

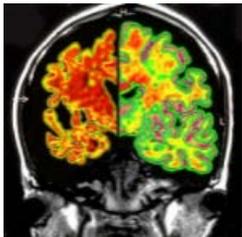
# U of T Technology Opportunities

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## Information & Communications Technology

### Alzheimer's Language Analysis System (ALAS)



P1620 • Donna Shukaris • [donna.shukaris@utoronto.ca](mailto:donna.shukaris@utoronto.ca) • (416) 946-7247

This analyzer detects changes in grammar and vocabulary occurring over time, and allows for differentiation between individuals who are simply aging and those that may be suffering from Alzheimer's disease.

### CyborGlog: A Computer Program for Capture, Sharing, and Annotation of Content



P1498 • Kurtis Scissons • [kurtis.scissons@utoronto.ca](mailto:kurtis.scissons@utoronto.ca) • (416) 978-3557

With the development of wearable personal electronics, such as smart phones, it has become increasingly easier to capture and share our personal experiences with others. We have entered an age of "inverse surveillance" where we are recording our personal experience as we engage in that activity. Developed in part by Dr. Steve Mann, this invention relates to a system, method and computer program for capture, sharing, and annotation of what is being recorded, thus enabling the analysis of the information is being captured.

### Divcam – Distance Mapping Camera



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DivCam, which uses the decay rate of illuminating light as a yardstick for three dimensional distance mapping of one or more target objects. Simultaneous focus of all of the objects in a scene, near or far, multiple or single, without the usual physical movement of the camera's optics, represents a true advancement that is further distinguished in terms of high-resolution, distance mapping, real-time operation, simplicity, compactness, lightweight portability and a projected low manufacturing cost. Lead potential applications include: general purpose of mapping distance of any object, robotics, TV camera to fabricate virtual studios, medical use as a laparoscope, aid to the blind, non-contact fingerprinting, and cameras to generate side profile of objects from front view profile.

### Enveloping Anatomy Learning System (Anatomy Glove and Video)



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Professors McKee and Agur have developed an anatomically-correct hand skeleton glove. The glove is currently in use by students and professionals. The concept behind the 'glove' is to allow users to precisely locate corresponding bone structures and muscles on their own hands. The glove provides a platform to draw and mark locations of the study areas while the students can now clearly observe and interact with the learning materials on a personal level, resulting in a more effective learning experience than traditional methods. The 'Anatomy Glove and Video' package gives students the opportunity to further learn about the hand bone structure by following the video demonstration showing human specimen.

## Extended Touch Technology

**XTOUCH**

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The Extended Touch Technology (Xtouch) is a system and method for detecting and localizing taps on any surface by utilizing the audio input source within a mobile device. The novelty of this invention is that the system does not require any additional hardware and could be implemented on almost any device with a single microphone. Essentially, Xtouch technology turns any surface into an interactive medium for end users.

## Forest Fire Management Decision Support System

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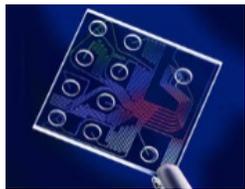
*Fire Data Insights'* patent-pending technology can extract, filter, and process performance and fire suppression effectiveness data from Aircraft Tracking Systems. This allows agency staff to make better decisions on how to deploy their limited resources for greater effectiveness in fighting fires. This technology will be of interest to forest fire management agencies around the world.

## iTest: A Remotely-accessible, Modular Platform for Testing Motors

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The invention is a quantum leap towards end-to-end motor solutions, which allows end-users to test motors with a load condition of their own real-world application. This will provide the customer with more detailed and accurate information than what is usually given in the datasheets for motor performance, enabling the user to make a more reliable and efficient decision. When purchasing a motor, drive-system or transmission mechanism, the customer mostly depends on the data graphs provided by the manufactures. If the application that the customer is intended does not run satisfactorily on the motor they have purchased, then the system needs to be returned and the customer needs to wait to receive and test the next motor. Our system will save a significant cost of shipping and returning of the unit and the time wasted during the process. The outcome of this project will help motor manufacturers have distinct advantage in their product offering. This advantage will help a manufacturer sell more of their motors comparing to their competition, and possibly charge a premium for their motors. The invention will realize the value by providing manufacturers the access to the necessary hardware and software technologies to capitalize the benefit.

