Radiology Letter

A Radiologist's Approach to Imaging Vistas — *Stony Brook University*

Spring 2002

Ultrasound in the Department of Radiology: *An Update*

By Matthew Rifkin, M.D.,
Professor and Vice Chairman
Chief, Division of Diagnostic Radiology
Chief Division of Cross-sectional Imaging

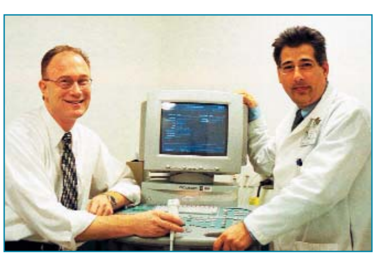
Dr. Matthew Rifkin

The use of diagnostic ultrasound other than conventional radiology is one of the oldest imaging techniques, first introduced in the late 1950s and early 1960s. It is also the first and least expensive of the more advanced cross-sectional imaging techniques that include CT and MRI. In spite of the significant technological advances and developments in CT and MRI, ultrasound continues to be an important tool in diagnostic imaging. The Ultrasound Section of the Cross-sectional and Body Imaging Service has grown significantly and undergone major changes in the course of the past few years.

The Cross-sectional Imaging Service, which until recently had been dispersed throughout the Radiology Department, has been reorganized. All images related to cross-sectional imaging of the body are now viewed in a single reading room where all of the cross-sectional imaging physicians gather to interpret studies and consult with the clinicians of the patient care services. This simplifies the clinician's needs to obtain information and review the patients' cases in a more timely and coherent fashion.

Within the physical structure of the old ultrasound scanning area, a single reading room has been developed to accommodate ultrasound interpretations, the Body CT Service and the Body MRI Service. Musculoskeletal MRI has been moved to the musculoskeletal reading area in the central core of the Radiology Department.

In addition to the interpretation and consult area for body imaging, the Ultrasound Section has been revamped with a physical integration of the Vascular Lab of the Department of Surgery. The Ultrasound Section now includes eight diagnostic scanning rooms (six for Radiology and two for the Vascular Lab). Ultrasound has been fortunate to acquire four state-of-the-art ultrasound machines within the past two years and is in the midst of purchasing two additional state-of-the-art units in the coming months. This will make the University Hospital at Stony Brook Ultrasound Facility among the most modern ultrasound laboratories in the United States.



(l-r) Dr. Mark Wax and Dr. Eddie Fiore

Our physician staff has been relatively stable for many years. However, with increasing demands to perform far more imaging studies than we have done in the past, we have had to increase the number of our radiology attendings. We are fortunate to have been able to recruit a number of new faculty to our service.

Dr. Maryanna Mason joined our staff in January 2002. Dr. Mason, a Long Island native, was a fellow in the Cross-sectional Body Imaging Section at University Hospital at Stony Brook in 1996 to 1997 and joined our practice recently after spending a number of years in the community radiology service. She is a welcome addition, and we are all pleased to have her back on board.

Dr. Harris Cohen, a nationally known figure in Ultrasound and Pediatric Radiology, also joined our staff in the end of January 2002. Dr. Cohen also a Long Island native has spent many years on the faculty of both SUNY Downstate and North Shore University Hospital. Most recently, he was Chief of Pediatric Radiology at the Johns Hopkins Medical Institutions. Our community is indeed fortunate to have a physician of Dr. Cohen's caliber join our faculty.

Members of our ultrasound staff.

In addition to our new faculty, we are fortunate to still have a large number of our cross-sectional imaging faculty on board. These include:

Dr. Lucy van de Vegte completed her Cross-sectional Body Imaging fellowship at SUNY Stony Brook from 1986 to 1987 and has been on staff since that time. Dr. van de Vegte is Board Certified in Diagnostic Radiology and also in Pediatric Radiology.

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HIGHLIGHTS

STONY BROOK
STATE UNIVERSITY OF NEW YORK

Chairman's Corner

by Donald P. Harrington, M.D.

