BMETS Newsletter

September 2008

http://www.BMETS. org

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The President's Thoughts

I don't know how to begin after reading Chris's dissertation of "war and Peace". I am excited about the 25th anniversary and what the organization has accomplished and the new agenda we have set forth (scholarship, credit card use for payment and the expanded web page). I second everything Chris said (there I did it in a sentence lol).

My hope is to get all we want accomplished in my 3rd term as we have a lot to get done, and to honor those who have served at the anniversary celebration. My overall goal is to get the membership to step up and take a look at where they want our organization to go and maybe apply for a officers position(oh I said it). I will serve if elected a 4th term but I want to give the opportunity to anybody that wants to serve—an invitation to please apply. I have been honored and humbled by the support and input of the membership and in my 28 years as a Biomed, this has been the best 3 years of my career. Thanks to all.

Respectfully,
Rob Bain MS, CBET
President BMETS

Rob Bain

List of Members that Donated to the BMETS Scholarship Fund This Month

Allen Hoffman

The Vice President's Quill

Ladies and Gentleman of the Baltimore Medical Engineers and Technicians Society Welcome to the 25th Anniversary of our organization; I am privileged to be the Vice President at this time and date in the organizations history. While reading thru all the Newsletters that Roy Shipley handed to me some months ago, I came across several newsletters with past history lessons that are still pertinent today as they were during their reprint. I found out that the Executive Committee – the Officers – back in 1987 – 1988 decided to purchase a computer and a printer for the Secretary to use for the record keeping of the membership and to provide a monthly newsletter. The Officers requested from the members Tech Notes, information to pass on to the members of what has been learned, reminding us what we still need to learn, and other items with in the pages to support the organization, the members and the community over all. In that light during my search I found 4 months worth of interesting information back in 1993 – 1994 time frame when Steve Davis was the Secretary (I don't know the person, nor have I ever heard of him. I know I would like to meet him at the Party, if he shows up), he added in the Newsletter from November 93 till Feb 94 and some months after that a column called "Tek Notes". Read my **Tad Bit of History** for this month to find out what was in that column. Let me know what you think at the Party.

Speaking of the Party, I hope and pray that all of you out there (minus some VIP's) have turned in your membership to our Treasurer "Victoria Chapman"; yes, she has returned to fill in for the retired Ralph Wells, Sr. – who is missed for the forward thinking process on several issues with B.M.E.T.S. If you have not filled out your membership for the 2008 – 2009 year, please do so before September 12, 2008 make sure it gets to Vickie so that way you will be able to walk right in the door. Else members will have to pay their dues at the door. Did I mention VIP's well, Yes, I did. One of the people I have invited to our little party was the Governor of our fine State; Honorable Martin O'Malley to our celebration party; I have not heard from his office as of the writing of my article; Rick Schrenker – one of the Founding Father's will be here, Frank Wienberg (unknown at this time), and other VIP's that have not made it across my desk yet.

Let us welcome and greet these special people with warm hugs, a hearty hand shake, and a cold beer. Rob and I have a few things planned during the party so be prepared for almost anything.

Chris Jones, Sr.

I would like to thank several people that have not gotten the thanks they should get; my first thanks is to Frank, Rick, and Ethan for having the forward thinking idea to start this organization we belong, All the Past Presidents, Vice presidents, Treasurer's and Secretaries, and even the Web Master (Where are you Rich!!), Thank you Roy Shipley for trusting me with the copies of the Newsletters – the cats have not used them, the dog has not eat them yet. Most of all I would like to thank the membership for allowing this humble servant to embellish his wisdom and knowledge, great speaking ability, and his sense of humor to be heard during all those monthly meetings – Ok you all can stop laughing now, get back in your seats and go back to work.

See you at the Party! God I love this job!!

Chris Jones, Sr. MCP CPACS Assoc.

Vice President B.M.E.T.S.

