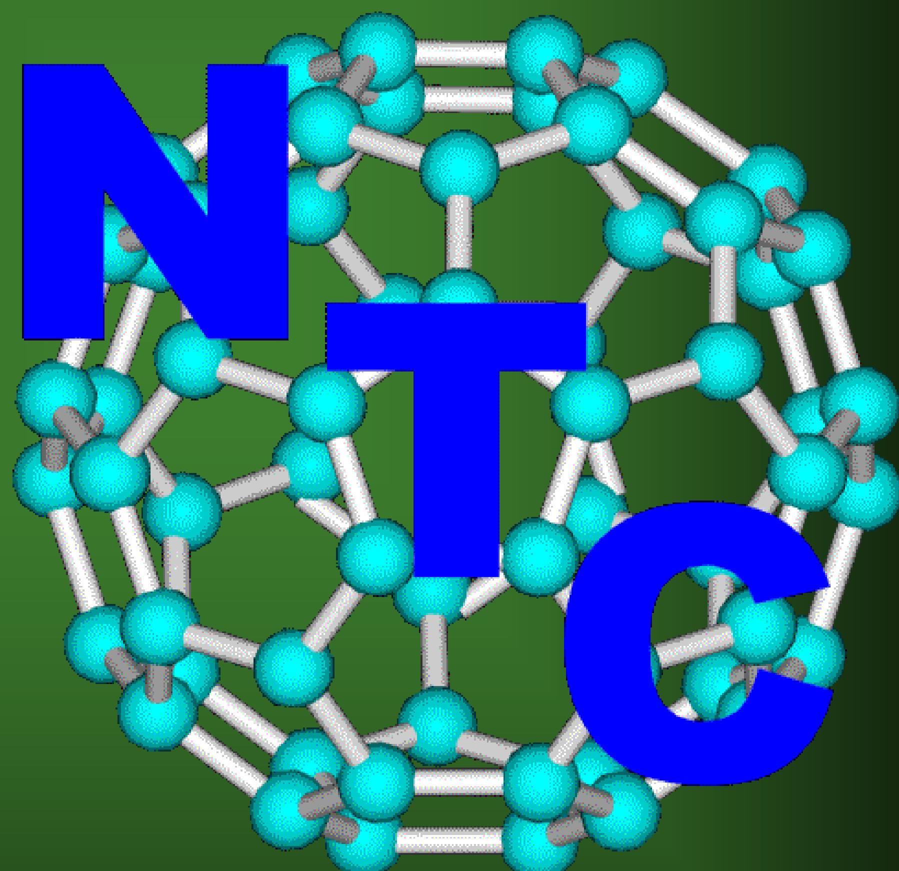
March 2011 issue

IEEE NTC NEWSLETTER



INSIDE THIS ISSUE:

President's Column

Prof. Ning Xi of Michigan State University has been elected as the new IEEE Nanotechnology Council President and will serve the Council starting from January 1, 2010 to December 31, 2012. Dr. Xi received his D.Sc. Degree in Systems Science and Mathematics from Washington University in St. Louis, Missouri in December 1993. He received his M.S. degree in computer science from Northeastern University, Boston, Massachusetts, and B.S. degree in electrical engineering from Beijing University of Aeronautics and Astronautics. Currently, he is the John D. Ryder Professor of Electrical and Computer Engineering in the Department of Electrical and Computer Engineering and the Director of Robotics and Automation Laboratory at Michigan State University. He is a Fellow of IEEE. Dr. Xi has accomplished tremendously in the research of robotics and automation, in particular in the area of nano robotics, nano manipulation and nano assembly. He and his graduate students have developed an augmented reality enhanced nano manipulation system, which enabled humans to directly manipulate nano scale objects in the nano environment. This lays down the foundation for the assembly of nano scale devices and systems. Dr. Xi served as the vice president for publication of IEEE Nanotechnology Council (2006-2007). He was the General Chair of 2009 IEEE Nanotechnology Materials and Devices Conference.

Dr. Xi intends to lead the Council to better serve its members. The major goals of his presidency are to enhance the technical spectrum of the IEEE Nanotechnology Council, to increase its industrial participation, and to strengthen the financial standings of the Council. Specific endeavors he strives to complete in the next two years include (1) to further improve the publications of IEEE Transaction on Nanotechnology and IEEE Nanotechnology Magazine; (2) to work with other IEEE societies to develop more conferences, workshops and symposiums in the areas most representative of nanotechnologies; (3) to develop the nanotechnology lecture series to promote the research, development, and education of the nanotechnology, and to reach out to industries and general public. The successes of these efforts will enable the IEEE Nanotechnology Council to financially viable, and promoting it to become the premier professional organization of nanotechnology in the world.