Please join me in welcoming three new faculty members — Harris Cohen, M.D., Maryanna Mason, M.D. and Mindy Scheer, D.O. Both Drs. Cohen and Mason join our faculty in the Division of Cross-Sectional Imaging, and Dr. Sheer in the Division of Diagnostic Radiology and Breast Imaging. Dr. Cohen is a Professor of Radiology and comes to us from Johns Hopkins Medical School in Baltimore, Maryland. Prior to that he was a tenured Professor at SUNY Downstate. His additional expertise in the area of Pediatric MRI and CT complements our Diagnostic Pediatric Section which is headed by the Director, Dr. Thomas Smith. As Vice Chairman of Research Activities, Dr. Cohen will assist me in the responsibility for the clinical research enterprise in radiology. Many of you remember Dr. Mason who was a fellow at Stony Brook several years ago. She comes to us from a private practice on Long Island and will assist in revamping our third and fourth year Medical Student Program. Dr. Sheer, a former fellow in Breast Imaging, also joins the faculty in the Division of Diagnostic Radiology and Breast Imaging.

As Chair, I am pleased to present to the community the publications and abstracts of our faculty and staff. Our faculty is strong academically and well regarded in their field of subspecialty radiology. Congratulations to our authors!

For the fiscal year 2002, we will near the 200,000 procedure plateau. When I came to Stony Brook as Chair in 1991, our annual number of procedures was 99,000 — a phenomenal growth in ten years. This has been predominately driven by the increase in imaging capabilities in the MRI and CT area and most recently, PET scanning.

With the changes in reimbursement to hospital-based facilities, the Department is opening a new state-of-the-art imaging facility in Lake Grove (across from the Smith Haven Mall). This facility will have both high-field and open MRI, CT and PET scanning capabilities in a modern customer service orientated private practice facility. A 3 Tesla MRI imager is being purchased — the first in Nassau and Suffolk County. In addition, our Research MRI Center will move to this location. More to come in the next issue...

Donald P. Harrington MD

THE RADIOLOGY LETTER

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Donald P. Harrington, M.D.	*Chairman*
Michael J. Cortegiano	*Administrator*
Christine R. Hubbard	*Editor and Staff Writer*

Research in Digital Mammography in the Department of Radiology

Research in the area of x-ray digital mammography has been established in the last two years in the Department of Radiology. A fortuitous confluence of expertise exists with Wei Zhao, Ph.D. an expert in flat panel detector technology, Gene Gindi, Ph.D. an expert in image processing aspects, and Paul Fisher, M.D. with vast experience in clinical mammography. Digital receptors of the sort being developed by Dr. Zhao, allow for the possibility of digitally manipulating the image to achieve certain goals impossible to do with film-based mammography. One such area being investigated is tomosynthetic and tomographic 3D mammography, wherein several views of the breast are taken over a large angular range, and the data combined using image processing algorithms to obtain a 3D reconstruction of the breast. The hope is that low contrast lesions not detectable on conventional mammography will be visible on resliced tomographic images. This work is being funded by a Carol Baldwin Foundation grant (Gene Gindi, PI), a grant from the Army DOD Breast Cancer Program (Wei Zhao, PI), and a grant from RSNA to Dr. Paul Fisher. Further development of Selenium-based flat panel detector technology is also being pursued by Dr. Zhao through a new grant with the Whitaker Foundation. The technical side of our research involves optimizing hardware aspects of the flat panel detectors, and developing sophisticated reconstruction algorithms for low-dose tomography.

(left to right) Wei Zhao, Ph.D., Paul Fisher, M.D., Gene Gindi, Ph.D.