BMETS

Baltimore Medical Engineers and Technicians Society

Application for Individual Membership

Full Name: ____
Address: ____
City: ____ State: ____________ Zip: ___________-________
Job Title or Expertise: ____
Health Care Facility or Business: ____
Business Phone: (_____) __________________ Fax Number: (_____) ___________________
E-Mail Address: ____

	Check Box	
$45 *†		Regular - Clinical engineers, biomedical engineers, biomedical equipment technicians, or managers and supervisors employed by a hospital, educational institution, manufacturer, or shared service, and actively involved in the field of biomedical instrumentation or engineering.
$45 *†		BMET Associate - A classification that allows individuals directly working with the field to participate in the areas defined by the bylaws.
$45 *†		Associate - Individuals interested in joining the Society but not qualified for membership in another classification.
amount		Scholarship Fund – I wish to donate $________.____ to the BMETS Scholarship fund
///////////	///////	//
Free † Circle choice		Retired - Individuals who have been qualified for regular membership but are now retired from employment. Student - **Full-time** student of Howard County Community College, Johnson Technical Institute, and ECPI in a clinical engineering, biomedical technology Active Military – Reserves or National Guard
$200	/////// /////// ///////	**(see Web Site for Corporate Membership Application.)** Corporate - Any Hospital, Educational Institution, Equipment manufacturer, or Independent Service organization with more than one person to join. Corporations may register up to 5 individuals for $200.00

Newsletters are sent in an e-mail format ONLY? (Make sure your email is entered above.)

May we publish all this information in the BMETS Directory? ____Yes ____No

Are you willing to serve as a: ____BMETS Officer? ____ Committee Member?

________RSVP for September 18, 2008, 25 Year Anniversary Celebration Dinner, Thursday, 6-10 pm

Signed: ______________________________________ Dated: ___________________________________

Mail to: Vickie Chapman, 7279 Procopio Cir., Columbia, MD 21046

NOTE: The Corporate Membership is a separate membership form located on the B.M.E.T.S. web site listed below.

† Your application is subject to acceptance by the Membership Committee.

Website: www.BMETS.org

Class 1 Recall: Levitronix CentriMag Extracorporeal Blood Pumping System; CentriMag Primary Console (with v200 Application Software On Board)

Date Recall Initiated March 17, 2008

Audience: Cardiothoracic healthcare professionals, perfusionists, hospital risk managers, biomedical engineers

Product: Levitronix CentriMag Extracorporeal Blood Pumping System and Primary & Backup Consoles (manufactured by Levitronix, GmbH, Zurich, Switzerland).

The product is distributed from the manufacturer in Switzerland to distributors world-wide including the United States. The company manufactured and distributed these products from January, 2001 through March, 2008.

Use: The CentriMag Blood Pumping System (consisting of the blood pump and console) is used to provide short-term (up to six hours) extracorporeal (that is, outside the body) circulatory support during cardiac and other types of surgeries such as liver transplants. This device temporarily replaces the function of the heart and lungs in order to maintain the appropriate circulation of blood and oxygen levels in the body during the surgical procedure.

Recalling Firm: Levitronix, Inc.
45 First Avenue
Waltham, Massachusetts 02451

Reason for Recall: Use of the Valleylab Force FX-C or Valleylab SSE2L with the CentriMag Blood Pumping System may result in stoppage of the pump and may cause serious injury or death.

Public Contact: Patients with questions or concerns may call Levitronix at 1-866-487-2837.

FDA District: New England
FDA Comment: Levitronix issued a voluntary device correction letter on March 17, 2008, to its U.S. distributor and requested that they contact their customers. On July 24, 2008, the firm updated their March 17, 2008, correction letter.

The Revised Letter : informed Levitronix customers not to use Valleylab Force FX-C or SSE2L electrosurgery device with the firm's CentriMag Blood Pumping System; and, included a new warning related to the use of the Valleylab device .

This recall action is an interim fix while the firm further investigates the source of the problem.

For more information about this recall, please see the company's website at : http://www.levitronix.com/Documents/Medical_us/Dear_Doctor-Final.pdf

Calendar of Events
Check the Web Page for Updates

September 18 — 25th Anniversary Celebration

October 16 — Monthly Meeting—Topic, Speaker, Place to be announced later

November 19 — Monthly Meeting—Topic, Speaker, Place to be announced later

B.M.E.T.S- "25th Year Anniversary Celebration Dinner"

* Not many Organizations make it to this milestone "Let's Celebrate"

Date: September 18th, 2008
Time: 6 p.m.
Location: Town & Country Caterers. http://www.town-countrycaterers.com
2319 Hammonds Ferry Road, Baltimore, Maryland, 21227

Members Event -(2008-2009 Membership year). Free for BMET members—Guest Fee $30.00
Membership dues may be paid at door or received by BMETS Treasurer, prior to September 12th, 2008, for access to event. "No Exceptions".

RSVP is still required by 9/12/08.