Contact Info
2120 Engineering Building
Michigan State University
East Lansing, MI 48824, USA

Tel: 517-432-1925
Fax: 517-353-1980
E-mail: xin@egr.msu.edu

Editor`s Column

Welcome to the first issue of the NTC IEEE Nanotechnology Newsletter for 2011. Thank you very much for your readership and your invaluable comments on how to improve the newsletter. It is our hope that the newsletter will become a platform for both dissemination of information on the latest work on nanotechnology as well as for exchanging ideas. In this issue, I am happy to include two articles that report on the ability to manipulate tiny objects, and the potential of nanoparticles for cancer therapy applications. Also in this issue, Prof. Leburton from UIUC has kindly shared his experience at Peking University and Seoul National University as the IEEE Distinguished Lecturer. I encourage you to continue to support the newsletter by sending us commentaries, articles, news and whatever you think the general community of nanotechnology is interested in.

We look forward to hearing from you.

Sincerely,

Dr. John T.W. Yeow

Systems Design Engineering Department,
University of Waterloo,
Waterloo, ON, Canada.

IEEE NANOTECHNOLOGY COUNCIL

Tiny Robots, Massive Potential

Pinhas Ben-Tzvi and Will Rone

Robotics and Mechatronics Laboratory,
The George Washington University.

As nanotechnology has evolved from science-fiction to a fertile field of study in science and engineering, researchers have worked to translate macro-scale systems to the molecular level. An example of this is robotics, where efforts have been made to integrate nanosystem design and control to create useful technologies for a suite of applications. On the nanoscale, three major challenges related to design and control manifest: locomotion, manipulation and supplying power. These challenges can be addressed by adapting biomimetic solutions and utilizing these solutions in various applications.

Biomimetics

The dominant approach in designing nanorobots has been to mimic features observed in nature. Specifically, cells have been the starting point for a wide range of research relating to nanorobotic locomotion. Flagella are one such feature adapted for their robust performance at the nanoscale while still providing flexibility in terms of manufacturability and control [1]. Beyond mimicking nature, work has also been performed to integrate natural components with synthetic components. Martel *et al*. have shown progress in utilizing bacterial magnetosomes in conjunction with flagella nanomotors to manipulate micro-objects [2]. Furthermore, natural materials have been explored to ensure biocompatibility of nanorobots if introduced to the body, ensuring the immune system does not attack these therapeutic agents as threats [3].

Locomotion

Mimetic approaches are key to advancing nanorobotic locomotion because of the drastically different physics present at the nanoscale. In the macro-scale, inertial and gravity body forces dominate, with viscosity and surface tension considered secondarily (e.g., the prevalence of inviscid flow modeling). However, as the characteristic length decreases, intermolecular forces and Brownian motion become more significant, while body forces become negligible [4]. As a consequence, many of our macro-scale propulsion strategies, such as internal combustion or electric motors, would fail, if they could be mimicked at all. In addition, as previously stated, biomimetics has helped solving this problem by providing examples of flagellular propulsion and magnetotactic steering.

Flagellular locomotion is a result of the forces generated by a flagellum - a hair-like structure attached to the nanorobot - rotating in a viscous liquid. This rotation causes a net propulsive force on the robot, moving it forward in whatever direction it is pointed [5]. Magnetotactic steering allows for the direction of the nanorobot to be controlled by the alignment of magnetosomes (membrane-based iron nanoparticles) with an applied magnetic field - just like a compass. By externally manipulating this magnetic field, the nanorobot can be “steered” [6].

Beyond the mechanics of locomotion, strategies are needed to control the collective motion of a swarm of nanorobots effectively and efficiently to achieve goals cooperatively. Macro-scale control schemes have been explored for application in nanorobotic systems, including neural networks [7] and particle swarm optimization [8]. While simulations have been the primary means of assessing viability at this stage, some experimental testing has been performed [7].

Manipulation

Nanomanipulation has key applications in both manufacturing nanorobots and utilizing them to affect change in their environment. Technologies such as atomic force microscopy, previously used to observe nanoscale systems, have been explored as potential manipulators [9]. More broadly, nanorobot swarms have also been used to reconfigure micro-size blocks due to the force exerted by the robots pushing against them, as shown in Figure 1 [10].

Arguably, more important than the actual manipulation mechanism is the strategy for providing force feedback to the operator or nanorobot when performing a task. This is necessary to ensure its accurate movement and delicate handling of fragile components. Force feedback sensors have been successfully implemented and tested at the nanoscale, where a cantilever is coupled with a piezoresistive circuit to convert contact deformation into a force measurement [11]. Similar work has also been extrapolated into haptics research, where the rendering and stability of the controller operating between the human and nanomachine was studied and optimized [12].