## Lab-On-A-Chip: Microfluidic Flow Cytometry



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This technology specifically addresses the shortcomings of the latest microfluidic based flow cytometry devices. The device combines integrated optical circuits, electrodes, laser induced fluorescence and electrophoresis to provide an integrated, more efficient and lower cost solution that can be used for patient analysis/diagnosis, as well as early disease detection. This device performs on-chip single-cell analysis, an essential component of early disease detection, diagnosis and prognosis. The lead application is targeted at blood disease, specifically leukemia and lymphoma, thereby enabling more efficient diagnosis/analysis, with the practical benefit of enabling more efficient examinations through distributed point-of-care locations, including physicians' offices and/or homecare. This technology can also be applied to other various fields-of-use within human health (including HIV, cardiovascular disease, drug development) and beyond (i.e. zoology, forestry and environmental monitoring).

## Location Tracking and Proximal Determination Technology

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Orienteer is a method to support information and content sharing between proximate devices. It uses sample images from a mobile device's camera and uses computer vision to extract visual features from the samples image. These features are then matched against those from images captured by other devices. In doing so, the system can then determine the orientation of each

device relative to one another. The Orienteer service will allow application developers to support rich orientation-aware interactions in their own mobile software.

## Psiphon – A Circumvention Software



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Psiphon provides a suite of network software aimed at preserving security, privacy, and access to content. By deploying our award-winning solutions, you will be able to make use of Psiphon's robust network infrastructure and operational expertise, ensuring your content gets past blocks and filters. With Psiphon, you can brand the products however you choose, and lead people using them straight to your front page. Have a look at our individual products, and find out what makes Psiphon the right delivery partner for your content. [www.psiphon.ca](http://www.psiphon.ca)

## Subdermal Deception Detection

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Professor Lee and his team are developing a novel covert method for detecting deception using subdermal optical technology. The technology under development concerns an entirely novel approach to deception detection. This new technology, called subdermal optical deception detection (SODD) utilizes a well-known optical effect: lights can travel beneath the skin and reflect, which allows us to obtain optical images of subdermal hemoglobin concentrations with the use of polarized red filters during truthful and deceptive communication. Our goal is to develop this method to be fully automated and thus can be used by medical, law enforcement, and military professionals.

## Synchronised Control of Unmanned Aircraft

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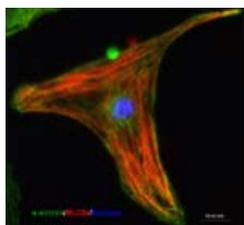
With the rapid growth of unmanned vehicle systems (UVS), including both aerial vehicles and ground vehicles, there is an increasing demand in autonomous coordinated applications, thereby allowing them to work in formations for military missions as well as civil and commercial applications. A generic motion synchronization technique has been developed by the Professor Liu to enable and improve formation performance. The technology provides a highly accurate ability to control the relative position, velocity and orientation of each individual vehicle through real time communications, and ensures they perform coordinated tasks.

## U of T Medical Electives System

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Online course registration and management system for medical school elective courses. The Licensee will receive two versions of the University of Toronto Medical Electives System, one for use by students within Canada), and the other for use by students outside of Canada. The system allows students to submit their credentials and select requests for elective courses, and process the payments of elective courses via credit card pending administrator's approval. On the administrative side, the system supports the workflow of authenticating a student's credentials via their home school, and once verified allows the student to be registered to his/her elective courses, processes his/her payment, and communicates the status of the student's request to the student at each step in the process.

