IMAGING THE FUTURE pdf

1: Magneto-acoustic technology may be the future of medical imaging

As technology advances quickly, the opportunities (and implications) for teaching and learning in traditional school districts will continue to evolve. A recent district partnership encouraged us to take a look into the not so near future to paint a picture of possible futures.

Researchers at Stanford University talk to us about magneto-acoustic imaging, a technique that combines the strengths of existing medical imaging tools; improving safety and the potential for greater compactness and lower cost. What is Magneto-Acoustic imaging? Magneto-acoustic MA imaging is an emerging medical imaging technique that uses ultrasound to detect Lorentz forces from RF currents flowing in tissue in a static magnetic field. It merges the high spatial resolution of ultrasound with the tissue contrast of electromagnetics. MA imaging also shows potential for portable, low-cost imaging devices and non-destructive testing equipment. Ultrasound imaging has excellent spatial resolution but poor image contrast, as the acoustic properties of most soft tissues are similar. Dielectric properties of tissues are quite variable at low RF frequencies, allowing good contrast, but wavelength is measured in metres, giving very poor resolution. At higher RF frequencies penetration is an issue. In MA imaging, the tissue is placed in a constant, roughly uniform magnetic field. Lower frequency RF currents are introduced in the tissue, roughly perpendicular to the magnetic field. The currents and field interact to produce oscillatory Lorentz forces in the tissues. Ultrasound waves are then generated at tissue conductivity boundaries and can be detected at millimetre resolution. What does MA offer over other medical imaging tools? Illustration of a simplified magneto-acoustic imaging system. The magnetic field strength can be much weaker and inhomogeneous compared to MRI, allowing more economical deployments. MA is unique in its ability to generate tissue contrast â€” cell membrane structure and macroscopic structures, such as blood vessel generation in cancers and necrotic cores, all influence electrical conductivity. MA technology is amenable to silicon integration and miniaturisation, as ultrasound transducers, RF electrodes and electronics for complete tomographic reconstruction can all be produced on silicon. To make this vision a reality, we require a low peak power MA RF excitation technique that can be feasibly integrated on silicon. What do you report in your Letter? This is possible because the ultrasound waves produced by MA Lorentz forces are coherent with the RF excitation. We have shown that with SFCW RF excitation, peak power requirement can be reduced by a factor of over pulsed excitation; with equivalent resolution, contrast and SNR. What does this allow? Past attempts used inefficient, difficult to implement, high power pulsed RF systems. Peak power levels could have been impossible to scale to humans. Excitation and detection intervals had to be separated, as in traditional ultrasound, but MA generates an RF EM signal and detects an acoustic signal. As a result, simultaneous transmission and detection is possible with high SNR and simplified low-power exciters. The simplified exciters are scalable as arrays for interesting spatial encoding arrangements, and could perhaps be integrated in silicon as conformal electronic arrangements. What are the key remaining challenges? In MA, the ultrasound Lorentz force signals are emitted throughout the volume, so spatial encoding must be done purely by surface ultrasound phased array receivers. This requires tomographic reconstruction algorithms and possibly even steerable magnets, so different orientations of tissue boundaries can emit MA signals. Technology now exists to make integrated receive arrays, and a basic system prototype is 3â€”5 years out. The first application would be in pre-clinical animal scanners, where the electrical contrast capability would open fundamental studies in tumour contrast and MA contrast agents. Since our Letter, we have performed experiments with capacitive non-contact RF excitation electrodes on a multilayer target, successfully detecting the boundary between each layer. We are also in the planning and simulation stage of a small-scale version of the MA system using coin-sized permanent magnets. How do you think this area will develop over the next decade? Technology will drive application integration, allowing higher density ultrasound detector arrays, RF exciters and novel magnet architectures. Bioelectromagnetics will play a role in developing contrast agents. While human scale imaging is the main goal, there are interesting possibilities for micro-scale sensing. Integration of bio- and nanotech on silicon is already popular, particularly in DNA sequencing, and will continue to grow. MA sensing and other on-chip diagnostic techniques will become popular alternatives to the lab-based approach. Medical imaging and diagnostic tools will shift from clinics to bed-sides and then eventually into the home. Similar to "personal computing", this type of "personal medicine" can open the door to new possibilities, the least of which is performing diagnostic tests at home and sending results to our doctors over the internet.

2: The professional and organizational future of imaging

Improving access and precision, and decreasing costs along the care pathway. What lies ahead for the future of medical imaging? In , Carestream is pushing the boundaries of engineering innovation in radiology in four important areas.