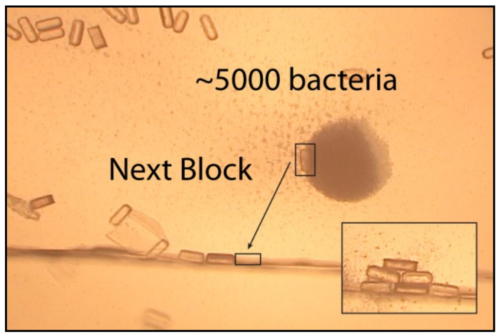


Figure 1 *Bacteria swarm controlled to manipulate blocks into a pyramid configuration [10]*

Supplying Power

To locomote, manipulate or perform any other function, the nanorobot must have a supply of power from some source, either externally provided to the system or inherent to the system design. One mode for supplying power to the system externally has been through electromagnetic radiation, such as visible light, similar to how a plant absorbs sunlight and stores it in ATP (adenosine triphosphate). A design for a motorized nanocar has been proposed (shown in Figure 2) where light will excite a bond in the vehicle's design to force a paddlewheel-like operation of a portion of the molecule [13]. A second externally powered mode of operation was previously described regarding magnetosomes and magnetic field manipulation for steering.

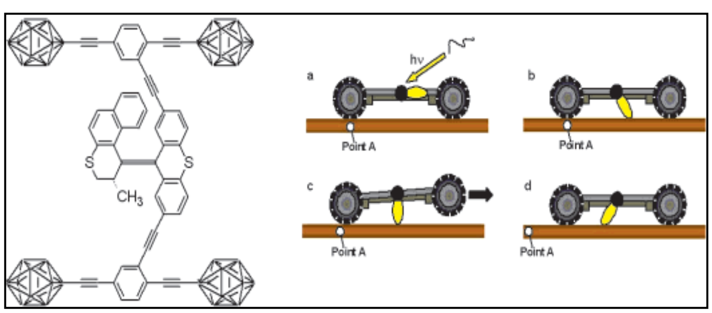


Figure 2 *"Motorized" nanocar chemical structure and locomotive mode [13]*

Internal powering has been accomplished through chemical reactions and by piezoelectric materials. For chemical powering, research has been performed on the feasibility of harvesting energy from glucose by nanorobots travelling in the bloodstream [14]. For piezo-based power supplies, piezo arrays have been analyzed numerically for their ability to convert mechanical vibrations and ultrasonic waves into power for a nanosystem, using power processing built into the design of the generator [15].

Applications

Beyond the generalized research being performed in terms of system design and control, specialized research into specific applications is being carried out. Nanomedicine is by far the most prevalent and promising potential application, which is opening up new avenues for diagnosis and treatment currently unavailable [16]. Specific applications include vascular surgery, targeted destruction of cancerous cells and treating brain aneurisms [17, 18]. The entry of a nanorobot into a capillary near a neuron is shown in Figure 3. Because of the nano-length-scale of these devices, they are able to pass through certain areas of the body, such as the blood-brain barrier, previously inaccessible to most treatments.

Though not explored to the same depth as nanomedicine, additional applications under consideration for nanorobotics include environmental monitoring [12], data storage [19], and space exploration [20]. Where nanomedicine is primarily concerned with creating new treatments and tools, nano-related advances in these other fields focus on providing greater efficiency (e.g., reducing the weight of payload travelling to space).

Potential Problems

The utilization of nanorobots presents significant new challenges in terms of safety. With nanomedicine being the largest target for implementation, an assessment of potential problems associated with introducing nanorobot to the body is appropriate. Cytotoxicity is a prevalent concern; any robot introduced to the body should be extensively tested for undesired effects not just in the cells it is targeting, but all it may come in contact with. Cytotoxicity has been addressed in relation to other nanomaterials [21], and the complexity associated with nanorobots will only amplify the potential for this problem.

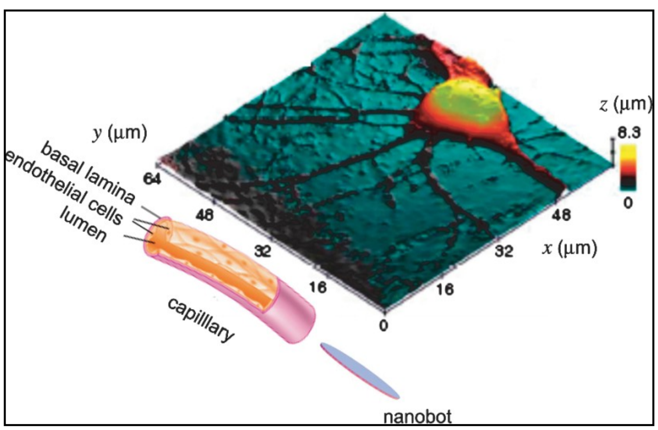


Figure 3 *Size and shape requirements for a nanorobot operating in a capillary near a neuron [3]*

Conclusion

Although the ubiquity of nanorobots is still decades away, advances are continually being made to bring us closer to that day. Advances in system design and control will allow us to adapt our knowledge to the nano-scale, and advances in manufacturing will allow us to implement these novel adaptations. These will revolutionize how we study ourselves and the world around us.