Send RSVP after you have paid your membership dues for 2008-2009 membership year.

"Bull and Shrimp Feast"
Menu to follow on separate flyer.

Beer, wine and soda included (mixed drinks by cash bar).

Vendor Sponsored Event - No Formal Presentation.
As of May 1st, vendors sponsoring event:

* 1st Call BioMedicial,Inc.
* Destiny Surgical Products/Skytron
* Strickler Medical,Inc.
* Fluke BioMedical
* Trisonics

Brian Zelubowski

25th year Anniversary Celebration Chairman

Tools of the Trade

The Most Complete Evaluation and Control Portable Tool

The Rigel 355 is a unique hand-held ventilator tester for both adult and pediatric ventilators. The Rigel 355 offers highly accurate measurements of: Respiration Frequency, Tidal volume, Maximum Pressure, Minimum Pressure, Ventilation, Expiratory average flow, Inspiratory average flow and Ratio I /E.

The Rigel 355 has a build-in dynamic memory to store performance graphs for download to your PC. When used with the included RESPI software, the Rigel 355 offers a full stand-alone ventilator test system which provides real time graphs on your PC.

The RESPI software provides additional parameters such as: Maximum Expiratory Flow, Tidal Volume of Inspiratory and Expiratory, Inspiratory Average Pressure, PEEP, Index of Internal and External Resistance, Resistance and Compliance of the Passive lung, Inspiratory and Expiratory Time.

Hand-Held	Pediatric and Adult Ventilation
Battery Powered	Large LCD display

http://www.rigelmedical.com/products/rigel_355.asp

BMETS Web Site Statistics

August 2008 = 29821 Total Hits

July 2008 = 18999 Total Hits

June 2008 = 28174 Total Hits

BMETS Monthly Meeting Sponsors for 2008

Axess ULTRASOUND

For ultrasound parts, probes, or service, call 1-800-248-4153.
EVERYTHING ULTRASOUND

http://www.axessultrasound.com/

Richardson Electronics

http://www.rell.com

RSTI

http://www.rsti-training.com/

SKYTRON

http://www.skytron.us/

FLUKE Biomedical

http://global.flukebiomedical.com/busen/home/default.htm

echoserve

http://www.echoserve.com

GLOBESTAR SYSTEMS

http://www.globestar.com

Tad Bit of History

By Chris Jones, Sr., Vice President

From the Past:

It started in November's issue in 1993, it was called "Steve's Tek-Notes" and at that time Steven Davis, CBET was the Secretary of the Baltimore Medical Engineers and Technicians Society. During the next four months of the Newsletter, he put out information to the society about a new technology that in 1993 was out there, but not really well known. Do I have your peaked interest now? Good, the technology he discusses is "Magnetic Resonance Imaging" MRI. The following is taken from those four months worth of information, *BMETS Newsletter*, Volumes 11, Number 3 thru 6, November, December 1993 and January and February 1994.

"*Magnetic Resonance Imaging (Part I)*"

MRI has emerged as a powerful medical diagnostic imaging modality in most medical centers and larger hospitals. As biomedical equipment technicians (BMETs), you should understand the basic physical principles of MRI, the types of equipment used to apply these principles, and the diagnostic strengths of the MRI image.

The next few news letters will contain a series of articles designed to give you the basic understanding. This article provides an overview of the MRI process and explains some of the basic principles of the technology.

Overview

An MRI system is a device that produces two and three dimensional images of normal and pathological anatomy and physiology. A patient is placed within the bore of the powerful tunnel-like magnet which causes the magnetic movement of atomic nuclei to align with the direction of the external magnetic field. A radio-frequency (RF) pulse sequence is then transmitted through an antenna coil to the patient which upsets the uniformity of the alignment. When the RF sequence is completed, the protons relax and emit minute RF signals characteristic of proton density and distribution. These RF signals are received by a sensitive antenna coil, and the frequency distribution is processed and transformed to create and image. This image is representative of the anatomy and physiology of the tissue of interest. MRI complements other imaging modalities such as x-ray, Fluoroscopy, and Computed Tomography (CT) by providing superior images of the cranial contents, spinal column/spinal cord, liver, and the genitourinary system while avoiding the hazards associated with ionizing radiation.

MRI at the Atomic Level

Any atomic nucleus which possesses a magnetic movement will attempt to align itself with an externally applied magnetic field. In the human body, hydrogen is the most abundant nucleus with this property. The nucleus of the hydrogen atom contains one proton and not neutrons. Because of its abundance in water and most organic molecules, information on the distribution and relative mobility of individual hydrogen nuclei with in the tissue can be used to construct images.

