Phys. is a daunting task, without considering the many other specialist journals in which medical physicists publish. I suspect that, being Canadians, we rarely nominate papers from other journals. The judges will feel most comfortable with papers in familiar territory.
e) It's a lot of thankless work.
f) As I will show below by using one objective criterion of excellence, high-impact papers have not been recognized by this process, and furthermore, many winners of the award have proved to have relatively low impact. I suggest that it is difficult to judge the value of scientific papers as soon as they are published.

Note that I am **not** saying that the winning papers have been unworthy, or that the judges have been unfair. On the contrary, I suspect the judges recognize they are faced with an impossible task, do the best they can, and try to avoid being on the committee next year. Can we find a better way to do this?

3. An Objective Criterion

There is an objective, albeit imperfect, way to evaluate scientific papers and that is the number of times the paper is cited in the years following its publication. As stated by Christensen and Sigelman [1], "frequency of citation implies scholarly acceptance, or at least acknowledgement of importance through utilization of others' work." Electronic access to the Science Citation Index makes it very easy to acquire and use these data. For example, libraries are using citation analysis to decide which journals are worth subscribing to. To facilitate this, the Institute for Scientific Information (ISI) calculates an "impact factor" for each journal. For the purposes of this article the impact factor is the average number of times a paper in that journal is cited per year. (For the exact definition see ISI's website.) Some libraries consider an impact factor of 2.0 to be the cutoff for subscription. Just to provide some calibration, the impact factor for PMB in 2002 was 2.34 and for Med. Phys. it was 2.39. To put it another way, an average paper in these journals should be cited about twice a year. Promotion and tenure committees are also starting to look at the impact of a candidate's publications rather than just the volume. Is it fair to say that good papers are always frequently cited? Probably not – the reasons for citation are themselves not objective or uniform. However, it is probably fair to say that frequently cited papers are "good" and there are precedents for using this criterion.

4. Applying Citation Analysis to the Fedoruk Problem

Citation analysis can be used to answer a number of interesting questions. What was the most frequently cited Canadian medical physics paper published in a given year? Were these papers recognized by the SFA process? How many citations have been generated by SFA winners? To answer the first question I used the Web of Science (Thomson-ISI) to search the Science Citation Index. For example one can easily search for all papers published in the journal Medical Physics in 1999 where the word "Canada" appeared in the authors' affiliation. These can then be sorted automatically by number of times cited. One can also search for papers by particular authors. For papers published before 1995 McMaster's subscription to Web of Science limits the search tools available, so I had to rely on my ability to recognize Canadian authors. I suspect I have made some errors, but in the interest of sparking discussion, Table 1 lists the "Retro Fedoruk Award" winners for the years 1990 – 2002. (Note this is the actual year of publication while the SFA award is for a paper published in the preceding year). I have not included review papers because these are known to have a

(Continued on page 30)

Fedoruk Award... (Continued from page 29)
citation bias, and I have also excluded some papers with medical physicists as co-authors on the grounds that they were not medical physics. For example, if a paper applies a mature technique to answer a biological or clinical question, I have ruled it ineligible -–this question is further discussed in Section 6 below. Table 1 lists the total number of citations garnered by each paper and an average annual citation rate calculated by assuming that a paper published in, for example, 2001, has had two years, 2002 and 2003, in which it could be cited. The annual citation rate for the winners ranges from 7.5 to 27.3 and is well above the 2.0 threshold. The sixth column shows whether the winner was recognized by the SFA process as a winner or honorable mention. These data were acquired from the COMP directory list of SFA winners and the honorable mentions published in Interactions. For some years I could not find a list of honorable mentions and those years are indicated by an asterisk. As far as I can tell, the medical physics paper published in a given year that currently is most frequently cited was recognized by the SFA process only once! The last column shows the average annual citation rate of the SFA winner. This ranges from 0 to 11.3, with 9 of the 13 winners falling below 2.0 citations per year. Again, I am **not** saying that these are not good papers, but they have not had a high impact by this measure.

