IMAGING & IMAGE-GUIDED INTERVENTIONS

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GTx-Eyes: A Software Platform for Multi-Modality Image Guidance

Surgeons, scientists, and engineers in the Guided Therapeutics (GTx) program at UHN have developed a custom 3D visualization and navigation platform for image-guided surgery, radiation therapy and interventional radiology. The software package provides registration and visualization of 3D imaging (e.g., CT, MRI, cone-beam CT, SPECT, PET), planning contours, real-time optical/electromagnetic tracking of interventional tools, and endoscopic video. Fusion of 2D video with 3D volumetric data provides virtual endoscopy and augmented reality views of sub-surface anatomical structures (e.g., carotid arteries, optic nerves). Real-time tracking combined with virtual critical structure “no fly zones” enables visual/auditory proximity alerts to act as an early-warning system for complex interventional procedures. This advanced image-guidance technology allows for precise intervention performance while minimizing complications. Clinician feedback and human factors research has been essential to optimize the user display for safe and effective medical use. The modular software architecture promotes the rapid development of new clinical applications using a shared set of software components. The use of the system as a dynamic ‘surgical dashboard’ in the OR is being evaluated in two ongoing UHN clinical studies (head & neck oncology, minimally-invasive skull base surgery).

GTx-oscope: A Handheld “Head’s Up Display” System for Image-Guided Surgery

Surgeons, scientists and engineers at the Princess Margaret have developed an augmented reality (AR) system which allows the clinician and surgeon to simultaneously see the “real” surgical bed with a “virtual reality” 3D-image of underlying tissue structures. In contrast to bulky stationary or wearable devices and other AR devices which lack depth information, this system is small, hand-held and mobile, making it more applicable to surgical theatre use. The system is integrated with a heads-up surgical dashboard (“GTx-Eyes”) which enables real-time optical tracking. The GTx-oscope allows the projection of diagnostic medical images (e.g., CT, MRI, CBCT, PET, SPECT) and surgical planning contours (e.g., tumour, critical structures) on the patient’s surface anatomy. The projection can be either direct (on body surface), or indirect with the use of a semi-transparent display screen. The system is currently undergoing clinical trials within UHN’s TECHNA-Guided Therapeutics Operating Room (TECHNA-GTx-OR).

Endoscopy-Enhanced Radiation Therapy Planning and Visualization

This technology enables the integration of clinical endoscopy examinations into radiation therapy planning and response assessment. 2D optical and 3D CT image sets are co-registered by tracking and registering the coordinates of an endoscope relative to the planning CT image set. From here, users can perform several functions, including contouring on 2D images and display 3D dose levels on real-time video images. For many cancers, for instance the head and neck, esophagus, bladder, etc., superficial margins are often more clearly defined in the 2D optical image. With our system, users can contour lesions visible on the 2D image. These regions of interest are projected onto the 3D CT planning image, generating a 3D ROI that can be exported in a format compatible with any standard clinical treatment planning software. For treatment response assessment, the system can import radiation dose from the treatment planning system. The dose can then be displayed on top of live 2D video, enabling the clinician to compare treatment response, such as tumor regression or normal tissue toxicities, to the delivered dose. This is an especially attractive feature for examinations of radiation proctitis following prostate treatments, and mucositis following head and neck treatments. Current testing on phantoms demonstrates a registration accuracy of ±1mm. The Endoscopy-enhanced Radiation therapy planning system is currently in clinical testing for H&N and esophageal cancers.

Patents Pending US13/947,263 – H. Chan, M. Daly, J. Irish
Cone-Beam CT Image-Guided Gamma-Knife Perfexion Stereotactic Radiosurgery

UHN has developed, tested, and implemented, in close cooperation with Elekta inc., a cone-beam CT-based image guidance system with Elekta’s Gamma Knife Perfexion stereotactic Radiosurgery platform. The implementation of image-guidance onto the system was originally envisioned to improve treatment efficiency by allowing fractionation activities, reduced margins, on-line planning and an increased scope of treatable indications. UHN scientists, physicists and engineers came up with the concept, developed the prototype and tested it in the clinical setting.