Tad Bit of History

Steve's Tek-Notes, Excerpts from BMETS newsletter, Nov 1993—Feb 1994

The single-proton hydrogen nucleus is constantly spinning. Combined with its electrical charge, this spinning creates a magnetic dipole similar to a microscopic bar magnet. When these spinning protons are introduced to the external magnetic field, they attempt to align themselves by precessing. Precessing is defined as a slow gyration of the axis of rotation of a spinning body. More specifically, the axis of rotation of the proton tends to wander and trace out a circle. The vector sum of individual magnetic dipoles results in a net magnetization vector parallel to the external magnetic field. RF pulses, with frequency equal to the angular velocity of precession, are then applied to create a transient magnetic field perpendicular to the main external field. The precessing protons absorb this RF energy and are forced to a higher energy state. This causes a tip of the net magnetization vector's axis of precession. These are a decrease in the longitudinal component and creation of a transverse component. The profile of the RF pulse sequence can be set to tip the vector by any number of degrees. Once the RF pulse is removed, the nuclei relax in a two-fold process: (1) they release RF energy that is transferred as a very small amount of heat to surrounding molecules, and (2) they return to the lower energy state, which restores the axis of the net magnetization vector parallel to the external field. The longitudinal component of the net magnetization vector increases to its original size, constant T1, the longitudinal relaxation time, is the time required for the net magnetization vector to return to its maximum value in the direction of the external field. The time constant T2, the transverse relaxation time, represents the decay of the transverse component of the proton.

This concludes the overview of the MRI process and the first details of the basic physics. Future newsletters will explain basic physics, discuss various sub-systems which comprise the complete MRI system, compare and contrast MRI to other imaging modalities and discuss current technology trends.

"***Magnetic Resonance Imaging: MRI Concepts and Principles (Part II)***"

In Part I of this series, I provided an overview of the MRI process and began an explanation of the basic physics and illustrated how an image is produced based on the principles presented.

Physics of the Image

A key principle in the generation of MRI images is the alignment of protons. When exposed to a strong magnetic field, protons tend to align with that field in a state of relaxation. When these protons are excited by the introduction of a radio-frequency (RF) energy, they precess out of alignment and enter an excited state. When the RF energy is terminated, the protons return to the relaxed state in alignment with the external magnetic field, and give up the energy they held in the excited state. It is the relaxation or return to alignment by the excited proton that we will focus on to gain an understanding of how MRI differentiates between various tissues.

Tad Bit of History

Steve's Tek-Notes, Excerpts from BMETS newsletter, Nov 1993—Feb 1994

Primary MRI Parameters

Proton relaxation occurs at a rate that has time constants associated with: (1) the time it takes the protons to return to the relaxed state, and (2) the time it takes the protons to lose phase coherence. (This latter requires an in-depth explanation which goes beyond the scope of this series). Specific names are given to these two time constants whose values are characteristic of a particular tissue. These time constants are:

T1 – The longitudinal relaxation time. It is seen as the regrowth of the magnetization vector component in the Z-Pane.

T2 – The transverse relaxation time. It is seen as the decay of the magnetization vector component in the XY-Plane.

By knowing the values of a tissue's specific T1 and T2, you can further differentiate between tissues when using a combination of the two properties. This can be accomplished by generating a pulse cycle which takes advantage of one or the other properties. These are called T1 and T2 weighted images. Before proceeding further, let's explore the composition of the MRI pulse cycle. Basically, it's very simple. First, a pulse is generated at the pre-determined frequency. The system then waits for the return signal (echo) as the protons return to relaxation, and then another pulse is generated. Two time intervals result from this cycle:

TR – the time interval between two successive pulse cycles; i.e. "Time to Repeat" (Usually measured in milliseconds).

TE – the time interval from one pulse to the measurement of the echo signal; i.e. "Time to Echo".