Managed Care Update

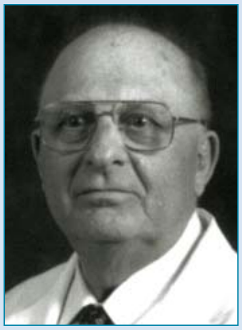
- Aetna Healthcare
- Aetna US Healthcare
- American Health Plan
- American Medical & Life
- Anthem Health
- APA Partners (formerly HHS)
- Beech Street
- BC/BS Managed Care Network (HealthChoice, Child Health Plus, Fed Emp, Empire Deluxe, Blue Choice Sr. Plan)
- Blue Cross/Blue Shield
- Cambridge
- CIGNA
- First Health
- GHI
- HealthFirst
- Health Net POS (formerly PHS)
- Heritage
- HIP (Hip Access & Hip VIP)
- Horizon
- Island Group Administrators
- J.J. Newman
- Local 1199 National Benefits Fund (Members Choice)
- Magna Care
- MDNY
- Medichoice
- Members Choice
- Metropolitan Empire
- Multiplan
- Oxford (Liberty and Freedom)
- SelectPRO
- Suffolk Health Plan
- Tricare
- United Healthcare
- US Healthcare
- Vytra Healthcare

New Faculty

Maryanna Mason, M.D. joined the faculty staff as an Assistant Professor of Clinical Radiology in the Division of Cross-sectional Imaging at the University Hospital. Dr. Mason received her medical degree from the New York Medical College in Valhalla, New York, followed by a Pathology internship at North Shore University Hospital in Manhasset, New York, and a Radiology residency at the Long Island Jewish Medical Center in New Hyde Park, New York. She completed a fellowship in Cross-sectional Imaging at Stony Brook. Previous appointments include an attending at South Shore Radiologists, PC and Good Samaritan Hospital located in West Islip, New York. Dr. Mason is Board Certified and is a member of the New York State Medical Society, Radiological Society of North America and American Roentgen Ray Society.

Harris L. Cohen, M.D. F.A.C.R. joined the faculty staff as Professor of Radiology, in the Division of Cross-sectional Imaging, Chief of Ultrasound, Chief of Pediatric Body Imaging and Vice Chairman of Research Activities. Dr. Cohen received his medical degree from the State University of New York (SUNY) - Downstate Medical Center, followed by a Medical internship at the Nassau County Medical Center, and a Diagnostic Radiology residency at SUNY - Downstate Medical Center in Brooklyn, New York. He completed a Diagnostic Radiology fellowship at the Childrens' Hospital-National Medical Center in Washington, D.C. Dr. Cohen's previous appointment was at the Johns Hopkins Medical School in Baltimore, Maryland where he was Visiting Professor of Radiology and Director, Division of Pediatric Imaging. Previous appointments include SUNY-Downstate Medical Center and Kings County Hospital in Brooklyn, New York where he was a tenured Professor of Radiology, Vice Chairman of Academic Affairs and Clinical Research Director, Division of Ultrasound and Co-Director, Division of Pediatric Imaging. He served as Medical Director of SUNY-Brooklyn's School of Ultrasound between 1985-1988 and 1993-2001. Prior to his appointment at the SUNY Downstate Medical Center, he was an Associate Professor of Radiology at Cornell University Medical College and served on the staff of North Shore University Hospital-Cornell University Medical College in Manhasset, New York as Associate Director of the Division of CT, US and MRI. Dr. Cohen is Board Certified in Diagnostic Radiology and has a Certificate of Added Qualifications in Pediatric Radiology. Dr. Cohen is a Fellow of the American College of Radiology, the American Institute of Ultrasound in Medicine, the Society of Radiologists in Ultrasound and the American Academy of Pediatrics. He is the author/editor of three Radiology textbooks, i.e. Obstetrics and Gynecology (Diagnostic Medical Sonography (2nd Ed.), Vol., Ultrasonography of the Prenatal and Neonatal Brain, and Fetal and Pediatric Ultrasound: A Casebook Approach. Dr. Cohen is editor-in-chief of the ACR Professional Self Evaluation "Syllabus" series and is a board examiner in Diagnostic Ultrasound.