### Cardiomyocyte Label-Free Isolation

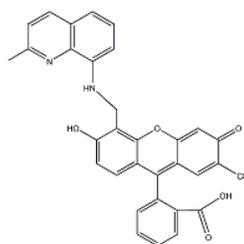


P1638 • Marilee Krinsky • marilee.krinsky@utoronto.ca • (416) 978-2514

This technology, from the labs of Dr. Milica Radisic's, enables the isolation of cardiomyocytes (CMs) from heterogeneous populations. The enrichment is rapid and the cells are label-free. The technique is appropriate for skeletal myoblasts, red blood cells and smooth muscle cells as well as for antibody tagging of cells with weakly expressed surface markers. The technology works for CMs derived from human stem cells as well as mouse and rat CMs, and enables separation of human atrial vs. ventricular

CMs in a label-free manner. It has applications for research, drug testing and cell therapy, and is simple to use with a column format.

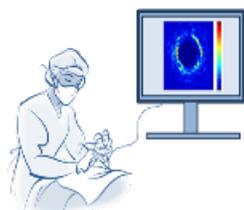
### Controlled Nitric Oxide Release for applications in Wound Healing and Glaucoma Treatment



P1489 • Jennifer Fraser • jen.fraser@utoronto.ca • (416) 946-5515

Nitric oxide (NO) has been shown to play a critical role in enhancing wound healing and potentially beneficial in several disease conditions in the eye such as primary open-angle glaucoma (POAG) and corneal wound healing. Our novel NO releasing polymer complexes provide controlled release of NO for an extended duration (10 days or more), suitable for wound treatment particularly for chronic non-healing wounds. This U of T developed technology presents a significant advantage over prior art systems that generally cannot maintain the release of NO for more than a few hours.

### Device to Predict Cortical Breach in Spinal Fusion Surgery



P1685 • Ian Stewart • iani.stewart@utoronto.ca • (416) 946-7734

Spinesonics Medical Inc. presents Pedicprobe<sup>TM</sup>, a novel navigation sensor to provide an innovative solution for guiding the insertion of pedicle screws (traditionally positioned by feel) into the spine. The device is currently under development and will offer real-time ultrasound-based visualization at the tip of a surgical toolkit.

Benefits and Advantages:

- Real-time imaging for real-time adjustments
- Unique: Non-radiant, portable, affordable
- Effective: Improved clinical benefits and outcomes
- Lower costs in healthcare (less revision surgeries) and surgeon training

### Discovery of Genes That Control Pathogen Resistance in Plants

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The research team has identified novel genes that play a key role in pathogen resistance in plants. Given the economic impact of pathogen infection of agriculturally and horticulturally important crops, there is a need for plants having increased pathogen resistance, methods of enhancing a plant's immunity to pathogens and methods for screening populations of plants for plants exhibiting enhanced pathogen resistance. Future studies are planned to generate new cultivars with enhanced disease resistance and prolonged- life expectancy.

### Gd-Free MRI Contrast Agents

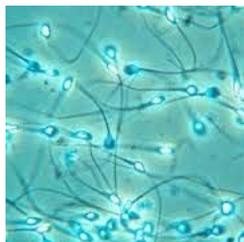
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Via rational design, we have successfully synthesized a series of novel manganese porphyrins (MnPs), to be used as a Contrast Agent, with significant higher relaxivity at high field and optimized biocompatibility, as tested both *in vitro* and *in vivo*. In

addition, we have demonstrated that different pharmacokinetic properties are more ideal for different applications (e.g., cancer imaging, perfusion MR, tissue targeted imaging, DCE-MRI or magnetic resonance angiography (MRA)).

Currently, two novel MnPs; MnTCP and (MnTPPS3)<sub>2</sub>, have been selected for further validation through clinical trials. Both MnPs, exhibit an anomalously high T1 relaxivity (r1) at high magnetic fields, an unusual property that is distinct from that of typical clinical Gd CAs, such as Gd-DTPA (Magnevist). We have demonstrated these novel porphyrin-based imaging agents have great potential, not only to replace the existing Gd-based clinical CAs, but other biomedical applications.