LICENSED to Elekta Inc.

Magnetic Resonance-Guided Radiotherapy Integrated LINAC

A technology suite for MR-guided RT (MRgRT) has been developed employing a movable MRI magnet. The MRI magnet can be moved into a shielded radiotherapy suite in a short time for imaging without interference from the linear accelerator. The linear accelerator is located as close as possible to the MRI for imaging without interfering with the MRI functionality. After imaging, the patient can be transferred quickly to the LINAC, with treatment commencing rapidly afterwards. The MRgRT suite includes a room for imaging only applications as well as an image-guided interventional suite for brachytherapy, where the magnet can be moved between these suites and enable simultaneous room utilization.

LICENSED to IMRIS Inc. – D. Jaffray, C. Menard, S. Breen, M. Carlone

Image-Guided Pre-Clinical Irradiator System

A team of scientists at the Princess Margaret Cancer Center has developed, in partnership with Precision X-Ray Inc, the first commercially produced pre-clinical Image Guided X-Ray Irradiation System, the X-RAD 225Cx. It was developed through the need to perform critical cancer research in the laboratory which more directly corresponds to actual image-guided radiotherapy treatments (IGRT) done on patients. The system combines cone-beam CT imaging technology with X-ray irradiation capability all housed within a self-shielded cabinet and controlled by a proprietary imaging and control software. The integration of these two capabilities adds sub-millimeter targeting accuracy to high-dose pre-clinical radiation therapy research.

LICENSED to Precision X-Ray Inc. and marketed as X-RAD 225Cx with worldwide unit sales.
UHN scientists and engineers have developed a unique fiber optic probe spectroscopy platform which quantitatively measures tissue fluorescence at a point in tissue for in-vivo surgical and biopsy applications. This device is able to compensate for the dramatic effects of tissue optical property variation on fluorescence readings, allowing true quantitative assessment of fluorophore-tagged pathologic tissue. This is important for surgical applications which rely on quantitative fluorescence signal to properly identify fluorophore-labelled pathologic tissue for the purpose of guiding resection, giving real-time information to the surgeon to determine the presence of malignancy in the surgical site. In partnership with University of Dartmouth, this quantitative fluorescence ‘point probe’ has been further integrated into a biopsy device for interoperative guidance of tissue biopsy procedures.

The primary application of this ‘smart biopsy’ device is to provide real-time, intraoperative guidance for on-the-spot determination of the presence and degree of malignancy during a biopsy procedure so as to enable a faster and safer workflow. It has applications in many different clinical scenarios, however clinical trials are underway for brain tumour procedures.


UHN and Precision X-Ray have developed an optical imaging system integrated with a cone-beam CT (CBCT) imaging device that can be used for 3D optical tomography pre-clinical imaging registered to CT data sets. The optical system employs a highly cooled EMCCD camera and computer controlled filter wheel mounted on the CBCT imaging gantry, perpendicular to the x-ray imaging axis. This system can be used to acquire multiple optical images at any angle as the gantry rotates and at any of the five optical bandwidths. With the computer-controlled system, multiple image acquisitions can be combined into a single image sequence. Images can be viewed as overlays of luminescence, white light and X-ray/fluoroscopic images. Optical tomographic reconstructions can be overlaid and registered to the CBCT image set with a resolution of 1 mm to allow precise targeting of tumors or other specific organs and tissues of interest. The system is integrated with Precision X-Ray’s XRAD 225Cx μ-IGRT pre-clinical imaging/irradiator system and is marketed as OptiMAXIGRT Cx.