Mindy Sheer, D.O. joined the faculty staff as an Assistant Professor of Clinical Radiology in the Division of Breast Imaging and Diagnostic Radiology. Dr. Sheer received her medical degree from the New York College of Osteopathic Medicine in Westbury, New York, followed by a Transitional internship at St. Barnabas Hospital in the Bronx, New York, and a Radiology residency at the Winthrop-University Hospital in Mineola, New York. She completed a fellowship in Breast Imaging at Stony Brook. Dr. Scheer is Board Certified and is a member of the Radiological Society of North American, American Roentgen Ray Society, American College of Radiology, American Osteopathic College of Radiology and American Osteopathic Association.



Congratulations to Zvi H. Oster, M.D. who has been selected as a recipient of the 2001 Radiology Editor's Recognition Award for reviewing with "Distinction" articles for the Radiology journal. Only 109 of approximately 800 reviewers were selected to receive this award. Names are listed in the 2002 issue of Radiology.

Research Activities in IRIS Laboratory (Part 3)

The Laboratory for Imaging Research and Informatics (IRIS: www.mipl.rad.sunysb.edu/micl), directed by Jerome Z. Liang, PhD, Professor of Radiology and Computer Science, has been conducting researches in Medical Imaging field ranging from image formation and processing to visualization. The objective of these researches is to develop technologies for image-based patient diagnosis, treatment planning and follow-up evaluation.

[A] Image Formation Related Researches:

Image formation aims to reconstruct an image of the inner organs of the body from acquired data of the patient. The acquired data can be any projections of the body, such as in computed tomography (CT), the encoded frequencies and phases of the water molecules inside the body, such as in magnetic resonance imaging (MRI), and etc.

(A.1) Quantitative Cerebral Perfusion Single Photon Emission Computed Tomography (SPECT):

SPECT utilizes radiotracers to label the tissue activities and provides functional information of the tissue or organ. Due to many factors, such as biological effect on tracer emission, Poisson noise of the emission, body absorption of the emission, detection errors, and etc, acquired data are heavily contaminated by these uncertainties. By currently available image formation methods, the reconstructed images from the acquired data look very noisy and blurred, see the middle of Figure 1, as compared to its phantom on the left. By modeling those factors into mathematical equations and solving the equations, we achieved a significant improvement, as shown on the right of that figure.

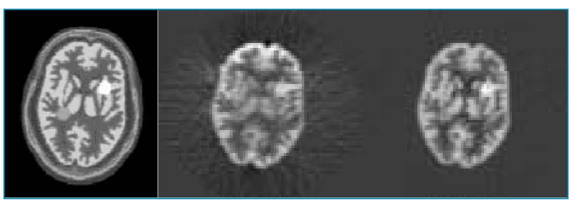


Figure 1: Comparison of our quantitative SPECT reconstruction (right) with the conventional reconstruction (middle) for the 3D Hoffman brain model (left). Our analytical approach achieved the quantitative reconstruction of 128x128x32 array size in less than 5 minutes by a HP/J210 desktop computer without transmission scan due to the unique head attenuation property (although transmission scans are usually required for photon attenuation compensation in SPECT).

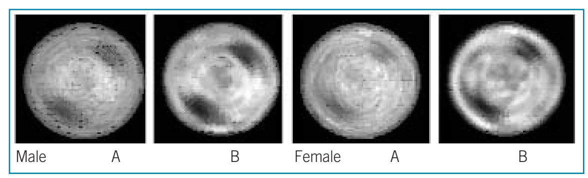
This project relies on the radioactive tracers to tag the cells' dynamic metabolism and, therefore, directly reflecting the cells' functions. The emission of the tracer is collected by a state-of-the-art detection system. The collected counts are then manipulated by a sophisticated image reconstruction to generate a volumetric image, which reflects the true tracer concentration in each image element or voxel. The task of achieving the quantitative measurement of the concentration is very challenging due to the low-count nature of SPECT modality. In addition, the emission information is contaminated by those degrading factors mentioned above. The image reconstruction algorithm must compensate for those factors accurately and efficiently to generate the image of the true concentration distribution. The compensation usually requires an attenuation map obtained by a CT-type transmission scan of the body. Our research focuses on the development of quantitative image reconstruction algorithms with improved or optimized data-collection geometry.