By varying the values of TR and TE, we can create images which are either T1 weighted or T2 weighted. To produce T1 weighted imagines, we use a short TE to eliminate the impact of the T2 properties, and a short TR so the effects of the T1 properties are not eliminated. To produce a T2 weighted image, we use a long TR to eliminate the T1 effects, and a long TE so the contribution of the T2 is not eliminated. It is important to recognize that there is no distinct definition of T1 or T2 weighting; however, the spectrum between the two is continuous – any combination of TR and TE can be selected. Knowing the tissue characteristics of T1 and T2, and having an idea of what you are trying to image allows you to select the proper values of TR and TE to yield a relatively T1 or T2 weighted image. The last parameter of MRI is spin density. Very often, MRI scans will use a TR and TE, which eliminates the effects of both T1 and T2. The only remaining factor to influence the contrast of the image is the density of protons in the region of interest (the concentration of free hydrogen). Spin density images use a long TR and a short TE to eliminate the effects of both T1 and T2.

Tad Bit of History

Steve's Tek-Notes, Excerpts from BMETS newsletter, Nov 1993—Feb 1994

In summary, the three main parameters of MRI are T1, T2, and spin density. The creation of MRI images is weighted toward either of these parameters to take advantage of the physical property of a specific tissue that will aid in its imaging. The weighting of the images is accomplished by varying the TE and TR associated with the pulse trains used to excite the protons. The differences in these three primary MRI parameters are responsible for the differences in contrast between tissues and disease processes seen in MRI images.

The next article of this series will explore the mechanics of how this raw data is transformed into useful information, or a "slice" image.

"Magnetic Resonance Imaging: Concepts and Principles (Part III)"

In Part I and II of this series, I provided an overview of the MRI process and explored the basic physics of the images. I also explained why different tissues appear as different intensities in the image. This article will explain how these different intensities are isolated in three-dimensional space to produce a two-dimensional image.

Gradients

The MRI process acquires a set of two-dimensional image planes through a volume of tissue. Each image plane contains intensities located by an "X" and "Y" coordinates. The entire volume of tissue can be represented by "stacking" multiple image planes. Therefore, data representing any tissue volume element is defined by its "X" and "Y" coordinates with in the image plane, as well as its location along a "Z" axis representing its position in the "stack".

MRI uses gradients to locate points in space on the three coordinate axes. A gradient is a quantitative change in a variable from one point in space to another. The slope of a hill is an example of a gradient; the height changes along a certain direction. MRI uses gradient magnetic fields oriented along the three major orthogonal planes in space to establish a coordinate system. A gradient is imposed in each direction causing the field strength to vary linearly along the length of the field. The "Slice select" or "Z" gradient is used to locate the level of position of each of the planes in the stack, while the "frequency" or "X" gradient and "phase encoding" or "Y" gradient are used to locate points of intensity within each plane. These magnetic field gradients are not continuously active, but are briefly turned on at various points during the pulse cycle.

Tad Bit of History

Steve's Tek-Notes, Excerpts from BMETS newsletter, Nov 1993—Feb 1994

The Slice Select Gradient

The slice select gradient imposes a gradual change in the main external magnetic field from the head to the foot of the patient during the application of radio-frequency (RF) pulses. It is created by adding an additional set of coils to the ones that produce the main field. Since the frequency of precession of individual proton magnetization vectors is directly proportional to the strength of the applied magnetic field, and the magnetic field varies linearly along the "Z" axis, the frequency of the RF pulse sequence must match the frequency of precession of the protons in order to excite the protons to a higher energy state.

Therefore, we can "select" a tissue slice at any point along the "Z" axis by simply tuning the frequency of the RF pulse to match the precessional frequency of the protons contained in that slice. In practices, a range of RF frequencies is used, which allows us to define a finite image slice thickness. Slice thickness can also be modified by changing the slope of the "A" gradient. The steeper the "A" gradient, the thinner the image slice.

The Frequency Encoding Gradient

A magnetic field gradient applied in the direction of the "X" axis (across the patient) during signal measurement is known as the frequency encoding gradient. This causes the precessional frequency of the tissue protons to vary linearly across the patient, resulting in "columns" of proton magnetization vectors processing at different rates. Although the resultant signal measured by the receiver coils is a sum of the signals from all protons with in the slice, information necessary to reconstruct the image is extracted through complex frequency analysis that is beyond the scope of this series.