LICENSED to Precision X-Ray Inc.
R. Weersink, K. Wang, P. Dejean, D. Jaffray, J. Siewerdsen, P. Lindsay, B. Wilson

Researchers at UHN have developed a unique handheld optical molecular imaging platform which enables rapid diagnosis, interventional guidance and response assessment of wound infections at the point-of-care using proprietary optical imaging technology. The device and software tools leverage unique capabilities of multiplexed fluorescent imaging to provide real-time and quantitative information about pathological bacterial load and connective tissue changes in and around wounds that can be tracked and documented in the medical record. The technology is non-invasive and does not require contrast agents. Validation from on-going multicenter clinical trials shows the platform can provide image guidance to the clinician for targeted swabbing/biopsy, better cleaning and debridement procedures and faster chronic wound closure rates (compared with clinical best practice). The goal is to commercialize this UHN imaging innovation in order to heal difficult wounds faster, increase clinical workflow efficiency and standardization, provide evidence-based cost-reduction, and improve clinical outcomes for a better quality of life of patients with wounds.

LICENSED to MolecuLight Inc.
Patents Pending - R. DaCosta, B. Wilson, K. Zhang
Sub-Surface Fluorescence Topography (SSFT) for Depth-resolved Fluorescence of Buried Pathologies

UHN’s biophotonics group has developed a wide-field fluorescence technique and instrument which is able to provide a map of fluorescence buried underneath the surface of tissue in a depth-resolved fashion. The technique is called Sub-Surface Fluorescence Topography (or SSFT) with the primary application being detection of fluorescently-labeled cancer tumors or other pathologies of interest which reside beneath the surface. The technique will aid the surgeon in the resection activities which balance risk of recurrence against excessive normal tissue damage. The instrument extracts information of the sub-surface fluorescence and is able to reconstruct topographical maps of the fluorescently-marked tumor cell nest. A commercial system has been modified for SSFT proof-of-concept in pre-clinical applications with development of an intra-operative imaging system for intracranial brain tumor resection currently underway.

Patents Pending - US13/516,977 and CA - B. Wilson, A. Kim

Forward-Viewing Intravascular Imaging for Guided Therapeutic Intervention

This technology developed by UHN and Sunnybrook scientists and surgeons is a forward-looking imaging platform that enables cardiovascular and other restricted space catheter-based imaging as well as an image-guidance technique for therapeutic device interventions. Although side-viewing OCT/ultrasound catheter, endoscopic and angiography techniques are already established in clinics and surgical suites, there is currently no imaging platform that is small, sensitive and robust enough to be used in forward-viewing intravascular applications. As a result, there is an entire class of indications, including vessel occlusions that cannot be imaged, or treated with non-invasive techniques. The prototype device is small (1.5-2.0mm dia.), sufficiently flexible for cardiovascular applications and low cost (~$100) compared with current side-viewing equipment. Additional applications may include GI, gynecological and neurosurgery interventions.

Granted Patents US7,972,272, CA - N. Munce, V. Yang, A. Thind, B. Courtney

Endoscopic Fiber Optic Shape Tracker (EFOST)

Scientists at UHN, University of Toronto, and Tufts University have developed a system using optical fibers which continuously tracks in real-time the position and shape of endoscopes, colonscopes and other types of flexible medical devices during diagnostic and surgical procedures. The tracking in real-time of the endoscopic shape potentially allows for the safer delivery of the device to human body area target.

LICENSED to MedTrac LLC (Atlanta).

Granted Patent US8,219,180 and Pending US Patent - Caroline Cao, Lothar Lilge, Paul Milgram, Peter Wong
Photo-Dynamic Therapy Device for the Treatment of Bony Metastases in the Spine and Bone
Scientists and surgeons at the University Health Network have developed a novel device which enables the use of photodynamic therapy for the treatment of tumors, lesions and other disease in the bone. This device is secured/implanted to the treatment area on the bone, providing a stabilized and consistent platform for the optical conduit that enables the visualization of the tumour site and the repeated use of various light-based therapy treatments, including PDT. The device is currently in clinical trials at Sunnybrook Health Sciences Centre for spine metastases.