What lies ahead for the future of medical imaging? In , Carestream is pushing the boundaries of engineering innovation in radiology in four important areas: Accelerating processing speed Expanding the parameters of 3D and 4D Capturing images at the right place at the right time Automating workflow Accelerating processing speed of diagnostic images Processing speed is essential to creating high-quality diagnostic images. GPUs can quickly compute functions and algorithms, reconstructing images in less than six minutes. In contrast, CPUs can take 20 to 30 minutes to render the same image. Faster processing not only creates better images; it speeds up workflow. And when imaging centers can increase throughput, they get a faster return on their investment. Our advanced imaging science also shapes our DRX Detectors. Expanding the parameters of 3D and 4D The application of 3D and 4D technologies have the potential to create better images for improved diagnostics in radiology. These improvements enable sharp 3D reconstructions. We are also exploring possibilities for our cone-beam CT to generate 3D images in other areas of the body, not just extremities. Another hot development in the future of medical imaging is 3D modeling â€" putting physical models in the hands of physicians and surgeons. Imagine the insights that a surgeon can gain from seeing and touching a 3D visualization of a pathology or organ prior to surgery. Advances in ultrasound in particular lay the groundwork for 4D imaging. These include matrix array technology that allows the capture of a full volume set, and the turbo processing power of GPUs that power fast frame rates. Capturing images at the right place at the right time Diagnostic images captured at the right place and at the right time give physicians, surgeons, and care centers an important tool to help provide better patient care and at less cost. For this reason, Carestream has been building out our solutions for point-of-care and critical care, in addition to supporting our traditional systems and rooms for radiology departments. The non-motorized system will be easier to transport and position in cramped critical care areas. Even 3D imaging is getting more flexible. Orthopaedic and sports medicine offices can capture on-the-spot 3D weight-bearing images in their offices. This gives orthopaedic practices an opportunity to increase revenue. A point-of-care imaging system could help reduce risks associated with transporting patients from an intensive care or neurosciences critical care unit to the CT scanner suite. It could also offer high-quality imaging in the operating room. Point-ofâ€"care-imaging is a priority for us because it enables a better patient experience and supports better patient care. Automating workflow to help reduce acquisition scan time Baby boomers are aging, driving up the demand for healthcare including medical imaging. Yet staff levels at many facilities are remaining flat. Automation can help imaging staff keep pace with the exploding demand, and reduce the potential for operator error. Automation is especially important for procedures in cardio and ob-gyn that are measurement intensive. Take ultrasound for example. The quality of study relies heavily on the operator. In contrast, measurements taken with Smart Flow imaging technology are angle independent and reduce the number of key strokes required. Automation also can lessen the burden on orthopaedic and sports medicine doctors. Currently, they need to execute as many as five or six clicks to calculate patella alignment. Better images across the patient care pathway to help improve diagnostics I hope you found this glimpse into the future of medical imaging at Carestream informative. As a company, we are laser focused on applying our superior technology to help you improve access and precision, and decrease costs along the care pathway. Want to learn more? Get a closer look at our solutions here.

3: Imaging in Conference â€“ Visualizing the Future of Health Care with MR Imaging

Imaging the future August 19, Professor Miles Padgett, Principal Investigator of QuantIC, the UK Quantum Technology Hub in Quantum Enhanced Imaging explains how quantum science is leading to new technological applications in imaging across the industrial, scientific, security, healthcare and environmental sectors.

Despite its youth, these techniques have revolutionised medicine. Much of modern medicine relies on the 3D imaging that is possible with magnetic resonance imaging scanners and computed tomography CT scanners, which make 3D images out of 2D slices. Almost all surgery and cancer treatment in the developed world relies on it. So an interesting question is where medical visualisation will take us next. Today, Charl Botha at the Leiden University Medical Center in The Netherlands, and a few friends take a short tour of the history of medical visualisation and throw some light on the future of this fascinating field. Perhaps the most important factor in medical visualisation is the way the data is taken and here there are numerous advances in the pipeline. In the last five years, commercial CT scanners have become available that can take five slice volumes in a single second. There are also various new diffusion imaging techniques which reveal the diffusion of water through the body. Images of these structures is opening important new areas of study in neuroscience and biomechanics. Then there are the imaging techniques that work on the level of molecules and genes. The great potential of these is that they can reveal pathological processes at work long before they become apparent on the larger scale, in the form of tumours, for example. Collecting the data is just one part of the challenge, of course. Representing it visually in a way that allows the most effective analysis is also hugely difficult but again there have been huge advances. One of the most spectacular is the representation of medical data topologically, in other words showing the surfaces of objects. Beyond this, hyper-realistic images can show what lies beneath certain layers. The images at the top of this page are recent examples of this. These kinds of images are crucial for reconstructive surgery but a huge challenge for the future and the subject of much current research, is to create images of the potential outcome of interventions that show the result of the surgery. Another area of growing importance is the visualisation of multi-subject data sets. The idea here is to take images of a particular condition from lots of different patients and to combine them in a way that shows the progression of the disease or how it varies between different population groups, for example. Clearly, the challenges here are manifold. The final piece in this puzzle is the way medical practitioners view images and once again this is changing rapidly. The technology driving this change is essentially the iPad. And yet it has already transformed the way many doctors access and interact with images, not least because it frees them from desk-based computers. One area that Botha and co do not cover in their future is the cost of these imaging techniques and how they can be made cheaper. For the other 99 per cent, these techniques are essentially science fiction. The biggest challenge of all is to find ways of making powerful medical visualisation techniques cheap enough for everyone. From Individual To Population: Will you lead or follow? Join us at EmTech Digital

4: What is the Future of Film for Western Blot Imaging?

A combined future Cooks, Caprioli and Takats all agree that it is just a matter of time before mass spectrometry imaging becomes an integral part of our healthcare systems. The remaining challenges are regulatory not scientific, says Cooks.