## High Throughput Device for Sperm Separation for the use in Artificial Reproductive Technologies



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The research team has developed a one-step, easy-to-use device for semen purification for human assisted reproduction and animal artificial insemination. It is intended to revolutionize sperm selection by removing the need for centrifugation steps which causes sperm DNA damage. Improving the DNA quality will improve the success rate of fertilization. Further studies are currently underway to refine existing prototypes and validate the device for use in humans and animal.

## Identification of a Novel Biomarker Signature for Beta Cell Dysfunction in Diabetes

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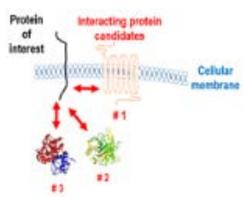
The inventors have discovered a new biomarker signature for gestational Diabetes Mellitus (GDM) and Type 2 diabetes (T2D) that demonstrates a link between beta-cell dysfunction and diabetes and thus provides a target for therapeutic drug development. Converging lines of evidence have shown that significant increased levels of Cx, a furan fatty acid (Carboxy-4-Methyl-5-Propyl-2-Furanpropanoic Acid), is involved in maintaining glucose homeostasis and in the possible development of these diseases.

## Linker Microemulsions as a Transdermal Drug Delivery Vehicle

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We have developed a novel formulation for biocompatible microemulsions for use as delivery vehicles for active ingredients in transdermal, topical and oral delivery. The formulation is based on five basic ingredients: lecithin (extracted from soybean or other source); a lipophilic additive such as long chain alcohol or long chain fatty acid, monoglyceride, or sorbitol ester; a hydrophilic additive containing C6-C9 fatty acids partially saponified; a C8-C20 fatty acid ester; and water. Particular combinations of these ingredients, at specific ratios, yield thermodynamically stable microemulsions capable of increasing the solubility (in isotonic solutions) of hydrophobic drugs such as lidocaine, and alpha-tocopherol acetate by more than 20 fold.

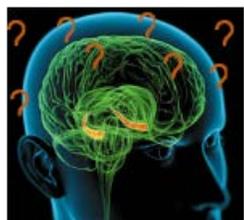
## Mammalian Membrane Two-Hybrid (MaMTH) Technology, a Novel Protein Interaction and Drug Discovery Tool



P1715 • Ian Stewart • iani.stewart@utoronto.ca • (416) 946-7734

Complex multi-protein clusters play vital roles in many aspects of biology. Deregulation of these clusters may lead to several human diseases including cancer, cystic fibrosis, cardiovascular and neurodegenerative disorders. This technology uses a bait (protein of interest) - prey (candidate molecules) system to detect and identify novel interacting partners in a mammalian genetic system. Dr Stajlar has built upon his initial patented Membrane Yeast Two-Hybrid (MYTH) invention to propose a unique platform to discover new target molecules for research and drug development purposes.

## Methods for the Prevention and/or Treatment of Memory Impairment



P1661 • Ian Stewart • iani.stewart@utoronto.ca • (416) 946-7734

Over 234 million surgical operations are performed worldwide each year. General anesthetics have dramatically reduced human suffering, but the mechanisms of action of these drugs remain poorly

understood. The hippocampus (memory centre in the brain) shelters a population of inhibitory receptors that underlie the memory-blocking properties. GABA (i.e., g-aminobutyric acid) receptors are the most abundant and widely distributed within the central nervous system of mammals. Therefore, these receptors play pivotal roles in virtually all brain functions including memory. Up- and down-regulating the activity of these receptors impairs and improves memory function, respectively.

Dr Orser's research aims to understand how anesthetics regulate key inhibitory receptors in the brain. Post-anaesthetic memory loss represents an undesirable and poorly understood adverse effect. Such memory issues after surgery may lead to reduced quality of life, increased admissions to long-term care facilities, premature retirement and death. Modulating the activity of GABA receptors before, during, and/or after the surgery may help patients avoid memory issues, and reduce secondary health care costs due to general anesthesia.