Granted Patents US7,771,426, EU, CA – S. Burch, B. Wilson, S. Bisland

Efficient User Interaction with Polygonal Meshes for Medical Image Segmentation
A technique for improved auto-segmentation of medical images has been developed to facilitate rapid and accurate segmentation or delineation of structures of interest for treatment planning and other applications. The technique further allows an efficient integration of manual and automated inputs in the mesh deformation process which combined allows the accurate and rapid planning for adaptive radiation therapy treatments. The technique is available for non-exclusive licensing.

Patents Pending US20090310835, EP, CN, JP, RU - L. Dawson, M. Kaus

Organ-Specific Enhancement Filter and Probabilistic Refinement for Robust Segmentation of Medical Images
An organ-specific feature enhancement filter as well as a probabilistic model has been developed to improve the reliability of segmentation of medical images. The method quantifies and represents the underlying region of interest as a probability map based on a set of features which subsequently enhances the ROI to be segmented, e.g. by 3-D deformable models. Segmentation is, therefore, guided by the probability map instead of original gray value data. The techniques are available together or separately for non-exclusive licensing.


Automatic Projection of Landmarks to Generate Additional Correspondences in Image Registration
When registering multiple multidimensional images based on landmarks, the system improves the distribution and density of the points in correspondence across images, which are of crucial importance for the accuracy and reliability of the resulting registration transform. Such accurate, efficient and robust tools for image registration and any downstream processing, such as contour propagation or image fusion, are highly demanded for various medical applications, such as adaptive radiotherapy. The technique is available for non-exclusive licensing.

Fluence Field Modulated CT

FFMCT proposes a new paradigm for CT imaging that attempts to better manage the tradeoff between image quality and dose to the patient. In this approach, the pattern of x-ray fluence incident on the patient is dynamically changed during the scan, guided by dose and image quality models that are task and/or patient specific. Research has indicated that FFMCT can potentially deliver user-prescribed, regionally-varying image quality objectives, while reducing radiation exposure to the patient, which according to the most recent publication may be on the order of 30-50% depending on the application. The technique is being improved regularly as evidenced by the string of publications.


Ultra-Fast Compressed Sensing Tomography

UHN researchers have developed and implemented in software a new way of computing compressed sensing solutions to imaging problems that speeds up tomography, especially for CT. It dramatically improves the radiation dose vs. image quality tradeoff for CT scans. Testing has shown that a 512x512 diagnostic image can be reconstructed in a few seconds, without any numerical optimization and acceleration, with 50-90% decrease in radiation dose for CT and 50-90% reduction in scan time for MR depending on the region of interest and targeted image resolution. Moreover, when applied to CT or MRI, it allows fast computations of the images acquired even if only partial data is available, which can be the case if the imaged specimen is moving while the scan is taking place (i.e. cardiac and pediatric applications).

Patent Pending WO2013188957 - P. Gill, M. Hashemi, N. Paul

‘Cold Cathode’ - Modified Spindt Field Emission X-ray Cathode

UHN and U of Waterloo scientists have developed a CNT-Spindt hybrid field-emitter that helps alleviate the problems faced by ‘cold cathode’ technologies for application in pulsed X-ray tubes (CT scanners without moving parts) and flat panel X-ray sources. Current ‘cold cathode’ technologies in development (ie. carbon nanotubes (“CNT”) and Spindt emitters) are directed at replacing traditional thermionic cathodes which suffer from high power consumption, high operating temperatures and slow response times. However CNT’s themselves suffer from uncontrollable density and uniformity as well as high gate voltages, while Spindt emitters require ultra-high vacuums to operate. UHN’s hybrid field-emitter design includes automatic self-aligned growth of CNT’s to ensure uniform height, and a ballast resistor that overcomes non-uniformity of local field enhancement factor at the emitter apex. These two features significantly improve the durability and stability of ‘cold-cathode’ technology and are believed to be the enabler for the ‘cold cathode’ technology to succeed.