One of the most useful imaging techniques is magnetic resonance imaging MRI. MRI, unlike X-ray radiography, can render high-contrast images of soft tissues, such as the brain, heart, and even tumors, in stunning detail. With the development of a wide array of powerful MRI-based techniques like 3D imaging, the need for faster and more efficient ways of implementing MRI increases. A team of researchers led by Todd Constable, Professor of Diagnostic Radiology, Biomedical Engineering and Neurosurgery at Yale, has developed a novel way of improving the efficiency of MRI using magnetic field gradients with nonlinear geometries. New Zealand Brain Research Institute. Nuclei with a non-zero spin, such as hydrogen nuclei, have a magnetic moment that can interact with magnetic fields. Our tissues are full of hydrogen atoms, especially in the form of fat and water. Unlike the compass, however, which always points toward the north pole, hydrogen atoms can orient their magnetic moments in two possible ways: If a hydrogen atom in the lower energy state absorbs a photon with just the right amount of energy, it can reverse its orientation and flip into the higher energy state. The energy required depends on the strength of the magnetic field; at field strengths typically found in MRIs, the protons are excited by photons in the radio frequency range. When pulses of radio waves are applied in an MRI machine, some of the hydrogen atoms will absorb the radiation and flip, returning to their original state after the pulse disappears. As the protons relax, they release energy in the form of electromagnetic radiation, like a radio signal that can be received by an antenna. Receiver coils in the machine can detect this signal, called the free induction delay. By analyzing characteristics of the signal that vary in different tissues, such as the relaxation rate, the MRI machine can determine what kind of tissue the signal originated from. Using a combination of pulse sequences with many contrast differences, it is possible to gain a surprising amount of information about the sample, such as whether a tumor is malignant or not. However, this process requires time, as MRI exams using multiple pulse sequences typically take about an hour to complete. During this time, patients must remain completely still in the cramped tunnel of the MRI machine, surrounded by the clatter of electromagnetic coils turning on and off. The experience is frequently unpleasant, but as MRI techniques improve in efficiency, hour-long scans could become a thing of the past. The 2D image of phase and frequency values can be transformed into the final image through the use of a special mathematical technique known as a Fourier Transform. Parallel Imaging One major innovation in MRI efficiency has been the development of parallel imaging, which uses several smaller receiver coils in lieu of a single larger coil. Parallel arrays of coils allow data to be collected from multiple places simultaneously. But more importantly, they allow for a limited amount of spatial localization. Each coil has a small area of sensitivity, so some information about where a signal originated can actually be determined just by looking at which coils picked up the signal. Until recently, most advances in parallel imaging were the result of increasing the number of coils in parallel, with machines now being able to orchestrate up to coils in tandem. Unfortunately, the gain in efficiency from increasing coil numbers experiences diminishing returns due to factors like cost and inductive effects between the coils. Conventional MRIs use linear magnetic field gradients to encode spatial information. However, the receiving coils in an MRI are usually oriented in a circle around the sample. In other words, can we encode spatial information about the hydrogen atoms in a form that can be retrieved from a MRI signal? The conventional solution to this problem is to encode spatial information by applying series of linear magnetic field gradients, i. The first gradient, called the slice-selecting gradient, allows a two-dimensional slice of the 3D space to be isolated for imaging. In the slice-selecting gradient, the magnetic field increases in intensity along the z-axis. As the strength of the magnetic field goes up along the z-axis, the difference in energy between the low and high energy states of the protons will also change, and the protons will be excited at higher resonance frequencies. If we apply a radio pulse containing only a few frequencies, then only the hydrogen atoms with resonance frequencies will absorb that energy and give off an MRI signal. Since the resonance frequency of a hydrogen atom is dependent on its location along the z-axis, a two-dimensional slice can be sampled from the 3D space by applying radio pulses with selective frequencies. Once we have the 2D slice, the other two gradients, which vary along the x- and y-coordinates, are also applied using electromagnetic pulses. Like the slice-selecting gradient, these gradients allow hydrogen atoms to be localized in the x- and y-coordinates by causing two properties of the hydrogen atoms, the phase angle and resonance frequency, to vary along each respective axis. These two properties can be decoded from the MRI signal. By applying a series of these phase and frequency encoding gradients pulses and measuring the signal that results from each one, a 2D matrix with rows of phase elements and columns of frequency elements can be generated. A mathematical technique called an inverse Fourier transform is then used to reconstruct the final image from this data. Radial localization is provided by the field gradient and angular localization is provided by the array of receiver coils. The center placements form an O-like shape in the plane of the image, giving the technique its name: The center of the radial gradients is offset using a superposition of linear and radial gradients. This innovation makes the technique faster than conventional methods because the phase encoding gradient step is the most time-intensive step of MRI imaging. After multiple acquisitions at different center placements, the MRI machine returns a map of isofrequency contours in concentric circles, like a topographical map, but demarcating outlines of equal resonance frequencies rather than altitude. A transform analogous to the Fourier transform is applied to produce a projection of the image along concentric rings, which can be transformed into the final image using sophisticated mathematical techniques that account for the geometry of the field gradients used for spatial encoding. Constable and his team have successfully created MRI machines that can create radial magnetic field gradients, and preliminary studies of O-space imaging have shown that the technique can retrieve useful images with far less data than comparable methods. O-space imaging can reduce the amount of sampling required during an MRI scan by factors of up to sixteen-fold under optimal conditions, drastically cutting the amount of time needed to run an MRI scan. First, they are working in partnership with Siemens to create commercial MRI machines that can use O-space imaging. Second, they are examining if the concept of O-space imaging can be generalized to even more novel geometric field gradients. In this regard, they are working on forming a set of customized magnetic field gradients that are specifically designed to complement the geometry of any arrangement of coils. Using a mathematical method that focuses on finding the null space of the receiver coil array, or the areas least well characterized by their areas of sensitivity, Constable and his team are discovering magnetic field gradients with even more unusual shapes based on spherical harmonics. These shapes have the potential for even more efficient spatial encoding properties. This work is in the early stages and new hardware must be built to fully test the approach, but the preliminary results to date are promising. Acknowledgements The author would like to thank Professor Todd Constable for taking the time to share his research. Further Reading Stockmann, Jason P. The Basics of MRI. Retrieved November 16, , from http: Chapman and Hall, London,

5: Imaging in â€“ The Future of Radio Imaging â€“ Denzil Lacey

In the future, radiologists will not simply be interpreters of imaging studies. They will be the curators of quantitative and descriptive information." Looking beyond imaging is critical, adds Siemens' Wendt.