5. Advantages of a New Approach

My suggestion is simple: give the Sylvia Fedoruk award for a given year to the paper that has been cited most often over a fixed period. I would argue that period should be five to ten years. This gives enough time for papers to be recognized and cited by the community but not so much time that the work is an archeological curiosity. To make it simple, I suggest the 2005 prize be awarded to the paper published in 1995. What are the advantages of this approach?

a) The process is completely transparent and objective. Anyone with access to the citation index can figure out who the winner is.
b) There are no conflicts-of-interest, so no one is disqualified from the competition.
c) Any number of journals can be included because there is no need to actually read the papers!
d) The amount of work is minimal.
e) The award will be based on the judgement of the international scientific community, rather than a small number of well-intentioned judges.
f) The award will be based on a widely accepted tool for evaluating the impact of scientific publications.

6. Disadvantages of this Approach

Let me raise some, but I am hoping that this article will spark serious discussion among COMP members in which other advantages and disadvantages may become apparent.

a) There is a difference between the best paper and the most frequently cited paper. Maybe – but I challenge critics to come up with a workable system to quantify this difference.
b) Basing the award on citations will favor fields with more scientists and more frequent publication. This is true. One answer might be to restrict the papers to those published in PMB or Med. Phys. These journals are perhaps more representative of the research areas of COMP members. For interest I have prepared such a list and it is shown in Table 2. Interestingly, even these papers were not recognized by the SFA process! On the whole, the leaders are not as frequently cited as those in Table 1 but they are all well above the 2.0 benchmark. It could also be argued that these two journals are the official journals of COMP, and that COMP should promote them. However, this restriction is probably not consistent with the original intent of the award.
c) If the net is cast too wide, the winning paper might not be "medical physics". As discussed above, I did reject a couple of papers on this basis. It might be necessary to form an *ad hoc* committee to judge the eligibility of a paper, but I think this would be relatively easy to do.
d) It removes all the suspense and excitement of the announcement. True, but this could be replaced by the excitement of watching the race develop over ten years. Annual standings could be published in Interactions.
e) A change in procedure would have to be approved by the Saskatchewan Cancer Foundation and there would be a transition period in which there were two winners for a given year. Also true, but I think the SCF could be convinced that this process is fairer, more sustainable, and consistent with the goals of the award.

In conclusion, I would encourage COMP members to let me and the executive know what you think of this proposal.

References (because I had to have at least one citation):

[1] J.A. Christenson and L.Sigelman, Accrediting knowledge: Journal stature and citation impact in social science, **Soc. Sci. Quart. 66:** 964-975 (1985).
[2] There are several interesting essays on citation analysis and journal impact on the ISI website (www.isinet.com)

Footnote:

I am aware that my name appears in Tables 1 and 2 and that some may think this article arises from a deep-seated resentment of the fact that I have never won the SFA. While this cannot be completely ruled out until my next therapy session, the origins are quite different. I serve on the Editorial Board of PMB and the meetings always include a discussion of the journal's impact factor. The Board is also supposed to award a prize for the best paper published in PMB in a given year – a task that will sound familiar. In thinking about ways to do this better I generated a list of the top ten papers ever published in PMB. Becoming increasingly obsessed, I did the same for Med. Phys. This list included four papers from Canadian institutions. When I showed the list to a colleague, he asked whether those papers had won the SFA. One thing led to another – this article is the final result. One last note: the data in Tables 1 and 2 were acquired in mid-December, 2003. Obviously, the numbers are always changing. These tables are my best attempt to identify the most frequently cited papers but I did not conduct an exhaustive search (I have a real job). If any reader knows of more frequently cited medical physics papers, I would be pleased to modify my tables. Perhaps someone would like to search out a "hall of fame" of the ten most frequently cited Canadian medical physics papers ever published?