Another example is shown below.

(A.2) Quantitative Myocardial Perfusion SPECT:

According to American Heart Association statistics, more than 40% deaths annually are due to heart problems. Currently, the gold standard for chest pain evaluation in an emergency room is the rest/stress SPECT studies. We have spent, in the past years, a great effort on quantitative myocardial function imaging using SPECT modality. Our developed image reconstruction technique is quantitatively accurate, computational efficient, and statistically robust, see Figure 1 for cerebral perfusion study. An experimental study on myocardial perfusion is presented below.

A myocardial perfusion model was constructed by injecting adequate Tc-99m radiotracer solution into a plastic heart phantom with two defects reflecting variable myocardial malfunction. The heart was inserted into a plastic model of the human chest. Two chest models of male and female were used. From the acquired data by a SPECT system, both the conventional and our developed techniques were applied to reconstruct the images, as shown in Figure 2. Our goal is to show the robustness of our technique to the body characteristics, in addition to those degrading factors mentioned in (A.1).



The Bulleyes Display of the 3D Results

Figure 2: Top row are the results of current technology of the male (left) and female (right) models. The dependence on the body characteristics and the low resolution/contrast are seen (A). The improvement in resolution/contrast (B) is significant, which was accomplished in less than 15 minutes on a HP/735 desktop computer for 128 cubic size.

[B] Image Processing Related Researches:

Image processing aims to quantify useful features embedded inside the reconstructed images and present the features in various ways for user inspection to achieve a clinical task. The critical step in image processing is image segmentation, which labels different features or tissues in the images.

We have been developing image segmentation technology for many years for CT, MR and Ultrasound images. The developed techniques have been used to extract various features, such as colon lumen for virtual colonoscopy, blood vessel lumen for virtual angiography, spine for virtual myelography, small structures inside the temporal bone for surgical repair of congenital aural atresia, bladder lumen for virtual cystoscopy etc, as presented in the 2001 spring and fall issues. Another application for multiple sclerosis (MS) analysis is presented.

From acquired multi-spectral images of relaxation times T1 and T2 and proton density weighted scans, a series of image processing means, such as interpolation, noise reduction, resolution enhancement, and correction for radio frequency induced inhomogeneity, are applied prior to image segmentation. The segmentation step removes the skull/scalp and other non-brain tissues first, then estimates the parameters characterizing the tissue features, and finally groups the voxels of similar characteristics together for extraction of regions of interest (ROIs). The whole process is executed in a fully automated manner by a PC platform. Results of an example are shown by Figure 3.

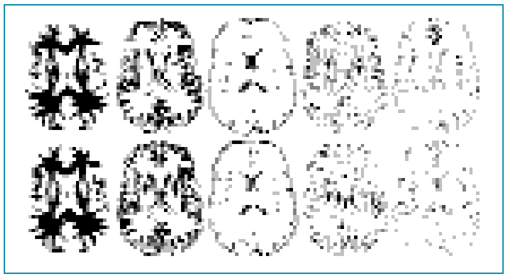


Figure 3: On the top are computerized mapping of white matter, gray matter, cerebrospinal fluid (CSF), mixture of white and gray matters, and mixture of gray matter and CSF from a set of T1, T2, and proton-density weighted MR images. On the bottom is the corresponding atlas from textbook, which were generated by neuroradiologists' drawing on the same set of MR images. Our computerized means performs comparatively to the experts' hand-drawing atlas.

From the segmentation, we extract the central CSF from the global CSF, in which some times a user interactive means is desired to edit on the segmentation, e.g., to include the fourth ventricle, see Figure 4.