Received Oct 23; Accepted Nov This article has been cited by other articles in PMC. Introduction The field of biomedical imaging and particularly the specialty of radiology have expanded dramatically over the last decade. The current role of the radiologist is being challenged as use of images by clinicians is becoming increasingly important. Some of the main challenges radiology faces are due to the increasing workload and subsequent shortage of radiologists, the increasing availability of technologies allowing partial outsourcing of imaging services teleradiology , the ease of the use of images and therefore an increased ability of knowledgeable clinicians to read them. Moreover, control of patients is central to turf wars, and here radiologists are at a disadvantage in comparison with other clinical specialists. Thus according to William R. Pierre Schnyder, head of radiology at CHUV in Lausanne Switzerland , described self-referral politics as representing the cornerstone of turf wars [2], with interventional radiology being especially at risk. The possibility of controlling specific imaging units or imaging technologies offers an attractive alternative for self-referring clinicians, but it may stimulate detrimental competition for patients, space, and resources. Moreover, internal competition among specialists interested in imaging may result in a deterioration of normally collegial relationships. There is also evidence that self-referral of imaging services often leads to overuse of services and creates unjustified health care expenses [1]. Additional knowledge in understanding the acquisition and display processes of medical images is not something that can be acquired as a sideline to the practice of another medical specialty. Preserving the integrity of radiology as a specialty also has additional advantages. Margulis, former head of radiology at UC San Francisco, suggested that fragmentation has a negative effect in that it separates those outside the imaging specialty from advances in the general field, removes them from cooperation with other radiologists and basic scientists in imaging, and usually makes them too one-sided and less valuable to patients [3]. That risk comes from unwarranted exposure to radiation, as well as from false-positive or false-negative examination results. The workflow of such a service includes quality assurance for professional and technical staff, monitoring of the appropriateness of referral, report generation, archiving, and last but not least supervision and consultation by highly trained super-specialized radiologists [4]. However, an integrated comprehensive imaging service does not exclude the possibility of decentralizing some of the facilities equipment for the sake of patient-centered care despite some wastefulness and inefficiency. Solutions for most of the problems clearly underscore the advantages of a comprehensive and integrated approach for the domain of diagnostic imaging and image-guided interventions, with a frequently beneficial and needed collaboration with clinical specialties on an equal basis. Limited decentralized services are delivered upon mutual local agreement between departments. Erosion and fragmentation of radiology as a specialty From the beginning, radiology has been vulnerable to the erosion of its domain of expertise because of its dependence on referrals from other physicians. This vulnerability makes radiology susceptible to efforts by other physicians to provide their own imaging services and not to refer patients to radiologists [1]. There is an excess of physicians in some specialties, and nonradiologist physicians have become more familiar with the imaging techniques most frequently employed in their practices. Also academic careers are frequently based on controlling the latest new technology. Fragmentation of the specialty, in contrast, represents a separation or break-away of some parts of the imaging services from the original organizational entity, i. The reasons for fragmentation can be explained by the dramatic expansion of the domain of activity of radiologists. No single person can master all the available knowledge. The response to this development has been a gradual increase in the degree of subspecialization of radiologists. Initially subspecialization occurred based on different modalities in the s and s, while later a organ-system-based subspecialization became much more appropriate and was gradually adopted both in the structure of radiological services as well as in the training curriculum [5]. Subspecialization is a clear need for radiologists in large academic and community hospitals and increasingly even in private practices. However, in most of cases subspecialty sections remain within the overarching department of radiology with the benefit of shared facilities, efficient use of resources, and common organizational structures. Typically, a fragmentation occurred in Europe with nuclear medicine. Whereas in the United States, nuclear medicine remained a subspecialty of radiology and mostly part of radiology departments, it became a separate medical specialty and frequently a totally autonomous organizational entity department in Europe [3]. In some parts of Europe, neuroradiology is increasingly trying to separate itself from departments of diagnostic radiology [6]. Something similar could happen with other subspecialties of diagnostic radiology such as cardiovascular, pediatric, or orthopedic imaging as well as with image-guided interventions [6]. Fragmentation has a negative effect in that it separates those involved in only parts of the profession from advances in the general field of imaging, removes them from cooperation with other radiologists and basic scientists in imaging, and usually makes them too one-sided and less valuable to patients [3]. Turf wars in radiology A search for "turf wars" and "radiology" on the Internet will return more than , hits. These so-called wars have been prompted by advances in imaging that have drawn other specialists to the turf of the radiology department, most notably those in cardiovascular medicine. Boundaries are being crossed, and conflict and competition have become inevitable [7]. Practically, on a ground of increasing financial restrictions, struggles between nonradiologists and radiologists are mostly related to financial considerations, power and, not infrequently, to personal fame. Control of patients is central to turf wars, and here radiologists, particularly diagnostic radiologists, are at a disadvantage in comparison with clinical specialists [8]. Additionally, during the mids and early s, radiologists frequently showed a lack of foresight or limited interest in new technologies, such as echocardiography and obstetrical ultrasonography, catheter coronary angiography, and ERCP, thus leaving an open door to internists, pediatricians, obstetricians, gynecologists, cardiologists, and gastroenterologists [2]. This can be achieved by collaboration or by the acquisition of cardiologic skills by radiologists or vice versa. Turf wars in image-guided interventions There is little doubt that current interventional procedures and future developments in image-guided interventions will dominate treatment in medicine [10]. This is a result of the intrinsic advantage over open surgical approaches: Whereas the basis of interventional radiology in the future is not in question, the