Year of Publication	Authors	Title	Total Citations	Citations per year	Fedoruk recognition	Citations/year SF Winner
2002	**D.A. Steinman J.B. Thomas H.M. Ladak J.S. Milner B.K. Rutt J. D. Spence**	Reconstruction of carotid bifurcation hemodynamics and wall thickness using computational fluid dynamics and MRI, **Magnetic Resonance in Medicine 47:** 149-159.	15	15	None	1.0
2001	**D.E. Hyde T. J. Farrell M.S. Patterson B. C. Wilson**	A diffusion theory of spatially resolved fluorescence from depth-dependent fluorophore concentrations, **Physics in Medicine and Biology 46:** 369-383.	15	7.5	None	2.5
2000	**I. Kawrakow**	Accurate condensed history Monte Carlo simulation of electron transport. I. EGSnrc, the newest EGS4 version, **Medical Physics 27:** 485-498.	55	18.3	None	1.3
1999	**R.S. Menon B.G. Goodyear**	Submillimeter functional localization in human striate cortex using BOLD contrast at 4 tesla: implications for vascular point-spread function, **Magnetic Resonance in Medicine 41:**230-235.	46	11.5	None	0.5
1998	**R.S. Menon D.C.Luknowsky J.S. Gati**	Mental chronometry using latency-resolved functional MRI, **PNAS 95:** 10902-10907.	57	11.4	None	2.4
1997	**J.S. Gati R.S. Menon K. Ugurbil B.K. Rutt**	Experimental determination of the BOLD field strength dependence in vessels and tissue, **Magnetic Resonance in Medicine 38:** 296-302.	121	20.2	None	0.2
1996	**A.Kienle L. Lilge M.S. Patterson R. Hibst R. Steiner B.C. Wilson**	Spatially resolved absolute diffuse reflectance measurements for noninvasive determination of the optical scattering and absorption coefficients of biological tissue, **Applied Optics 35:** 2304-2314.	79	11.3	None*	1.0
1995	**D.W.O. Rogers B.A. Faddegon G.X. Ding C.M. Ma J. We T.R. Mackie**	BEAM: A Monte Carlo code to simulate radiotherapy treatment units, **Medical Physics 22:** 503-524.	218	27.3	None*	8.6
1994	**R.M.Henkelman G.J. Stanisz J.K. Kim M.J. Bronskill**	Anisotropy of NMR properties of tissues, **Magnetic Resonance in Medicine 32:** 592-601.	102	11.3	Winner	11.3
1993	**R.M.Henkelman X. Huang Q.S. Xiang G.J. Stanisz S.D. Swanson M.J. Bronskill**	Quantitative interpretation of magnetization transfer, **Magnetic Resonance in Medicine 29:**759-766.	146	14.6	None*	1.3
1992	**T. J. Farrell M.S. Patterson B. C. Wilson**	A diffusion theory model of spatially resolved, steady-state diffuse reflectance for the noninvasive determination of tissue optical properties in vivo, **Medical Physics 19:** 879-888.	197	17.9	None	1.9
1991	**R.M.Henkelman J.F. Watts W. Kucharczyk**	High signal intensity in MR images of calcified brain tissue, **Radiology 179:** 199-206	103	8.6	None	0
1990	**V. G. Peters D. R. Wyman M.S. Patterson G. L. Frank**	Optical properties of normal and diseased human breast tissues in the visible and near infrared, **Physics in Medicine and Biology 35:** 1317-1334.	117	9.0	None*	0.8

Table 1. Most frequently cited Canadian paper in the field of medical physics published in a given year. See text for details.