References

[1] R. Majumdar, J.S. Rathore, and N.N. Sharma, "Simulation of swimming nanorobots in biological fluids," in *Proc. 4th Int. Conf. Autonomous Robots Agents*, Wellington, NZ, 2009, pp. 79-82.

[2] S. Martel, M. Mohammadi, O. Felfoul, Z. Lu, and P. Pouponneau, "Flagellated magnetotactic bacteria as controlled MRI-trackable propulsion and steering systems for medical nanorobots," *Int. J. Rob. Res.*, vol. 28, no. 4, pp. 571-582, Apr. 2009.

[3] G. Cerofolini, P. Amato, M. Masserini, and G. Mauri, "A surveillance system for early-stage diagnosis of endogenous diseases by swarms of nanorobots," *Adv. Sci. Lett.*, vol. 3, no. 4, pp. 345-352, Dec. 2010.

[4] T.E. Mallouk and A. Sen, "Powering nanorobots," *Sci. Am.*, pp. 72-77, May 2009.

[5] S. Subramanian, J.S. Rathore, and N.N. Sharma, "Design and analysis of helical flagella propelled nanorobots," in *Proc. 2009 4th IEEE Int. Conf. NEMS*, Shenzhen, CH, pp. 950-953.

[6] S. Martel, C.C. Tremblay, S. Ngakeng, and G. Langlois, "Controlled manipulation and actuation of micro-objects with magneto tactic bacteria," *Appl. Phys. Lett.*, vol. 89, no. , pp. 233904-1-3, December 2006.

[7] X. Yuan and S.X. Yang, "Multirobot-based nanoassembly planning with automated path generation," *IEEE/ASME Trans. Mechatron.*, vol. 12, no. 3, pp. 352-356, June 2007.

[8] K.H.S. Hla, Y.S. Choi, and J.S. Park, "Mobility enhancement in nanorobots by using particle swarm optimization algorithm," in *2008 Int. Conf CIS*, Suzhou, CH, pp. 35-40.

[9] K. Daeinabi and M. Teshnehlab, "Principles of nano-robotics based on atomic force microscopy," in *Proc. 2009 IEEE ICMA*, Changchun, CH, pp. 1589-1595.

[10] S. Martel and M. Mohammadi, "A robotic micro-assembly process inspired by the construction of the ancient pyramids and relying on several thousand flagellated bacteria acting as micro-workers," in *IEEE/RSJ Int. Conf. IROS*, St. Louis, MO, pp. 426-427.

[11] K. Domanski, P. Janus, P. Grabiec, R. Perez, N. Chaillet, S. Fahlbusch, A. Sill, and S. Fatikow, "Design, fabrication and characterization of force sensors for nanorobot," *Microelectron. Eng.*, vol. 78-79, pp. 171-177, March 2005.

[12] A. Bolopion, B. Cagneau, D.S. Haliyo, and S. Regnier, "Tuning the gains of haptic couplings to improve force feedback stability in nanorobotics," in *2009 IEEE ICRA*, Kobe, JP, pp. 4320-4325.

[13] J.F. Morin, Y. Shirai, and J.M. Tour, "En route to a motorized nanocar," *Org. Lett.*, vol. 8, no. 8, pp. 1713-1716, 2006.

[14] T. Hogg and R.A. Freitas, "Chemical power for microscopic robots," *Nanomed.*, vol. 6, no. 2, pp. 298-317, April 2010.

[15] Z.L. Wang, "Top emerging technologies for self-powered nanosystems: nanogenerators and nanopiezotronics," in *2010 3rd INEC*, Hong Kong, pp. 63-64.

[16] G.M. Patel, G.C. Patel, R.B. Patel, J.K. Patel, and M. Patel, "Nanorobot: a versatile tool in nanomedicine," *J. Drug. Target.*, vol. 14, no. 2, pp. 63-67, Feb. 2006.

[17] K.K. Jain, "Nanomedicine: applications of nanobiotechnology in medical practice," *Med. Princ. Pract.*, vol 17, no.2, pp. 89-101, Feb. 2008.

[18] R.M. Ion and G.C. Cocina, "$TPPS_4$ nanotubes architecture for nanorobots with application in cerebral aneurysm," in *Proc. 1st Int. Conf. BICS*, Mures, RO, 2008, pp. 201-208.

[19] A.A.G. Requicha, "Massively parallel nanorobotics for lithography and data storage," *Int. J. Rob. Res.*, vol. 18, no. 3, pp. 344-350, Mar. 1999.