domain of the procedures may be: There has been a huge amount of discussion of turf wars by and among many specialties, and interventional radiology is especially challenged, with many of the procedures being increasingly performed by nonradiologists e. Endovascular surgery applies to manipulative diagnostic and therapeutic procedures carried out through and within blood vessels. Many of the techniques involved are catheter-guidewire-based and use fluoroscopic or ultrasonographic imaging modalities for control. Access to the vascular tree for endovascular manipulative treatment can be gained via percutaneous puncture utilizing Seldinger wire-catheter-sheath technology or, less commonly, by open exposure and arteriotomy or venotomy. Endovascular treatment techniques have already changed the way arterial and venous diseases are managed. In addition, it is likely that these techniques will have an even greater influence on the way vascular diseases are managed in the future [15]. According to Veith at al. In some cases, these catheter-based treatments have been used directly by the vascular surgeon; in other circumstances, management has been by collaboration with the interventional radiologist [15]. Thus the role of interventional radiologists in percutaneous peripheral vascular interventions is currently being challenged in some hospitals by vascular surgeons and cardiologists [6 , 13]. It is worth considering published remarks made by some leaders of these specialties with regard to the degree of training they receive in such interventions. Porter, a leading vascular surgeon, made the following comment: I note that to become a highly skilled arteriographer requires three years of radiology residency, usually two years of angiography fellowship, and another two to three years of high volume clinical experience. Marin, also well-known vascular surgeons, discussed the possible threat that transluminal endovascular graft placement poses to the practice of vascular surgery [18]. Rapid rise in workload and complexity of examinations have resulted in a shortage of radiologists in many countries, which may unfortunately result in clinicians undertaking the interpretations themselves. In most European countries, radiologists at present are satisfied with their overall position within the health-care system and have no difficulties in finding professionally fulfilling and well-paid employment. The availability of high-speed internet transfer of images may result in centralized interpreting facilities which may affect the siting of radiological imaging equipment and the requirement for local radiologists. Improved image clarity and tissue differentiation in a number of situations have increased the ability of a knowledgeable clinician specialist to read his or her clinical diagnosis into the images, and often that diagnosis will be correct [3]. The advent of molecular imaging has brought the need for large-scale multidisciplinary collaboration with basic scientists knowledgeable in molecular and cellular biology, nanotechnology, probe development, image processing, etc. Advantages of preserving the integrity of radiology as a specialty Radiology as a distinct specialty and organizational entity provides some major advantages regarding imaging procedures compared with other medical specialties [1]. Referral Radiology is a referral specialty. With few exceptions, the radiologist depends on other physicians for requests for imaging examinations. This historical mode of practice is under threat. There is evidence that self-referral of imaging services is often economically motivated, leads to overuse of services, and creates unjustified health care expenses that are borne by health care payers and, ultimately, by patients [1 , 8]. Self-referral politics represents the cornerstone of turf wars, since radiologists, having no beds and no consultations, are unable to self-refer patients [2]. This paper strikingly demonstrated that physicians practicing self-referral requested 4 to 4. The same study showed that resulting charges per patient were 4. In aggregate, these data raised the specter of overutilization related to the incentive for inappropriate self referral [9]. Knowledge in image interpretation Residents in radiology have much to learn because the specialty is defined both by imaging technologies and by procedures that are becoming more numerous and sophisticated. This amount of training, however, provides only a foundation to practice the radiologic specialty; a continuous expansion and refinement of the knowledge of the radiologist is required over the duration of practice [1]. Knowledge in medical imaging is not something that can be acquired as a sideline to the practice of another medical specialty. Thus, it is understandable that the knowledge of radiologists is superior to that of other specialists who perform imaging and interpret images [1 , 6]. Broad clinical perspective A number of disorders may not be confined to one organ system, and there may also be circumstances in which the patient imaging examination identifies other abnormalities that were unsuspected and potentially life-threatening or unrelated to the symptoms being investigated. In these circumstances the radiologistâ€”having a broad perspective and a wide knowledge of anatomy, pathology, and imaging signsâ€”delivers an added value compared to a subspecialized clinician. It is important that there is good oversight to avoid the patient having unnecessary examinations and being referred to a variety of other physicians [6]. Technology mastery Medical imaging employs highly complex technologies that are increasingly driven by the sophisticated computer and image-processing systems that are used for the acquisition and display of imaging data for interpretation. Understanding the acquisition and display processes and having a working knowledge of the complex interactions among these processes helps to ensure that optimal images are acquired for the medical conditions being investigated and that the images depict pathologic conditions in the patient and not errors in the processes of acquiring, manipulating, and displaying imaging data [1]. Radiologists have been dedicated to maintaining and continuously improving imaging protocols [6]. In this endeavor radiologists have always closely cooperated with many other scientists, including clinical physicists, MR physicists, IT professionals, and image processing specialists. Many of the technological advancements as well as optimization would not have been possible without this decade-long cooperation. Indeed, some of these related professions are presently fully integrated within large radiological departments. The advantage of organizational integration of all imaging services Referring physicians and patients expect the delivery of optimized imaging services. Factors to consider include the availability of best possible equipment, quality and assurance systems for imaging equipment, room design, patient communication, informed consent, patient transportation, patient surveillance, all aspects of timeliness, standardized possibly evidence-based protocols, professional communication, after-hour service, and emergency and disaster preparedness [4 , 21]. An integrated comprehensive management and organizational structure of imaging services has clear advantages and is better equipped to meet such high demands.