### Minimally Invasive Intrathecal Drug Delivery

P1421 • Marilee Krinsky • marilee.krinsky@utoronto.ca • (416) 978-2514

We have developed novel blends of hyaluronan and methylcellulose (HAMC) as drug delivery systems which retain the wound healing properties of HA. The hydrogel alone reduces markers of inflammation and scar formation, assists dural healing, is non-cell adhesive, and is injectable through 30 G or smaller needles. Both polymers are well characterized and have been approved for multiple medical applications. Using HAMC we have demonstrated delivery of both large (150 kg/mol) hydrophilic biomolecules and small (~0.5 kg/mol) hydrophobic and hydrophilic drug molecules for time periods ranging from hours to months.

### Mitochondria Penetrating Peptides

P1599 • Jennifer Fraser • jen.fraser@utoronto.ca • (416) 946-5515

The invention provides an antimicrobial for treating Gram+ pathogens, comprising drugs (particularly repurposed anti-cancer agents) conjugated to Mitochondrial Penetrating Peptides (MPPs). Conjugation of drugs to the MPPs can improve efficacy of drugs with poor activity due to accumulation in the mitochondria. Due to the emergence of highly resistant pathogens, there is a need to identify new treatments to overcome this problem. We feel this is a highly promising solution and have demonstrated the effects; highly toxic to bacteria while remaining innocuous to human cell, *in vitro*. See Horton et al. Chem. Biol. 15:375-382 and Horton et al. Chembiochem 13(3): 476-85 for more information.

### MNAzyme Based Gold Nanoparticle Sensor



Point-of-care devices

P1694 • Ian Stewart • iani.stewart@utoronto.ca • (416) 946-7734

Point-of-care (POC) diagnostics is one of the fastest growing research themes. Simple, cost-effective, and rapid POCs are important to clinicians to make quick and appropriate treatment decisions.

This project combines two technologies to create a biosensor that can detect genetic targets, and be further exploited in POC devices. The technology lies on an enzymatic reaction that displays a colorimetric change when specific genetic targets are recognized. This detection strategy is a simple 1- to 2-step assay, low cost, with a better sensitivity than the standard diagnostic technique ELISA. This invention may provide easier and faster POC diagnostics.

### Multifunctional Bioactive Micro/Nano-particles to Enhance Anti-Bacterial Property, Integrity and Fracture Toughness of Dentin Hard Tissue in Root Canal Treatment

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This invention embodies a novel method that uses proprietary composition of stabilized multifunctional nanoparticles in combination with photodynamic activation to obtain durable and more effective endodontic treatments. The use of a natural biopolymer allows a better integration into the dentin host tissue, and the production of anti-microbial activity similar to natural dentin. The biopolymer nanoparticles conjugated with photosensitizers have the dual effect of increasing anti-biofilm efficacy and minimizing toxicity compared with standard root canal filling materials. The combination of engineered nanoparticles and

photo-activation will destroy remnant microbes and promote a natural mineralization of treated teeth, thus reinforcing the hard tissue dentin while limiting bacterial entrance.

## **Novel Industrial Enzymes for the Derivation of High-value Biochemical and Biopolymers from Plant Biomasses**

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Our research team has discovered, characterized and engineered novel gluco-oligosaccharide oxidases (GOOX) with the ability to detect and oxidize oligomeric sugars, and the potential to create high-value biochemicals and biopolymers from hemicellulose and cellulose extracted from plant biomasses. These novel industrial enzymes have application in a number of large global industries including: detergents, food and beverages.

## **Novel Methodology for In-ViVo Directed Evolution of DNA-Binding**

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This invention focuses on a novel method to block the division of cancer cells by administering minimalist hybrid proteins (MHPs). MHPs are short proteins (25-75 amino acid-long) capable to migrate into the cell nucleus of cancer cells to impair interactions between DNA and transcription factors (proteins), block cell division, and ultimately lead to cell death.