Year of Publication	Authors	Title	Total Citations	Citations per year	Fedoruk recognition	Citations/year SF Winner
2002	**G.X. Ding**	Energy spectra, angular spread, fluence profiles and dose distributions of 6 and 18 MV photon beams: results of Monte Carlo simulations for a Varian 2100EX accelerator, **Physics in Medicine and Biology 47:** 1025-1046.	5	5	None	1.0
2001	**D.E. Hyde** **T. J. Farrell** **M.S. Patterson** **B.C. Wilson**	A diffusion theory of spatially resolved fluorescence from depth-dependent fluorophore concentrations, **Physics in Medicine and Biology 46:** 369-383.	15	7.5	None	2.5
2000	**I. Kawrakow**	Accurate condensed history Monte Carlo simulation of electron transport. I. EGSnrc, the newest EGS4 version, **Medical Physics 27:** 485-498.	55	18.3	None	1.3
1999	**A.J. Curtin-Savard** **E.B. Podgorsak**	Verification of segmented beam delivery using a commercial electronic portal imaging device, **Medical Physics 26:** 737-742.	23	5.8	None	0.5
1998	**N.V. Klassen** **L. van der Zwan** **J. Cygler**	Gafchromic MD-55: Investigated as a precision dosimeter, **Medical Physics 25:** 1924-1934.	37	7.4	None	2.4
1997	**C.L. Gordon** **C. E. Webber** **N. Christoforou** **C. Nahnias**	In vivo assessment of trabecular bone structure at the distal radius from high-resolution magnetic resonance images, **Medical Physics 24:** 585-593.	40	6.7	None	0.2
1996	**J.R. Mitchell** **S.J. Karlik** **D.H. Lee** **M. Eliasziw** **G.P. Rice** **A. Fenster**	The variability of manual and computer assisted quatification of multiple sclerosis lesion volumes, **Medical Physics 23:** 85-97.	32	4.6	None*	1.0
1995	**D.W.O. Rogers** **B.A. Faddegon** **G.X. Ding** **C.M. Ma** **J. We** **T.R. Mackie**	BEAM: A Monte Carlo code to simulate radiotherapy treatment units, **Medical Physics 22:** 503-524.	218	27.3	None*	8.6
1994	**B.W. Pogue** **M.S. Patterson**	Frequency-domain optical absorption spectroscopy of finite tissue volumes using diffusion theory, **Physics in Medicine and Biology 39:** 1157-1180.	51	5.7	None*	11.3
1993	**D.A. Jaffray** **J.J. Battista** **A. Fenster** **P. Munro**	X-ray sources of medical linear accelerators: focal and extra-focal radiation, **Medical Physics 20:** 1417-1427.	71	7.1	None*	1.3
1992	**T. J. Farrell** **M.S. Patterson** **B. C. Wilson**	A diffusion theory model of spatially resolved, steady-state diffuse reflectance for the noninvasive determination of tissue optical properties in vivo, **Medical Physics 19:** 879-888.	197	17.9	None	1.9
1991	**J.A. Rowlands** **D.M. Hunter** **N. Araj**	X-ray imaging using amorphous selenium: a photoinduced discharge readout method for digital mammography, **Medical Physics 18:** 421-431.	43	3.6	None	0
1990	**V. G. Peters** **D. R. Wyman** **M.S. Patterson** **G. L. Frank**	Optical properties of normal and diseased human breast tissues in the visible and near infrared, **Physics in Medicine and Biology 35:** 1317-1334.	117	9.0	None*	0.8

Table 2. Most frequently cited Canadian paper published in Medical Physics or Physics in Medicine and Biology in a given year. See text for details.

FIRST CANADIAN GAMMA KNIFE SITE

(or 'itsy-bitsy, teeny-weeny, polka-dot photon fields')

Submitted by Anita Berndt and James Beck, Cancer Care Manitoba, Winnipeg, MB

On November 4, 2003, after months of preparation, training and measurements the first Canadian Gamma Knife® patient was treated. Start-up week with the Elekta mentor team was a bustle of activity with a total of 11 patients being treated.

A typical day for Gamma Knife® patients starts at 6:00 in the morning with frame placement. The patient is then imaged with a fiducial box clipped to their frame using MR and / or CT in order to provide the treatment coordinate system. Treatment planning times range from 20 minutes to about 2 hours, depending upon the complexity of the treatment plan. Actual treatment times vary from about 30 minutes to 2 hours depending upon the dose and lesion size. These planning and treatment times allow three patients to be treated on a typical treatment day.