[20] V.A. Yatsenko, "The development of nanosensors for space applications," in *5th Int. CAOL*, Sevastopol, UA, 2008, pp. 210-212.

[21] A.M. Schrand, H. Huang, C. Carlson, J.J. Schlager, E. Osawa, S.M. Hussain, and L. Dai, "Are diamond nanoparticles cytotoxic?," *J. Phys. Chem. B*, vol. 111, no. 1, pp. 2-7, January 2007.

Optimization of surface and core properties of nanoparticles for targeted cancer therapy

Frank Gu

Department of Chemical Engineering,
Waterloo Institute for Nanotechnology,
University of Waterloo.

The application of nanotechnology in medicine, also known as nanomedicine, involves the use of precisely engineered materials at the nanometer scale for medical diagnosis and treatment. One of the most exciting research topics in nanomedicine is targeted drug delivery. By combining molecular and cellular targeting capabilities and controlled drug release properties, targeted drug delivery offers the possibility of achieving precision-guided drug delivery to individual diseased cells and thereby maximizing therapeutic efficacy with minimum side effects. Our primary research passion focuses on development of therapeutic nanoparticles for targeted cancer therapy. Cancer was once considered an incurable disease, but today most patients diagnosed with early stage disease will survive their illness. For patients who are diagnosed with metastatic and advanced stage disease, cancer remains the second leading cause of death in the United States and Canada, exceeded by only heart disease. Chemotherapy has become an integral component of cancer treatment in most cancers. Despite the last 30 years of effort on oncology drug discovery, the conventional chemotherapeutic agents still exhibit poor specificity in reaching the tumor tissue and are often limited by the dose-limiting toxicities. The combination of developing controlled-release technology and targeted drug delivery are the two synergistic approaches that may provide a more efficient and less harmful solution to overcome the limitations found in the conventional chemotherapy. Controlled release occurs when the therapeutic drugs are encapsulated within a delivery system for subsequent release in a predetermined manner. Biodegradable polymers can be designed as nanoparticles in size range from 50 nm to over 10 mm and can release the encapsulated drugs through erosion, swelling or diffusion. It has been shown that controlled-release polymer systems can provide drug levels in the optimum range over a longer period of time than other drug delivery methods, thus increasing the efficacy of the drug and maximizing patient compliance.

The primary consideration of targeted drug delivery is to achieve more effective therapies while eliminating the potential for both under- and over-dosing. The conventional methods of formulating targeted therapeutic nanoparticles utilize post-particle surface functionalization, whereby nanoparticles with an antifouling surface properties are first formed by bulk synthesis and followed by conjugating targeting ligands onto the particle surface. Since cancer-targeting ligands typically carry an intrinsic net charge, it is difficult to obtain nanoparticles with high ligand surface density due to electrostatic repulsion between ligands. Furthermore, the post-particle surface functionalization method often requires the addition of an excess amount of ligands in order to offset the thermodynamic limit of the conjugation reaction. Consequently, the fine-tunability of targeting ligand density and other particle surface properties are limited and the resultant nanoparticles usually have surface properties vary from batch to batch. Our lab specializes in the conjugation of tumor binding ligands onto polymers with controlled release properties, these ligand-polymer conjugates can undergo macromolecular self-assembly and form targeted polymeric nanoparticles.

The ability to prefunctionalize nanoparticle surface with desirable ligands eliminates the need of post-priori modification, which in turn simplifies purification and facilitates large-scale production. This approach also enabled us to precisely synthesize nanoparticles with distinct physical and chemical properties by altering the compositions of the ligand-polymer conjugates. By controlling the polymer-drug interaction during nanoparticle self-assembly, we showed that conventional chemotherapeutic agents such as Docetaxel and Doxorubicin can be released at a tunable rate between 1 to 7 days in vitro. Since the nanoparticle sizes and surface properties can substantially affect the particle efficacy and toxicity *in vivo*, a library of targeted nanoparticles with different physiochemical properties were formulated by controlling the molecular weight and chemical composition of the ligand-polymer bioconjugates. Combinatorial screenings were conducted to identify the nanoparticle parameters that controlled the rate of targeted cell uptake in vitro and in vivo. The resultant optimized nanoparticles demonstrated a greater than 6 times higher particle accumulation in the tumor tissues as compared to the conventional nanoparticles without the targeting moieties. We are now in the process of conducting an *in vivo* efficacy study to evaluate the use of targeted nanoparticles to eradicate localized and disseminated cancer.

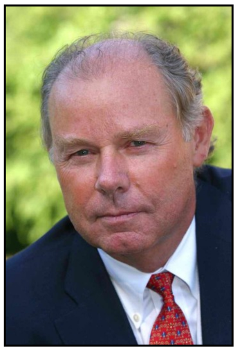
Author Contact Info
200 University Ave West,
Waterloo, ON,
N2L 3G1. Canada
Tel: 519.888.4567 ext. 38605
Fax: 519.746.4979

IEEE Distinguished Lecturer Program

IEEE Distinguished Lecturers are engineering professionals who help lead their fields in new technical developments that shape the global community. These experts:

- specialize in the field of interest of their Society/Council.