## **Novel Neuroprotective Peptides for the Treatment of Optic Pathologies**

P1629 • Marilee Krinsky • marilee.krinsky@utoronto.ca • (416) 978-2514

The inventors have discovered multiple peptides that target C-terminal interactions between proteins involved in cell death, thereby acting as competitive inhibitors of Retinal Ganglion Cell apoptosis. These peptides promote RGC survival after optic nerve transection (retinal trauma) or ophthalmic artery ligation (retinal stroke). We have observed neuroprotective effects via multiple routes of delivery: intraocular injection, intravenous injection, via injection into the injured optic nerve, and an eye-drop formulation. Further validation studies are underway for the clinical development of the technology towards the treatment of visual diseases such as glaucoma.

## **Nucleolin: A Novel Target for the Investigation of RSV Therapy**

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Dr. Hegel from U of T has identified the RSV receptor in humans and has shown that blocking the human receptor interaction with the RSV virus attenuates infection and reduces viral loads *in vitro* and *in vivo*. These observations provide a viable framework for the development of effective RSV therapeutics. The identification of a novel functional RSV receptor can contribute to the understanding of RSV infection and serve as a model system for the development of an effective RSV treatment paradigm. Nucleolin is a new target for studying the pathogenesis of RSV infection and provides a validated framework for the development of novel RSV therapeutics.

## **Pharmaceutical Intervention to Decrease the Threat of Hypoglycemia in Insulin-Treated Patients with Diabetes**

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Dr. Vranic's lab has been exploring the mechanisms by which counter regulation, glucose production and glucose utilization is altered in diabetes and following antecedent hypoglycemia. Research on a class of peptides, Somatostatin Receptor Type 2 (SSTR2) antagonists, has demonstrated that inhibition of Somatostatin action via inhibition of the main Somatostatin receptor in the alpha-cells of pancreatic islets normalizes the glucagon response, improves the corticosterone response, and markedly increases epinephrine hormone counter regulation in streptozotocin-diabetic rats, thus offering preliminary validation of this therapeutic strategy.

## QHREDGS Peptide in Survival and Expansion of Human Stem Cells and Their Cardiovascular Progeny

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We identified a novel peptide sequence, QHREDGS that promotes survival of cardiomyocytes and endothelial cells under conditions of oxidative stress or in response to apoptosis inducing agents. The QHREDGS peptide sequence is a binding site for Angiopoietin-1 protein growth factor, and supports myocyte integrin-based adhesion and cell survival. This sequence is entirely novel; no previous reports exist in the patent or scientific literature other than our own report. The peptide and peptide conjugate are unique because of the unique integrin binding site of the peptide. This has not been reported before as a fragment of the angiopoietin protein to bind integrin sites. The function of the peptide would therefore not be known. We have conjugated the peptide to hydrogels for cardiac regeneration, demonstrating improved survival of cardiomyocytes encapsulated in biomaterials *in vitro* and *in vivo*.

## Readily Available Unprotected Amino Aldehydes

P1590 • Ian Stewart • iani.stewart@utoronto.ca • (416) 946-7734

These novel amino aldehydes have cost-reducing potential for the fine chemical and medicinal chemistry sectors. Companies currently involved in the fine chemical and pharmaceutical industries could benefit from significant reduction in processing steps and the generation of advanced intermediates for drug or chemical manufacturing. This chemistry can be implemented to produce novel organic molecules for drug discovery platforms. A new class of compounds, containing two functional groups, an aldehyde and an unprotected amine has been developed. This finding has solved a significant problem in complex amine chemistry. Construction of complex biologically active molecules is now feasible with minimal use of protecting group manipulations.