Standardized workflow The workflow of an imaging service includes monitoring of the appropriateness of referral, quality assurance for professional and technical staff, report generation, archiving, and last but not least supervision and consultation by highly trained super-specialized radiologists Fig. For some parts of the process, information technology solutions may be beneficial and already available or under development [electronic order entry, automated decision support, computer aided detection CAD] [6].

6: Imaging the Future: How Innovative School Districts Are Looking Ahead

The Future of IBM Watson Health Imaging It's easy to envision a future world where IBM Watson ends up analyzing all medical images with accompanying EMR data because it can process such a large amount of information so quickly.

Pin Through our advocacy, advisory and coaching services, we work with impact-oriented partners including innovative school districts to invent the future of learning. This post is part of a blog series designed to share lessons learned, case studies, and thought leadership from our projects and campaigns. To learn more about our services division, visit GettingSmartServices. For the last 50 years, school districts have acted as a central pillar for American communities. They not only provide education for our students, but they provide a sense of culture and community in neighborhoods that is difficult for anything else to match. As we look to the future, innovative school districts will take this responsibility to new heights by extending the options, opportunities and services they provide. As technology advances quickly, the opportunities and implications for teaching and learning in traditional school districts will continue to evolve. A recent district partnership encouraged us to take a look into the not so near future in order to paint a picture of possible futures for how educational services might be delivered in district settings, and to help the district prepare to strategically respond to high growth and future facility needs. Imagining the Future When we think about planning for the future of learning, we can start by diving into the innovative practice that schools and districts are already engaged in around the country , but it is also important for us to think about what key emerging factors will impact the world at large like artificial intelligence. Paying attention to these scenarios can help us prepare and innovate. Personalized Learning High Impact Factor: We believe personalized learning also includes daily engagement with powerful learning experiences, flexibility in path and pace and the application of data to inform the individual learning trajectory of each student. Artificial Intelligence AI will have more influence on the lives and livelihoods of young people over the next few decades than any other factor. While AI will help address our most pressing problems, it has the potential to exacerbate gaps in society and pose existential threats. We are at a pivotal moment in time to disseminate the advanced technologies that are occurring in the technology sector in order to create an impactful connection to education that will transform the classroom. As access to technology increases and as the amount of information that technology can take in and process becomes more sophisticated, the amount of data that environments such as school communities can gather will have a direct impact on learning. Students and teachers will know more about what is happening in their brains including, but not limited to, mental and physical health. Sensors in buildings will allow us to consistently monitor and automatically adjust water and air quality. Students monitoring for health and safety combined with a super sophisticated privacy authorization, will present indicator-by-indicator information sharing. Imagine if every student had an intelligent digital assistant. The digital assistant will be able to monitor health and wellness, agile transportation scheduling, ongoing learning opportunities and complex schedules. In the next 5 years, student profiles are anticipated to become more substantial than they have ever been, but they will continue to get exponentially better and more comprehensive in the next decade. What does this mean for schools and districts? This will have implications for school staffing models. It has the potential to reduce staffing loads, and will change the way that districts staff with more focus on social-emotional components and less on content sharing which will be available from a variety of learning sources. AI, big data and continued technological advancements will exponentially impact the way that both teachers and students learn. As we prepare for a hyper-personalized and automated future, the involvement and engagement of high-quality and passionate teachers will be more important than ever as they act as the central bridge between the opportunity that technology offers and the relational advisory that students need. The Next 50 Years for Innovative School Districts Although it is difficult to say with complete certainty what learning will look like 50 years from now, the combination of new technologies with a deeper understanding of how the brain learns should yield a highly personalized experience for learners where students will progress by mastery of content rather than solely by age cohorts. Soon, data will be tailored to specific customer situations. Much like mobile push-learning , content delivery will be informed by learning data. Districts of the future will make the adjustments needed to prepare students for an unfamiliar future. There will be a greater emphasis on early education and the effects it has on equity and preparation. Students will be given more opportunity to engage in experiences and meaningful projects that prepare for an increasingly project-based world. Students will prepare for jobs that may not exist now and will be prepared to create their own paths toward college and career and life readiness , often starting before high school graduation. We believe that it will be more important than ever for districts to continue community conversations to shape what students should know and be able to do and to continuously redefine graduate profiles that are innovative and relevant. In addition to boldly thinking about what is possible in the distant future, we think that districts should start with what will be key in the near future. Maintain a strong connection to the community with connected community services that support students physical and mental health; Respond to competition with intention by providing a variety of options for students that fuel increased engagement and student success; Enable high quality options for a variety of learners including early learners ; Extend the classroom beyond school walls especially for middle and high-school students ; and Take steps to transition into a competency or mastery based system in which students progress based on mastery and have the option to combine a variety of learning experiences. When you imagine the future of learning, what do you see? What do you think is possible in education in the next 50 years?

7: The Future of Diagnostic Imaging | Medical Imaging Talk Blog

The only thing that seems to be certain at this stage is that the future of cameras will be based on CMOS imaging technology. What the best imager size is, and what is the best color separation system for these cameras will be, still needs to be defined.