A hypothesis is currently accepted that the decline rate of cognitive loss in MS is proportional to the brain atrophy with the central CSF as an important indicator. The correlation of our central CSF measure and the neuropsychological measure of brief repeatable battery (BRB) on MS patients is shown by Figure 5.

MS is a chronic, immune-mediated, demyelinating disease affecting the central nervous system. Approximately 80 to 100 per 100,000 people have MS in the United States, making it the most frequent cause of disability in early to middle adulthood other than trauma. Cognitive impairment affects approximately half (40-60%) of MS patients and exacts a tremendous socioeconomic and interpersonal toll on individuals with MS, their family members, and the health care system. Yet the cognitive problems are poorly understood. Our goal is to use MRI-based volumetric analysis to study the evolution of cognitive loss in MS and examine the correlates of cognitive decline rate over a three-year period or longer. Our findings will be directly relevant to the design of future clinical trials to arrest MS associated cognitive loss, and will inform patients, their families, and health care providers regarding the prognosis for cognitive functioning and related future health care needs.

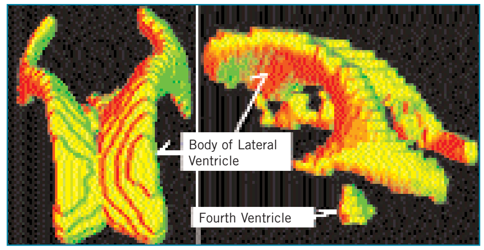


Figure 4: A 3D editing tool to tailor the fully automated segmentation results.

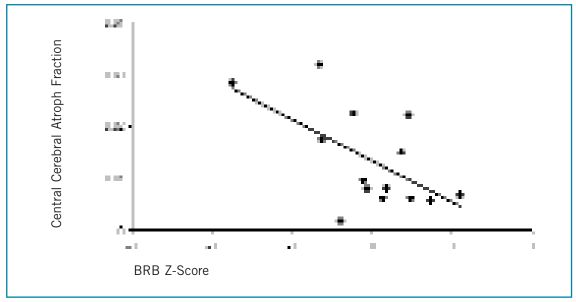


Figure 5: Correlation between BRB test and CCSF fraction measurement.

[C] Image Visualization Related Researches:

Currently, image visualization is based on either surface or volume rendering on the acquired 3D image. The surface-based rendering displays the boundary characteristics of a segmented ROI and can be in real time with hardware assistance, but lacks the information below the surface. Volume-based rendering projects a 3D image on to a 2D plan by a weighting along each view ray starting from the point of eye through the image volume. The weighting functional form is critically important for an accurate reflection of the true information. It is a very challenging research topic, in addition to the time consuming process of the ray tracing.

Based on our unique image segmentation of tissue mixture percentages within each voxel, rather than a label for that voxel, we can accurately capture the boundary characteristics of ROIs over a layer of voxels around the boundary, as well as the internal mixture features. These characteristics may be analyzed to reflect both the anatomical structure and growth tendency of the tissue type in the ROIs. These characterized features may be integrated into either surface- or volume-based rendering. An experiment was performed to show the feasibility of this innovative concept, see Figure 6.

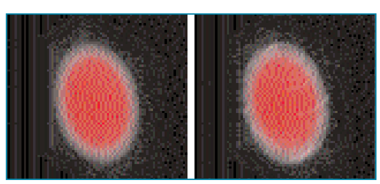


Figure 6: On the left is a rendering of a 3D object without the characterized features. On the right shows the features integrating into a 3D rendering of the same object, where the features were extracted from the mixture percentage segmentation within each voxel.

We hope that this innovative concept of feature-based rendering could provide a means to visualize both anatomical structure and growth tendency of a ROI, leading to differentiate the benign or malignancy of a detected abnormality.

Part 1 of these researches including virtual colonoscopy, surgical treatment planning, and virtual angiography was outlined in the 2001 spring issue.

Part 2 included virtual cystoscopy, virtual laryngoscopy, virtual bronchoscopy, and virtual myelography which was presented in the 2001 fall issue.