## Selective Enhancement of Electrical Nerve Excitability

P1692 • Donna Shukaris • donna.shukaris@utoronto.ca • (416) 946-7247

Electrical neuromodulation is an effective therapy for treating chronic disorders such as urinary dysfunction, Parkinson's disease, and pain. Although the current generation of implanted devices is widely accepted clinically, there is significant market interest in developing less-invasive methods of electrically activating the nervous system. The successful implementation of such an approach could significantly reduce the overall cost of therapy, and also capture a larger population of patients (e.g., mild to moderate symptoms) who would otherwise forego this mode of treatment. A technology developed by Dr. Paul Yoo at the University of Toronto has been developed to meet this market need.

## Small Molecule STAT3 Inhibitors: Promising Cancer Therapeutic Agents

P1613 & P1614 • Ian Stewart • iani.stewart@utoronto.ca • (416) 946-7734

Dr. Patrick Gunning at the University of Toronto has synthesized a library of >300 analogues of STAT3 inhibitors based on the previous inhibitor S31-201—the most potent member that displays more than twice the original potency for STAT3 dimer disruption. A key structural feature of these inhibitors is a salicylic acid moiety, which, acting as a phosphotyrosine mimetic, facilitates binding to the STAT3 SH2 domain. We have derived novel high-affinity ( $KD$ , 504 nM) STAT3 SH2 domain-binding ligands, which potently inhibit aberrantly-active STAT3 and its functions and blocks tumor cell growth, survival, migration and invasion *in vitro*. Intravenous or oral gavage delivery of most potent agents furnishes low micromolar levels in tumor tissues and results in growth inhibition in mouse xenografts of human breast and lung tumors.

## System to Enhance Expression of Key Pluripotency Genes and the Formation of Induced Pluripotent Stemcells during Somatic Cell Reprogramming

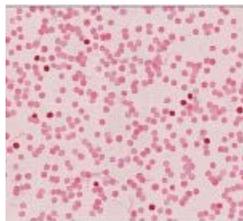
P1633 • Sonya Brijbassi • s.brijbassi@utoronto.ca • (416) 946-3483

Our group is the first to identify the muscleblind-like RNA binding proteins, MBNL1 and MBNL2, as conserved and direct negative regulators of a large program of cassette exon alternative splicing events that are differentially regulated between ES cells and other cell types. Our results reveal that MBNL proteins negatively regulate ES-cell-differential alternative splicing

network that promotes the expression of core pluripotency genes via FOXP1 and controls reprogramming of pluripotent stem cells. Thus we have identified a new system that may at least replace miRNAs in efficient reprogramming protocols based on our finding that suppression of Mbnl proteins is key for the rapid formation of productive (i.e. stabilization-competent and fully pluripotent) iPSCs.

## Physical Sciences & Engineering

### Automated Cell Counting System for Clinical Kleihauer-Betke Test



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The KB (Kleihauer–Betke) test is a blood test performed on approximately 15-20% of pregnant women to measure the amount of fetal hemoglobin transferred from a fetus to a mother's bloodstream. The most reliable way to do the KB test is by flow cytometry. However, because of the high cost of the equipment and the complexity and cost of its operation, the most used procedure in hospitals is manual counting. The system resulting from this project will be capable of rapid, automated, accurate counting of maternal and fetal red blood cells to provide reliable KB test results. The proposed automated RBC counting instrument for KB testing will be uniquely capable of filling a sizable market niche in the sector of women's healthcare.

### Energy Storage and Conversion



P1634 • Fabio Almeida • fabio.almeida@utoronto.ca • (416) 946-7248

Electricity storage technology that has the capability to both; store a large amount of energy and be charged and discharged quickly is urgently needed. The required technology must have both high energy and power density. While there are numerous methods of portably storing electrical energy, ranging from capacitors to batteries, there is often a trade-off between high energy and high power. The Seferos Group at U of T has developed novel conjugated polymers and plastics that are designed to behave as semi-conductors for use as supercapacitors. The technology is poised to fill a number of current technological needs, for example:

1. It will boost the adoption of alternative energy sources like solar, wind, and tidal by providing back-up power and smoothing out power fluctuations.
2. It will increase the range of electric vehicles
3. It will extend the life of batteries, and reduce the size of battery required, in electric vehicles and portable high power electronics.