A Canadian Gamma Knife® provides greater access to this treatment modality not only for Manitobans, but for all Canadians. This minimally-invasive approach is suitable for selected malignant tumors, many benign tumors, as well as conditions such as trigeminal neuralgia (face pain caused by the trigeminal nerve), arteriovenous malformations (abnormal capillaries in the brain with the potential to rupture and produce a fatal bleed) and tremors. Rather than undergoing a craniotomy and enduring a long recovery period, the patient can resume normal actives almost immediately. To date (December 7, 2003) 37 patients have been treated (25 Manitobans, 12 out-of-province patients), with about another 35 on the waiting list for treatment.

Further details regarding Gamma Knife® procedures and commissioning measurements to follow.

CORPORATE MEMBERS

ADAC-A Phillips Medical Systems Co
540 Alder Drive
Milpitas CA 95035 USA
Phone: (408) 321-9100
Fax: (408) 577-0907
website: www.adaclabs.com
Contact: Ms. Jennifer L. Anderson
janderson@adaclabs.com

Best Medical International
7643 Fullerton Road
Springfield VA 22153 USA
Phone: (703) 451-2378
Fax: (703) 451-8421
website: www.best-medical.com
Contact: Mr. Krishnan Suthanthiran
krish@best-medical.com

CNMC Company Inc.
2817-B Lebanon Pike
Nashville TN 37214 USA
Phone: (615) 391-3076
Fax: (615) 885-0285
website: www.cnmcco.com
Contact: Mr. Ferd Pusl
CNMCsales@earthlink.net

CSP Medical
1055 Sarnia Road, Unit B2
London ON N6H 5J9 Canada
Phone: 1-800-265-3460
Fax: 1-800-473-7710
website: www.cspmedical.ca
Contact: Mr. Steve Gensens
sgensens@cspmedical.com

Donaldson Marphil
3465 Cote des Neiges #602
Montréal QC H3H 1T7 Canada
Phone: 1-888-933-0383
Fax: (514) 931-5554
website: www.donaldsonmarphil.com
Contact: M. Michel Donaldson
donaldson.marphil@qc.aibn.com

Elekta Canada
114 Gartshore Drive
Whitby ON L1P 1N8 Canada
Phone: (514) 298-0744
Fax:
website: www.elekta.com
Contact: Mr. Jacques Verhees
jacques.verhees@elekta.com

Harpell Associates Inc.
1272 Speers Rd, Unit 2
Oakville ON L6L 2X4 Canada
Phone: (905) 825-2588
Fax: (905) 825-0234
website: www.harpellassociates.com
Contact: Mr. David Harpell, P.Eng.
David@harpellassociates.com

Hilferdine Scientific Inc.
85 Denzil Doyle Court
Kanata ON K2M 2G8 Canada
Phone: (613) 591-5220
Fax: (613) 591-0713
website: www3.sympatico.ca/hilferdine
Contact: Mr. Sean Eckford
hilferdine@sympatico.ca

Landauer, Inc.
2 Science Road
Glenwood IL 60425 USA
Phone: (708) 755-7000
Fax: (708) 755-7016
website: www.landauerinc.com
Contact: Mr. William Megale
sales@landauerinc.com

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naj@lap-laser.com

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447 March Road
Kanata ON K2K 1X8 Canada
Phone: (800) 465-3666
Fax: (613) 591-3705
website: www.mds.nordion.com
Contact: Mr. Peter D'Amico
pdamico@mds.nordion.com

Mentor Medical Systems Canada
1333 Boundary Rd, Unit 10
Oshawa ON L1J 6Z7 Canada
Phone: (800) 668-6069
Fax: (905) 725-7340
website: www.mentorcanada.com
Contact: Mr. Norm LeRoux
nleroux@mentorcanada.com