Patent Pending – D. Jaffray, J. Yeow, and F. Sun
Synthetic Echo-Time Viewing Technique and Software for MR Imaging

This post-processing magnetic resonance imaging technique allows a user to selectively vary the imaging “synthetic” echo-time (TE) dynamically through a range of echo-time values in an analogous way as “windowing and levelling” features in viewers. This allows for viewing of images at infinite TE’s with only a single T2 map of the anatomy. The technique has been implemented into a PACS viewer for demonstration and trials. In routine spin-echo or fast spin echo MR imaging, tissue contrast is governed by the TE. By an appropriate choice of TE, the contrast between native tissue and pathology may be optimized. The optimization is typically governed by the relative T2 values of the two species and a range of T2 values may be present in both native tissue and pathology and within pathologies. Any single TE value is likely to be suboptimal for the visualization of at least some of the tissue/pathology. Clinical trials have been performed using this post-processing technique in the diagnosis of meniscal and cartilage abnormalities in the knee with additional trials underway.


MRI Motion Compensator

One widely-used technique for motion-compensation in MRI uses navigator echoes to compare two different types of MR data to assess the anatomical motion over the course of the data acquisition. One drawback with conventional methods however is that residual motion may remain in the data because the data is selected based on a minimum (i.e. not necessarily zero) displacement criterion. In the present invention however, navigator data is acquired directly from the anatomy of interest. Unlike conventional methods, the navigators are used to specifically select data that differs by only rigid-body displacements. This is accomplished by selecting data based on the relative similarity, rather than the relative displacement between navigators. Thus, even if the overall anatomical motion is non-rigid-body, the image formed from the subset of selected data can be completely motion-corrected with the appropriate linear k-space phase factors.


Spiral-PR: A Polar k-space Trajectory System for Improved MRI Data Acquisition

In MRI, images are reconstructed from data acquired in a domain known as k-space. The order in which the k-space data is collected is called the k-space trajectory. The most common polar trajectories are spiral and projection-reconstruction (PR). One drawback with existing polar trajectories is that their ability to vary the sampling density is limited. Spiral-PR is a hybrid trajectory which employs spiral sampling on one or more k-space axes, and PR sampling on the remaining k-space axes. This arrangement makes it possible to greatly vary the k-space sampling density. As a result, this trajectory permits a large amount of flexibility in varying, and thus optimizing, the resolution-artifact tradeoff inherent in undersampled k-space acquisitions.

Temporal Dynamic Segmentation (TDS) for Automated 4D DCE Functional Imaging Analysis

This post-processing software tool provides a comprehensive and sensitive analysis method to simplify quantification and reduce workload in 4D DCE applications. Quantitative functional imaging methods have become more prominent for diagnostic target definition and early response detection of treatment efficacy. The development of 4D DCE data requires more sophisticated methods of acquiring 3D functional parameter maps. This developed methodology consists of a time-course, voxel-based approach to tissue classification and functionality for (a) segmenting vasculature and perfused tissue from 4D dynamic contrast-enhanced (DCE) imaging scans containing other anatomical structures, and (b) creating 3D functional parameter maps of perfused tissue for tracer kinetic analysis. Accuracy of segmentation has been established to be within 2%.

Patent Pending US12/954,808 - C. Coolens, J. Barfett, D. Mikulis, T. Krings

DCE Tool Software Plug-in for RIS/PACS Systems

The DCE Tool is a software platform for analyzing Dynamic Contrast-Enhanced CT/MR/PET (DCE-CT/MR/PET) perfusion studies for direct and quantitative assessment of tumour blood flow. The DCE Tool includes the analyses, mathematical modelling and algorithms which provide the complete post-imaging processing required for useful DCE applications. The software includes a simplified workflow for DCE analysis under a variety of kinetic models. ROI analysis as well as parametric map creation is supported. The software is plug-in capable which allows implementation on a variety of RIS/PACS frameworks. The platform is being used in clinical trials at UHN’s Princess Margaret Cancer Center. A ‘free-ware’ version of the DCE Tool is available at www.thedcetool.com to demonstrate its basic capabilities, while the full version including source code is available for licensing.