- travel to various technical and regional groups to lecture at events.



Dr. Jean-Pierre Leburton

Department of Electrical and Computer Engineering and Beckman Institute
University of Illinois at Urbana-Champaign
Urbana, Il 61801
E-mail: jleburto@illinois.edu

Talk Title

Merging Biology and Nanoelectronics: Can a semiconductor operate as a human cell?

ABSTRACT

The ability to manipulate the enormous information resources contained in DNA molecules for applications in information technology is one of the new great scientific challenges at the cross road of biology, information science, physics and electrical engineering.

In this talk, I will discuss revolutionary developments in material nanotechnology, which give rise to promising concepts in device electronics. Among new ideas, I will present a scenario that integrates biology and physics with MOS nano-electronics for probing the electrical activity of DNA molecules, thereby providing a means to identify electronically their molecular sequences. In particular, semiconductor membranes made of two thin layers of opposite n- and p-doping electrically tunable, can perform ionic current rectification and filtering through a nanopore, which are fundamental functions of biological membranes surrounding human cells, and provide fundamental ingredients for DNA sequencing.

About the author

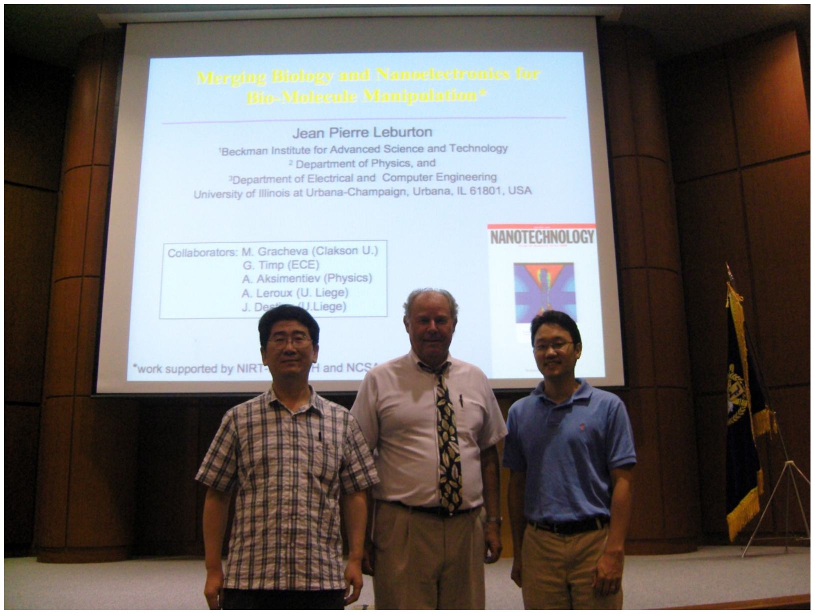
Dr. Jean-Pierre Leburton is the G. Stillman Professor of Electrical and Computer Engineering at the University of Illinois in Urbana-Champaign. He is also Professor of Physics and a full time Research Faculty in the Beckman Institute. Dr. Leburton joined the University of Illinois in 1981 from Germany where he worked as a research scientist with the Siemens A.G. Research Laboratory in Munich. In 1992, he held the Hitachi LTD Chair on Quantum Materials at the University of Tokyo, and was a Visiting Professor in the Federal Polytechnic Institute in Lausanne, Switzerland in 2000. He is involved with research in nanostructures modeling and in quantum device simulation. His present research interest encompasses non-linear transport in quantum wires and carbon nanotubes, and molecular and ionic transport through semiconductor nanopores for biomolecule manipulation and sensing.

From left to right: ***Grad. Student Chuang Qian, Prof. Qing Chen, Prof. J. P.Leburton, Prof. Haixia Zhang, and Prof. Zhihong. Li.***

In front of the National Key Laboratory of Micro/Nano Fabrication Technology, Peking University, ***October, 21, 2010***