Modus Medical Devices Inc
17 Masonville Crescent
London ON N5X 3T1 Canada
Phone: (519) 438-2409
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website: www.modusmed.com
Contact: Mr. John Miller
jmiller@modusmed.com

PTW-New York Corporation
201 Park Avenue
Hicksville NY 11801 USA
Phone: (516) 827-3181
Fax: (516) 827-3184
website: www.ptwny.com
Contact: Mr. Steve Szeglin
ptw@ptwny.com

Scanditronix Wellhofer North America
3150 Stage Post Drive, Ste 110
Bartlett TN 38133 USA
Phone: (901) 386-2242
Fax: (901) 382-9453
website: www.wellhofer.com
Contact: Mr. Dan Roberts
droberts@swna.org

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2185 Derry Road West
Mississauga ON L5N 7A6 Canada
Phone: (905) 819-5747
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website: www.siemens.ca
Contact: Ms. Fiona Lochray
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TENURE TRACK POSITION IN MEDICAL PHYSICS

Department of Physics and Astronomy

University of Victoria

The Department of Physics and Astronomy at the University of Victoria invites applications for a tenure-track position at the rank of Assistant Professor. We are looking for someone who will initiate an experimental program in the area of Medical Physics. Applicants are expected to possess an exceptionally strong and internationally recognized research record and outstanding promise for future research accomplishments. The successful candidate will have a commitment to graduate and undergraduate education, and will help to oversee our graduate program in Medical Physics. His or her work will be conducted in association with the staff of the BC Cancer Agency's Vancouver Island Centre (VIC), a state-of-the-art radiation therapy clinic; hence, the appointment must also be acceptable to the VIC. Involvement with the VIC will initially include some teaching and administrative relief.

At present, the Department of Physics and Astronomy consists of approximately 19 faculty members working primarily in the research areas of particle physics, astronomy/astrophysics, condensed matter physics, and ocean physics. The department has a successful and productive association with the near-by TRIUMF laboratory, whose applied programs include PET, medical isotope production, and proton irradiation therapy. See http://www.phys.uvic.ca for further information.

The University of Victoria is an equity employer and encourages applications from women, persons with disabilities, visible minorities, aboriginal peoples, people of all sexual orientations and genders, and others who may contribute to the further diversification of the University. All qualified candidates are encouraged to apply; however, in accordance with Canadian Immigration requirements, Canadians and permanent residents will be given priority.

Applications, including a curriculum vitae, publication list, statement of present and future research interests, and the names and addresses of at least three referees, should be sent to:
Dr. J. Michael Roney, Chair, Department of Physics and Astronomy,
University of Victoria, P.O. Box 3055 Stn Csc, Victoria, BC V8W 3P6, Canada

In order to be considered, applications must be received by the end of December, 2003. Initial starting date is expected to be July 1st, 2004.

At THE CREDIT VALLEY HOSPITAL, our value-centred leadership is based on respect and a dedication to excellence through understanding individual patient needs and the delivery of compassionate and expert care. We are embarking on a major development project to ensure we continue to meet the future needs of the community.

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Peel Regional Cancer Centre

Regular, Full Time

Position Summary

A key figure, you will play a major role in shaping the future of the startup and continuing operation of our radiation treatment program within our new Regional Cancer Centre set for completion in early 2005. A strategic thinker able to build toward an established vision, you will develop and coordinate the clinical support and academic activities of the physics and technical support team.

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With a Ph.D. in medical physics or directly related field, you have ten years experience in radiotherapy physics which includes expertise in machine commissioning, 3D treatment planning, HDR brachytherapy, and radiation safety. Ideally a member of the Canadian College of Physicists in Medicine, or equivalent, you have outstanding leadership, interpersonal, and organizational skills.