### Hybrid Polymer-Inorganic Nanocomposite Materials

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This technology is a platform for creating new material systems for use in the electronic, optical sensor or other industries. Researchers in the lab of Dr. Eugenia Kumacheva have developed self-assembly spherical polymer particles which can store a variety of additives such as dyes or other functional agents in either the spherical core or the surrounding polymer matrix. It has been shown that it is possible to imbed semiconductor or inorganic particles in the polymer system to create a self-organized periodic array of active nanoparticles such as quantum dots. This technology has three issued US patents associated with it.

### Microfluidic Device for Parallel Multiple Processes

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A group in the Department of Chemistry at U of T is developing multiple continuous microfluidic reactors and a process to scale up the synthesis of polymer particles. The target is to produce micro-beads with a narrow size distribution in the range from 10 to 500 microns, well defined structure and high conversion of monomer to polymer efficiency. High throughput continuous microfluidic reactors have a clear advantage in the synthesis of polymer particles because of the control in the dimensions, shapes and structures that they provide and may have an important role in the fabrication of ion exchange resins, calibration standards, spacers for flat panel displays and switchable windows and in various biomedical applications.

## Micro-nano Manipulation Portfolio

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Intelligent manipulation (e.g., grasping/gripping) of micro- and nanometer-sized objects requires the use of miniaturized micro grippers with integrated force sensors. Our gripping devices are capable of providing multi-axis force feedback to protect the gripper and detect the contact between the gripper and the object to be manipulated, and to provide gripping force feedback during grasping to obtain secured grasping while protecting the object to be grasped. They also include a mechanism for active release of objects via a plunger that are capable of accurate, rapid and repeatable actions for the manipulated object to overcome adhesion forces and land at a desired target location.

## Miniaturized Device Arrays for Applying Mechanical Forces to Biological Cells and Thin Films

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This system is a high throughput screening system that enables the characterization of biomaterial mechanical behaviour and screening of cellular responses in mechanically active environments. It allows systematic characterization of biomaterial mechanical behaviour; and screening of mechano-biological factors that direct cell fate and function. Neither of these outputs can be achieved using state-of-the-art technologies, and therefore we expect interest in the array platform from companies involved in the biomaterials, tissue engineering, and regenerative medicine biotechnology sectors

## Poly (3-alkyltellurophenes): Stable, Dopable Conductive and Semiconductive Polymers

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This is the first synthesis and optical characterization of the organic semiconducting polymer material Poly (3-alkyltellurophene). This material was discovered under work on NSERC Discovery Grant and Connaught Innovation Award. This material is related to the polythiophenes; they been researched and developed for use in multiple applications (including printed electronics, OLEDs, OPV, etc.) over the past 3 decades. The advantages of this new dopable semiconducting polymer compared to the polythiophenes (which are currently entering the marketplace) are the relatively small optical bandgap and absorption of lower-energy photons of red and near infrared light. This will primarily be advantageous for photovoltaic applications. Additionally, greater polarizability and higher dielectric constants are expected and are useful in electronic materials and semiconductors.

## Quantum Dot Processing

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Semiconductor nanocrystals, or quantum dots (QDs), have received great interest from the biological and medical communities due to their unique optical and electronic properties of QDs and their advantageous properties over organic-based fluorophores for many biological applications. QDs have high luminescence (1 QD = 10 to 20 fluorophores), high resistance to photobleaching, narrow spectral line widths, and size and materials-tunable emission that can be excited using one single wavelength. A major hurdle in the use of QDs for biological imaging and detection is the non-biocompatible surface coating. Researchers at U of T have developed a simple approach for the mass-scale and cost effective preparation of biocompatible QDs. These QDs maintain all of the optical and dimensional properties of their organic coated counterpart. They have also characterized the optical properties of these QDs in biologically relevant environments and demonstrated the ability to conjugate biomolecules onto their surface.

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