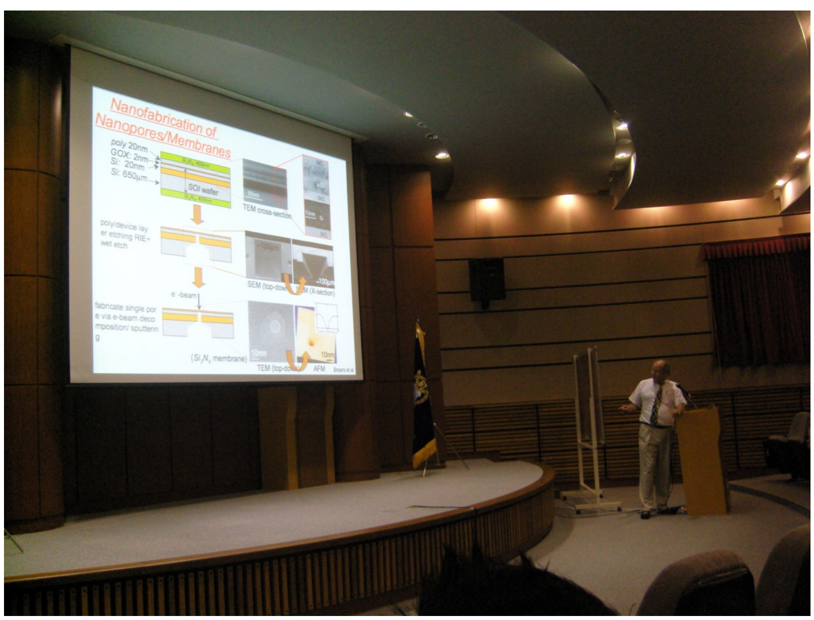
Prof. J.P. Leburton delivering his Distinguished Lecture at the Inter-University Semiconductor Research Center, Seoul National University, ***Aug. 20, 2010.***

IEEE Distinguished Lecturer Program



From left to right: ***Prof. Kwank Seok Seo*** (School of Electrical Engineering), ***Prof. J.P. Leburton*** and ***Prof. Jaeha. Kim*** (School of Electrical Engineering),

Distinguished Lecture at the Inter-University Semiconductor Research Center, Seoul National University, ***Aug. 20, 2010***



Prof. Leburton delivering his Distinguished Lecture in the National Key Laboratory of Micro/Nano Fabrication Technology,

Peking University, ***October, 21, 2010***

Inaugural Issue of Nano Communication Networks

On behalf of Elsevier, I welcome you to the inaugural issue of Nano Communication Networks, an international and archival journal providing a publication vehicle for complete coverage of all topics of interest to those involved in all aspects of nanoscale computing, networking and communications. Nano Communication Networks is a part of COMNET (Computer Networks) family of journals within Elsevier. The family of journals covers all aspects of networking except the nanoscale communications subject which is the target for this new journal. The target audience is researchers, academic people such as professors and graduate students, managers and operators of cross sections of interdisciplinary fields such as electrical engineering, computer science, computer engineering, biology, chemistry, physics, mathematics, bioengineering, biomedicine, medicine, who are interested in networking, communication, and in the design of nanoscale devices.

Click here to go to the first issue of Nano Communication Networks

Articles in the first issue:

Electromagnetic wireless nanosensor networks

Ian F. Akyildiz, Josep Miquel Jornet

Molecular communication: Harnessing biochemical materials to engineer biomimetic communication systems

Satoshi Hiyama, Yuki Moritani

Deterministic capacity of information flow in molecular nanonetworks

Baris Atakan, Ozgur B. Akan

Biological excitable media based on non-excitable cells and calcium signaling

Tadashi Nakano, Jianwei Shuai, Takako Koujin, Tatsuya Suda, Yasushi Hiraoka, Tokuko Haraguchi

Synthetic protocols for nano sensor transmitting platforms using enzyme and DNA based computing

Frank Walsh, Sasitharan Balasubramaniam, Dmitri Botvich, William Donnelly

A nanoradio architecture for interacting nanonetworking tasks

C. Emre Koksal, Eylem Ekici

PDF eXpress PLUS

A new, enhanced publishing tool for conferences is now available free of charge to IEEE conference organizers: ***PDF eXpress PLUS***.

Built upon the successful model of PDF eXpress, PDF eXpress Plus is a secure, Web-based application that greatly assists IEEE conference organizers in obtaining IEEE Xplore®-compatible PDFs from their authors. PDF eXpress PLUS is an enhancement to PDF eXpress which allows authors to deposit their validated PDF on the site for collection by the conference's publication or technical program chair, eliminating the need to track down individual authors. This also helps ensure that the publications chair has the most recent version of the paper.

The IEEE Conference Publications Operations and eXpress Conference Publishing teams are actively recruiting new users to take advantage of PDF eXpress PLUS, which is ideal for smaller conferences (50 to 100 papers expected to be presented) and when the publishing needs are simpler. To register your conference to use PDF eXpress PLUS, please visit our information page.

This doesn't mean that PDF eXpress is going away. Conference organizers who wish to continue with PDF eXpress can register here.

NTC Award Nominations

A. CALL FOR NOMINATIONS for:

INDIVIDUAL
IEEE NANOTECHNOLOGY COUNCIL (NTC) AWARDS

All nomination materials, including reference letters, must reach the NTC Awards Committee by October 15th each year.

Nominees must be IEEE members.