Grand Rounds

James Smirniotopoulos, M.D. presented a Grand Rounds on November 14, 2001 on "Meningioma". Dr. Smirniotopoulos is Chairman and Professor of Radiology and Nuclear Medicine, Professor of Neurology and Biomedical Informatics at the Uniformed Services University of the Health Sciences in Bethesda, Maryland.

Kenneth J. W. Taylor, M.D., Ph.D. presented a Grand Rounds on December 11, 2001 on "Carotid Ultrasound: Techniques, Pitfalls and Results". Dr. Taylor is Professor of Radiology, Surgery and OB/GYN, Department of Diagnostic Radiology and Director of Vascular Laboratory at the Yale University in New Haven, Connecticut.

Georgeann McGuinness, M.D. presented a Grand Rounds on January 18, 2002 on "High Resolution CT: Pattern Recognition and Clinical Applications". Dr. McGuinness is an Associate Professor of Radiology in the Division of Thoracic Radiology at the New York University Medical Center in New York, New York.

Harry Agress, Jr., M.D. presented a Grand Rounds on March 12, 2002 on "Role of PET Scan in Lung Cancer Evaluation". Dr. Agress is an Associate Clinical Professor, Chief, Division of Nuclear Medicine, Senior Attending Radiologist at the Hackensack University Hospital and Medical Center in Hackensack, New Jersey.

Ultrasound in the Department of Radiology

Continued from cover

Dr. Mark Wax has been on staff for a number of years and is a major presence in body CT. He completed his fellowship in body imaging at the Brigham and Women's Hospital. Dr. Wax's major interest has been in 3D CT and in particular, virtual colonoscopy. He has been actively pursuing research in this area, which is now an accepted clinical approach to evaluating the colon. He has been working with Viotronics, a company with facilities in the SUNY Incubator.

Dr. Erica Posniak completed her Cross-sectional fellowship at the University of Colorado in 1987 and has been on staff since that time. Dr. Posniak recently resigned from her part-time appointment at the Northport VA Medical Center and has since returned to University Hospital.

Dr. Roxanne Palermo was a resident at University Hospital at Stony Brook from 1995 –1999 and completed her fellowship in body imaging at the Mt. Sinai Hospital in Manhattan. She has been on staff for the past year, splitting her time between body imaging and mammography.

Dr. Eddie Fiore is joining our faculty in the end of the summer, 2002, after completing his Body Imaging fellowship at University Hospital in Stony Brook. Dr. Fiore will be splitting his clinical time between the hospital practice and our soon to be open imaging center.

Dr. Matthew Rifkin completed his fellowship in body imaging at the Johns Hopkins Medical Institutions. He joined the faculty at Stony Brook 3-1/2 years ago after spending time on the faculties of the Jefferson Medical College and the Albany Medical College. He assumed the position of head of the Body Imaging Service over one year ago.

The Ultrasound Section is also indeed fortunate to have a stable group of registered sonographers who provide the technical expertise for our excellent technique. Ms. Christine Gottesman, the lead technologist for the service has worked with us since 1991. Ms. Lydia Johnson has been in our Ultrasound Section since 1987. Both Ms. Linda Kraft-Randell and Ms. Irin Shoyket began in 1991 and Ms. Kerry Mignone started scanning with us in 1994. Our newest additions are Ms. Celeste Gorrono who began in 1999 and Ms. Greta Walker-Ametewee who started with us in January 2000. With the addition of Ms. Gorrono and Ms. Walker-Amatewee, the Ultrasound Section now provides technologist in-house support and ultrasound scanning 7 days a week, 16 hours/day.

All of us in the Ultrasound Section are pleased that we are able to provide modern, state-of-the-art ultrasound for our patients. We are committed to the highest quality ultrasound imaging available and look forward to serving all of our communities' needs.

An ultrasound exam being performed using one of newest state-of-the-art equipment and experienced staff .

Radiology Publications 2000-2001

Publications 2000

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