"Magnetic Resonance Imaging: Concepts and Principles (Part IV)"

In Parts I, II, and III of this series, I provided an overview of the MRI process, explored the basic physics, learned why different tissues appear as different intensities in the image, and explained how the raw data is isolated in three-dimensional space to produce a two-dimensional image. In this article, I will discuss the typical subsystems of an MRI in terms of hardware and function. The block diagram shows the subsystem associated with a typical MRI system. [1]

Tad Bit of History

Steve's Tek-Notes, Excerpts from BMETS newsletter, Nov 1993—Feb 1994

The Magnet

Modern MRI systems use either permanent magnets or superconducting electromagnets. The permanent magnet type MRI scanner uses a horseshoe magnet with the north and south poles configured so they face each other. This results in a magnet field that runs through the patient in an antero-posterior direction. Superconducting electromagnets consist of niobium-titanium alloy wire wound in a tight helical coil. When current passes through the coiled wire, a magnetic field is generated parallel to the long axis of the coil. Due to the natural resistance of the wire, the current generates large amounts of heat. For a given coil, the larger the current, the larger the magnetic field. To prevent the resistive heating, the coil is immersed in liquid helium at a temperature of -270 degrees C (-474 degrees F). At this temperature, niobium-titanium alloy becomes a superconductor, having essentially no resistance to current flow. Therefore, the coil can carry strong currents, and thus produce strong magnetic fields, with no appreciable heat production. Liquid nitrogen at a temperature of -196 degrees C (-320 degrees F) is used as a thermal insulator to reduce the boil-off of liquid helium.

Note: (1) The block diagram was unreadable when scanned during the writing of this article.

Magnet field strength is measured in terms of either Tesla (T) or Gauss (G) (1T – 10,000 Gauss). As a frame of reference for field strength, the earth's magnetic field is approximately 0.5 G, and small toy magnets range in strength from approximately 50 to 200G. Permanent magnet MRI scanners have typical field strengths of less than 0.4T, while most modern superconducting magnet MRI systems range in strength from 0.5 to 1.5T.

The Transmitter

The transmitter from an MRI system consists of an oscillator or frequency generator, modulation and gating circuitry, and a power amplifier. The oscillator generates a weak radio-frequency (RF) signal of precise frequency that is amplified through a series of linear amplifiers, then through a moderate power amplifier which boosts the signal into the 5,000 to 15,000 watt range. At these power levels, an MRI transmitter's signal could be detected and would cause interference for great distances if proper RF shielding precautions were not taken. For example, an MRI system transmitting at 63.5 MHz is close to the television broadcast frequency of channel 5. Finally, the high power pulse is fed to the RF body coil, which in-turn produces RF magnetic fields which interact with the precessing nuclei of the tissue of interest. As discussed in previous articles, the RF signal is turned on and off, or gated at specific times during the pulse sequence. The gating is controlled by timing signals from the computer.

Tad Bit of History

Steve's Tek-Notes, Excerpts from BMETS newsletter, Nov 1993—Feb 1994

The Receiver

The receiver coil is usually the same body coil used to transmit the RF signal. Specialized (optimized for particular anatomy) transceiver coils and reception with in a particular area of interest. As the nuclei or protons, which were forced to a higher energy state by the transmitted RF pulse, return to their equilibrium state, a current is induced in the receiver coil. The current is a sinusoid whose frequency equals the precessional frequency, and whose amplitude is proportional to the amplitude of the net magnetization vector. This voltage is only a few microvolt's and, therefore, must be amplified as much as one million times by high-gain amplifiers which introduce very little noise or distortion. RF shielding prevents leakage signals from the transmitter, or external RF signals from causing interference which can overwhelm the desired signal.

The Computer

The computer or computers associated with an MRI system serve multiple functions. They control and execute the pulse sequence, acquire the data, and process the data to create an image. Specifically, the computer must construct each of the necessary waveforms, control the timing of the RF and gradient pulses, control the digitizer, store the data, and repeat the sequence the proper number of times while changing the phase-encoding gradient. The computer then sorts and performs a complex frequency analysis known as the Fourier Transform on each set of data. The computer also controls various correction routines and data smoothing operation to remove artifacts. Most MRI systems include array processors or multiple processing units to reduce the time required for image reconstruction.

Future articles in this series will compare and contrast MRI to other imaging modalities, and discuss current technology trends.

This was the end of the series that Steve A. Davis, CBET, Secretary of the Baltimore Medical Engineers and Technicians Society wrote. I thought it very interesting that discussion of this series on the "new" technology of Magnetic Resonance Imaging came thru this newsletter to our members. I hope that all members get a great kick out of reading this reprinted articles and will add their "Two Cents" worth to the Tek-Notes of future newsletters.

Chris Jones, Sr. MCP CPACS Assoc.
Vice President B.M.E.T.S.