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If you are interested in helping shape the future of radiotherapy physics at a new, innovative, comprehensive cancer centre, please send your curriculum vitae and the name of three references by **November 30, 2003** to:

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Fax: (905)813-2280, Email: hr@cvh.on.ca

BC Cancer Agency
CARE & RESEARCH

MEDICAL PHYSICIST POSITIONS

The Vancouver Centre of the BC Cancer Agency is currently seeking to recruit Medical Physicists interested in providing clinical physics services to radiotherapy.

The British Columbia Cancer Agency is a multi-disciplinary diagnostic, treatment and research centre dedicated to cancer care of the highest quality. The Vancouver Centre treats approximately 3800 radiotherapy patients annually and has 7 linacs, most of these with multileaf collimation and portal imaging, a cobalt unit, two CT simulators, a conventional simulator, LDR and HDR afterloading units, well-equipped machine and electronic shops, and a multi-workstation treatment planning system. Clinical programs in stereotactic radiosurgery, IMRT, ultrasound-guided prostate brachytherapy, and proton therapy are offered. There is also an active academic program affiliated with UBC. An attractive salary and benefits package is offered.

Medical Physicist duties include participation in service to the various clinical programs, as well as treatment planning support and selecting, acceptance testing, commissioning and calibrating radiotherapy equipment. Opportunities are also available to participate in the development of new radiotherapy techniques and the introduction of new technologies.

Suitably qualified candidates can obtain an academic appointment at the University of British Columbia and supervise graduate students. Teaching opportunities also exist in the Radiation Oncology residency training program at the BC Cancer Agency and the Radiation Therapy Program at the British Columbia Institute of Technology.

The successful candidates should have a Ph.D. (preferred) or M.Sc. degree in Medical Physics or a related field, and a minimum of two years clinical experience. Preference will be given to those with certification by the Canadian College of Physicists in Medicine (or equivalent).

In accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. We thank all those who apply, but only candidates chosen for interview will be contacted.

If you are interested in joining our team, please send your current CV to:

Dr. Ingrid Spadinger

Interim Professional Practice Leader

Medical Physics
BC Cancer Agency
Vancouver Center
600 West 10th Avenue
Vancouver, BC, V5Z 4E6

Ph. (604) 877-6000, local 2027
Fax: 604 877-6059
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THE UNIVERSITY OF LETHBRIDGE

Department of Physics

CANADA RESEARCH CHAIR

The Department of Physics at the University of Lethbridge is pleased to announce the search for a CRC Chair, of Tier 2 type (see http://www.chairs.gc.ca), in the general area of hyperspectral imaging. Possible specific research subjects include: experimental astrophysics, infrared imaging spectroscopy, aeronomy, remote sensing, environmental monitoring, and medical imaging. We invite applications from individuals with the promise of leadership in their field.

Among primarily undergraduate universities in Canada, Lethbridge is consistently top-ranked in NSERC-funded research. For information on our department, see http://home.uleth.ca/phy/. Potential sources of research funding for the successful applicants include the Natural Sciences and Engineering Research Council, the Canada Foundation for Innovation, and the Alberta Ingenuity Fund.

The successful candidate will become part of the University's proposed Hyperspectral Imaging Laboratory, to be built on the success of the U of L Astronomical Instrumentation Group (see http://home.uleth.ca/phy/naylor/). The University wishes to expand in this area of expertise and to form one of the leading Canadian centres in the emerging field of hyperspectral imaging.

The candidates will be judged primarily on excellence in research and on their teaching potential. Applicants should submit a curriculum vitae that includes a list of publications, a research plan, a short statement of teaching philosophy, and must arrange for three letters of recommendation to be sent to: **Professor Mark Walton, Chair, Department of Physics, The University of Lethbridge, Lethbridge, Alberta T1K 3M4, Canada.** We will begin to consider complete applications **September 15, 2003**, and the search will continue until the positions are filled.

All qualified candidates are encouraged to apply; however, Canadians and Permanent Residents will be considered first for the positions. The University of Lethbridge is an equal opportunity employer.


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