With significant developments in AI and other technologies, this is an exciting time to be part of this burgeoning field. The following are five of the latest and greatest innovations that have rich potential for enhancing the profession and improving patient care. These models can help with diagnosis and guide surgeons through the most complex procedures. In this implementation, radiologists acted as consultants using their expertise to interpret the 3D printing models. The market is being expanded by the evolving needs of a growing geriatric population and the spread of chronic diseases. In recent times, a number of brand new and exciting MRI innovations have made their way into the market, including: Canon Vantage Gala 3T: This leads to quicker sampling and high-resolution imaging. The Cannon Vantage Gala 3T is also able to stack protocol sequences speeding up neurology exams. This innovation also improves the promptness of medical examinations. When these components are not used for long periods the Eco-Power technology deactivates them. This technology gives medical professionals access to images and reports across multiple hospital service lines. The Enterprise system improves data integration and provides a comprehensive record of all imaging across EHRs and systems. Mitchell Goldburgh, Global Solutions Manager of Enterprise Imaging and Analytics, says the enterprise solution helps consolidate work processes. Cinematic Rendering is the creation of Dr. Cinematic Rendering magnifies the texture of tumors and helps doctors determine whether tumors are cancerous. In the past two decades, medical sensors have played an important role in imaging. These innovations make image gathering more efficient plus decrease acquisition times. The end goal for these innovations is to replace time-intensive work with better segmentation to produce results in less time. What are the Pros and Cons of new technology such as AI? There are many pros and cons of new technology. On the positive side, AI technology has the potential to improve diagnosis and enhance access for those patients living in rural communities. On the negative side, many fear that AI technology will take over the job of radiologists. Why radiologists need to explore the exciting potential of these new innovations With any new change, the challenge is to adapt and thrive. New technology such as AI and 3D Printing has captivating potential. Yet at the same time, its promise should not be ignored. Jonathan Gordon Hey Medical Professionals! How are you are implementing the latest AI-Machine Learning technology? Drop us a note belowâ€¦. Contact the Merraine Group today to find out more about exciting opportunities in the Imaging and Radiology field! Leave a Reply Your email address will not be published.

8: 5 Future Trends in Imaging Technology to Watch - Merraine

It's been a few weeks since our last post in the "Imaging In " series and boy, this is going to be a good one.I predict that a lot of us wonder what the future of Radio Imaging will be.

Food and Drug Administration, which regulates medical devices and pharmaceutical drugs, and the Agency for Healthcare Research and Quality AHRQ , which oversees healthcare quality and safety standards, to name just two of many. Many industry experts believe the political volatility of the ACA, and other recently passed regulations will significantly impact healthcare in general, and medical imaging in particular, well into the foreseeable future. What contribution is imaging providing to these improvements and value based purchasing? Workflow improvements save time not only for the clinician and health system, but also for the patient. OEMs servicing equipment that they manufacture are regulated by the FDA, while third-party servicers lack such regulation. In some instances, the solutions that provide value may not be the latest and greatest imaging devices. As clinicians continue to face pressures to cut costs while also improving the quality of care, solutions that increase coordination and deliver efficiencies will be center stage. Deep learning will enable radiologists to improve diagnostic accuracy while also reducing examination time. In the future, radiologists will not simply be interpreters of imaging studies. They will be the curators of quantitative and descriptive information. One key factor is the lack of structured reporting. Accuracy and efficiency improves when measurements, location, and anatomical findings are generated as a byproduct of a radiologist viewing workflow. Philips also remains committed to the focus on miniaturization of imaging modalities, including ultrasound. There is also potential for intravascular ultrasound to equip physicians with the information they need to determine if additional imaging is needed and develop a diagnosis and treatment plan. Next to that, we want to make MR more definitive so it can provide personalized answers supported by quantitative data and deliver evidence-based outcomes. Jonathan Furuyama, product manager, MR Business Unit, Toshiba Medical, says that extreme cost pressures as reimbursements are falling requires clinicians to continue to do more with less. Shortening and simplifying exams that were historically time-consuming and difficult to perform, such as cardiac MR, is a key focus at GE Healthcare. According to the company, cloud technology along with new algorithms can now process large datasets unimaginable before for evaluation by a clinician in near real-time. The data analysis necessary for RS-fMRI is still rather complicated and laborious and confined to academic institutions. Finding more answers with spectral CT Dual energy, or spectral, imaging is opening up new opportunities for CT to help answer very specific questions for a specific disease. This will bring an ability to characterize lesions without time consuming and costly biopsies and will allow clinicians the ability to monitor treatment response. Dose management will continue to be an important conversation in Yet, a challenge remains, he says, in deciding how to use this information. The goal will be to detect and prevent inappropriate dosing before the patient is scanned, and to better correlate the image quality rela tionship between radiation and contrast dose. Education and advisory services will also continue to advance beyond proper use to increase productivity and value. Advancements in personalizing the data, such as size-specific dose estimates and organ dose information, will also be hugely impactful. Image analysis and processing will also undergo continued development, adds Gregg R. If we add in remote diagnostics, we can further reduce downtime. This type of preventative maintenance takes the burden off the user and helps them focus on the patient. However, the greatest impact could be in how this new technology would allow molecular imaging to improve patient outcomes and answer clinical questions in ways not possible today.

9: VIDEO: The Future of Imaging Informatics | Imaging Technology News

SIIM Chair Paul Nagy, Ph.D., FSIIM, CIIP, associate professor of radiology and deputy director of the Technology Innovation Center at Johns Hopkins Medicine, discusses how informatics technology is changing medical imaging, and highlights SIIM's recent accomplishments and future endeavors.