Download Individual Nomination Form

1. PIONEER AWARD IN NANOTECHNOLOGY

Description: The NTC Pioneer Award in nanotechnology is to recognize individuals who by virtue of initiating new areas of research, development or engineering have had a significant impact on the field of nanotechnology. The award is intended for people who are in the mid or late portions of their careers, i.e., at least 10 years beyond his or her highest earned academic degree on the nomination deadline date.

Eligibility: Any current member of the IEEE working in the Nanotechnology who is at least 10 years beyond his or her highest earned academic degree.

Employment of Candidates: The Council may grant two awards in this category, if the Awards Committee determines that the nominations are worthy. There may be one award for **academics** (persons employed by colleges or universities) and one for persons employed by **industry or government** organizations.

Prize Items: The award consists of $1000 ($500 each if two awards are made) honorarium and a commemorative plaque.

Selection/Basis for Judging: Factors that will be considered are: Distinction in long-term technical achievement, leadership, innovation, breadth, and impact on nanotechnology and engineering.

2. EARLY CAREER AWARD IN NANOTECHNOLOGY

Description: The Nanotechnology Council has established an Early Career Award to recognize individuals who have made contributions with major impact on the field of nanotechnology.

Eligibility: Any current member of the IEEE who is in the early stage of his or her career in the nanotechnology field, i.e., less than 7 years after being granted his or her highest earned academic degree on the nomination deadline date.

Employment of Candidates: The Society may grant two awards in this category, if the Awards Committee determines that the nominations are worthy. There may be one award for **academics** (persons employed by colleges or universities) and one for persons employed by **industry or government** organizations.

Prize Items: The award consists of $1000 ($500 each if two awards are made) honorarium and a commemorative plaque.

Selection/Basis for Judging: Factors that will be considered are: Distinction in technical innovation and achievement, and impact on nanotechnology and engineering.

3. DISTINGUISHED SERVICE AWARD

Description: Nanotechnology Council to establish a Distinguished Service Award to recognize an individual who has performed outstanding service for the benefit and advancement of Nanotechnology Council.

Eligibility: Any current or former member of IEEE Nanotechnology Council with outstanding service in one or more of the following areas: conferences and meetings, publications, editors, administrative committee, chapter leadership, or other distinguished services and activities for the Nanotechnology Council.

Prize Items: The award consists of $1,000 honorarium and a commemorative plaque.

Selection/Basis for Judging: Factors that will be considered are: Impact of service and contributions to the Council, leadership, innovation, activity, duration, breadth of participation and cooperation

B. CALL FOR NOMINATIONS for:

IEEE NANOTECHNOLOGY COUNCIL (NTC)
CHAPTER OF THE YEAR AWARD

All nomination materials must reach the NTC Awards Committee by March 31st each year.

Nominations may be made by any full IEEE member, or by a representative of the nominee chapter.

Download Chapter Nomination Form

Description. The IEEE Nanotechnology Council (NTC) Chapter of the Year Award is intended to encourage a successful and effective overall performance of the Chapter in terms of its activities. Exemplary Chapters must have a high number of activities and creativity. The Chapter must consistently be active in organizing activities throughout the year.

Eligibility. All existing/established IEEE-NTC Chapters are eligible for this award.

Prize Items. The award consists of $500 and a certificate.

Selection/Basis for Judging. The award is based on the best yearly activities in the categories of Chapter-sponsored technical activities, seminars, workshops, conferences, visits etc.

Other key requirements of the award are:

- Timely updates and reporting of Chapter officers and activities
- Minimum of (4) meetings/programs during the year
- Maintain an up-to-date Chapter Web site

Other activities may include:

- engagement with student activities
- joint activities with other member society chapters
- chapter visits to local industry/institutions
- member advancement/recognition
- membership growth efforts

Student`s Corner

Upcoming Events

Nanotechnology Council Conferences:

11th International Conference on Nanotechnology (IEEE NANO 2011)

Venue: Portland, Oregon, U.S.A.

Date: August 15-18, 2011

More info: http://ieeenano2011.org/

ONAMI Workshop on Nanotechnology Commercialization (in conjunction with IEEE NANO 2011)

Venue: Portland, Oregon, USA

Date: August 19, 2011

INEC 2011: IEEE 4th International Nanoelectronics Conference

Venue: Tao-Yuan, Taiwan

Date: June 21 –24, 2011

More info: www.inec2011.org.tw

IEEE NanoMEMS 2011

Venue: Kaohsiung, Taiwan

Date: February 20-23, 2011

More info: http://www.ieee-nems.org/nems2011/

DECEMBER 2010

Su	M	T	W	T	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

JANUARY 2011

Su	M	T	W	T	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

FEBRUARY 2011

Su	M	T	W	T	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28					

MARCH 2011

Su	M	T	W	T	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		