M. Haider, S.M Kim, I. Yeung, N. Gonzalez, T. Yeung
4D CT Capability for 3D CT Scanners
The availability of 4D computed tomography modalities has until now required the acquisition of new magnets and hardware. This technology enables the installed base of approximately 40,000 3D CT scanners to achieve 4D imaging at a fraction of the cost of new 4D CT equipment. 4D data is determined by making use of a series of 3D CT data sets acquired at various phases in the respiratory cycle in conjunction with a fiducial device. Using a known reference geometry, the technology does not require user interaction with any imagery, thus allowing the estimation of true internal position with sub-voxel accuracy. It also is capable of detecting irregularities in the breathing cycle, such as a cough, producing more reliable results. The technique is available for non-exclusive licensing.

Granted Patents US8,160,675, RU, CN, JP, Pending EU, CA – D. Jaffray, J. Hoisak, M. Kaus, T. Purdie
**Harmonic MRI Phantom**

The Harmonic MRI Phantom was developed specially to accurately measure, as well as correct for, MR distortion which is critical for the use of MR in guided surgeries and interventions. The phantom was optimized to take into consideration the inherent physics behind MR-distortion phenomena, which resulted in a simple design making it relatively inexpensive to manufacture, which translates into lower cost to the end-user. The optimized design allows the user to bundle several tests into one by using the shell to house other instruments. For example, the shell can house a dosimeter system for MR-linac and MR-60Co systems; other MR quality assurance instruments for the measurement of MR contrast, resolution, or field uniformity; or an additional MR phantom for validation or data redundancy.

LICENSED to MODUS Medical Devices Inc.
Patent Pending - T. Stanescu, T. Tadic

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**Multi-Modality Dynamic Imaging QA Phantom**

The phantom and accompanying analysis software allows the performance of quality assurance tests for dynamic imaging. Coupled with an accompanying flow-system, it is capable of creating a wide range of physiologically relevant contrast enhancement curves which are reproducible with minimal error between experiments. The phantom is based on a two-compartment model and is made up of an external cylinder with an internal section containing openings to exchange mass between the compartments. The phantom is controlled by an external flow pump. Separate contrast injectors are able to generate various contrast uptake curves of clinically realistic shapes. It is suitable for use in CT, MR and PET scanners.


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**Calibration Phantom/Software for Dynamic Contrast Enhanced CT Imaging**

This phantom/software system allows for the calibration of Dynamic Contrast Enhanced (DCE) CT techniques on a routine and reproducible basis. A variety of high-contrast vessels are simulated in the phantom replacing the need for different contrast concentration batches to be made. The multiple sizes and orientations allow the user to establish the accuracy of DCE CT measurements in light of partial volume effects and HU calibration. In addition, the sensitivity to motion can be investigated by placing the phantom inside the Quasar moving platform (Modus Medical Devices Inc.) or a similar device. Combined with the associated software, this system can be used for routine QC (daily, monthly and yearly) and CT commissioning.

LICENSED to MODUS Medical Devices Inc.
Patent Pending US13/320,385, CA – C. Coolens, H. Keller
Liposome-Based Multimodal Imaging Agents for Image-Guided Interventions and Diagnosis

Researchers at UHN’s STTARR innovation center have developed a multimodality imaging agent platform based on lipid nanoparticles which are capable of being intravenously injected for enhancing the performance of image-guided interventions such as surgery, radiotherapy and chemotherapy. The imaging agent is capable of being used in different modalities including combinations of CT, MR, PET, and optical imaging. The CT and near-infrared (NIR) fluorescence agent has been developed for surgical guidance. It has been comprehensively characterized with extensive pre-clinical trials showing its effectiveness in highlighting tumours (breast, ovarian, head and neck and lung) for several days after a single administration. Its multimodality nature and its extensive imaging window make it the ideal agent for both pre-operative surgical planning and intra-operative surgical guidance. Its specificity is currently at 100% in these pre-clinical models as evidenced by pathologic sampling. This particular formulation is expected to be an enabler for the image-guided surgery market as well as a more effective solution to displace current use of repeated administration of bolus contrast agents as well as invasively implanted fiducial markers.