No comments Doctors and pharmaceutical companies are beginning to open their eyes to the power of mass spectrometry imaging, finds Nina Notman Imagine what drug discovery would be like if you could look directly into a cell and see where your drug ends up. This could go some way to reducing the staggering cost of developing new drugs, by weeding out ineffective candidates before carrying out expensive trials. In the s, more than 50 new drugs were produced per billion dollars of investment, whereas today not even one drug can be brought to market for that amount of money. It is hoped that this will allow potential problems to be identified at a much earlier stage than they can at present. We want to be able to see if the compound gets to the target area The team can currently tell whether a molecule has entered a single cell in sufficiently high concentrations to have the desired therapeutic effect or whether it is just coated on the outside of the cell. The next generation instrument â€” currently in development â€” is aiming to enhance the sensitivity by two orders of magnitude and allow researchers to see where the drug goes at the organelle level. This resolution will also allow researchers to check that potential drug molecules are not lodging within the wrong cellular components, potentially causing toxicity. This is a fairly common problem. The imaging technique they are using for this is 3D secondary ion mass spectrometry, or Sims. In this technique, ions known as primary or projectile ions are fired at a surface in a vacuum. The bombardment causes molecules and their fragments to be released from the surface, some of which are ionised. These secondary ions are then analysed in a mass spectrometer. To obtain spatial maps in 2D, the primary ion beam is scanned across the surface and a spectrum is collected at each pixel. To get a 3D image, a second ion beam is used to shave off the surface, layer by layer. A 2D image is taken of each layer and these are then stacked on top of each other to give the 3D image. To prepare the samples, the cells are first incubated with the molecule of interest. They are then frozen and dehydrated before being put in the mass spectrometer. Ultimately, the aim is to look at all potential drug molecules with intracellular targets using Sims during lead generation. There is no comparable analytical technique able to provide the same information at such an early stage, West says. Moving forward The ultra-high resolution offered by Sims is also used for other practical applications, including in the design of efficient polymeric drug delivery systems, and for fundamental biological research such as identifying new biological pathways and observing the highly-curved lipid membranes that form when protozoa mate. Firing atomic ions at a surface can cause the molecules to fragment so much that it is difficult to figure out what the original molecule was from the resulting complicated spectra. Large argon clusters are also popular. He does, however, raise concerns that commercial instruments are not yet optimised for these new cluster ion beams: If we could increase the ionisation efficiency, I think that would also be an extraordinarily happy outcome. The other big challenge is with the amount of data produced, according to Gilmore. Brain surgery Shutterstock But not all mass spectrometry experts are hankering after better resolution and large data sets. Graham Cooks, from Purdue University, US, is instead focused on speed in his quest to get mass spectrometry imaging into the operating theatre. In Desi, a stream of charged aqueous spray droplets desorb and then ionise molecules from a surface. This is a far gentler form of ionisation than Sims, therefore much less fragmentation occurs and the spectra are easier to interpret. Desi is carried out under ambient conditions unlike Sims, which requires a vacuum , but cannot produce 3D images without slicing up a sample and analysing each layer separately. The pathologists look at the samples under a microscope. For the trials, when the surgeons have a question, they do two smears between glass slides rather than one. The first goes to pathology as usual, while a second is held in front of a Desi instrument in the operating theatre. The instrument then rapidly runs the spectrum of the lipids in the tissue sample against a library of spectra that have previously been collected for that disease. This is being trialled for both brain and breast cancer at present. American Association for the Advancement of Science The iKnife surgical mass spec system correctly identified tumour tissue during operations in its trial The iKnife analyses the ions in the smoke emitted as standard electrosurgical instruments cut through tissue. These knives are already fitted with a tube to take the smoke away from the operating table, and the mass spectrometer is simply fitted onto the smoke collection system. As the surgeon cuts, the spectra of the hundreds of different lipid ions in the smoke are continually collected and compared against a library. The machine then gives a continuous, real-time red or green feedback on a screen to the surgeon. No more trials have been carried out since then, as Takats is currently waiting for a clinical grade version of his device to be designed. A medical device has to be designed from scratch even if it is something that already exists, he explains. For most of us, strep throat â€" caused by Streptococcus pyogenesâ€" is harmless and fixes itself within a couple of days, but in the elderly and very young it can lead to serious complications such as rheumatic fever. This infection can be easily treated with antibiotics, but the results from the rapid immunity diagnostic test that is currently used are not considered to be very reliable. And the results 3 take just 10 seconds. Trials using this instrument are just starting in Indianapolis. A dual swab is taken from the mouths of patients suspected of having strep throat, and one half is sent for standard analysis whilst the second is analysed using the mass spectrometer. The results are then compared. He has already carried out preliminary tests to demonstrate its viability in detecting fatty liver disease in human liver samples and a juvenile onset form of macular degeneration in retinal tissue, with encouraging results. For Maldi analysis, the samples are coated in a matrix before being placed in the mass spectrometer. Due to the gentle ionisation method, the spectra are relatively easy to interpret, like those from Desi. A combined future Cooks, Caprioli and Takats all agree that it is just a matter of time before mass spectrometry imaging becomes an integral part of our healthcare systems. The remaining challenges are regulatory not scientific, says Cooks. Mass spectrometry is just the opposite. Meanwhile, the analytical manufacturer Waters, which is currently designing the clinical grade iKnife, has an alternative approach to enticing hospitals to use the instrument.

IMAGING THE FUTURE pdf

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