HIFU-Activated Imageable Radiation Sensitizer System

A technology has been developed for increasing the susceptibility of cells to radiation therapy for the purposes of increasing cell kill rate within a very narrow imagable region of interest (ROI), i.e. a tumor volume. A capsule containing a radiation sensitizing agent is delivered to the target tissue and can be imaged with MRI, CT, PET, etc.. A highly directional external stimulus such as HIFU or RF disrupts the capsules within the ROI, which releases and activates the sensitizing agent. A map of the spatial distribution of the radiosensitization agent within the target region is then generated from the imaging data set and used to modify the radiation treatment plan in order to optimize the dose and maximize the therapeutic ratio. A hardware implementation consisting of an imaging system to guide the delivery of HIFU or RF and an imaging system to guide RT delivery is also included in this platform. The same technology can be used in its inverse fashion to protect vital adjacent tissue from radiation damage. The application of this approach would see an entirely new paradigm develop with regard to image-guided radiation therapy delivery.

Patents pending US13/696,005, EU, CA – D. Jaffray, C. Allen, J. Zheng, D. Chithrani, J. Grant

Porphysome Targeted Imaging Agent and Payload Delivery Platform

Porphysomes are porphyrin-phospholipid bilayer nanostructures with demonstrated utility as the first biophotonic organic multifunctional nanoparticle for use in single and multi-modality imaging and combined imaging/payload delivery. The high-packing density of porphyrins within the bilayer shell results in extreme fluorescence self-quenching and unprecedented biophotonic properties rivaling inorganic nanoparticles such as gold nanoparticles with superior advantages. The inherent multimodal imaging nature of porphysomes has been illustrated for fluorescent imaging, PET imaging, photoacoustic, optical, and MRI imaging techniques. Additional capabilities including the targeted delivery of a variety of payloads have also been demonstrated. The expanded theranostic capabilities have been validated. In addition a Raman reporter molecule which serves as both a dye and a stabilizing, biocompatible surface coating agent on gold nanoparticles for SERS has been developed. The simplicity and cost-competitiveness of porphysome nanoparticles overcomes many of the hurdles encountered for clinical translation such as biocompatibility, tissue targeting, scale-up production, and reproducibility.

EDUCATION AND TRAINING

Medlantis.org On-Line Radiology Education Platform
UHN has developed and is operating an on-line CME-accredited education platform for the medical imaging community. The medlantis.org website includes over 200 video lectures developed from a roster of world-recognized practitioners and researchers. The 20-minute lectures are linked with a radiology library containing 45,000 pages of text, 93,000 images, and 2,500 clinical cases provided by Thieme, a world-leading publisher of medical education materials. The available content continues to grow with additional relationships with other renowned radiology clinics in North America. Medlantis.org subscriptions are being distributed around the world with several ‘Top 20’ hospitals and large medical device companies using it as their platform for medical imaging continuing education. Launched just two years ago, the website now hosts >5000 users per month and is growing. Subscriptions to Medlantis.org are available to individuals, groups, companies and universities.

K. Murphy

Online Interactive Educational Modules Based on 3D Anatomic Models
The Perioperative Interactive Education (PIE) team at UHN has created a wide range of online educational modules that can be used by medical educators in lectures or by trainees for self-study (http://pie.med.utoronto.ca, 500,000 visitors/year, 960 hospitals, 740 universities, 150 countries). These modules are based on 3D anatomic models of the following organs:

- Heart (Virtual TEE, Virtual TTE, Cardiac Embryology)
- Lung (Lung ultrasound)
- Liver (Virtual Liver)
- Spine (Virtual Spine)
- Surgical video illustrated with 3D models of organs and vessels (Toronto Video Atlas of Liver, Pancreas and Transplant Surgery)

These tools can be customized for particular industry application and integrated directly into privately-hosted facilities.

G. Tait