NTU NITHM- IITB Symposium
Healthcare and Medical Technologies II
Nanyang Technological University, Singapore
6th – 7th March 2017

Jointly organized by:
Contents

WELCOME BY PROF B.V.R. CHOWDARI, NANYANG TECHNOLOGICAL UNIVERSITY (NTU) SINGAPORE ..................3
WELCOME BY PROF DEVANG V. KHAKHAR, INDIAN INSTITUTE OF TECHNOLOGY BOMBAY (IIT BOMBAY) ........4
WELCOME BY PROF ROHIT SRIVASTAVA, INDIAN INSTITUTE OF TECHNOLOGY BOMBAY (IIT BOMBAY) ......5
INTRODUCTION TO NTU SINGAPORE .............................................................................................................7
ABOUT INTERDISCIPLINARY GRADUATE SCHOOL (IGS) .....................................................................................7
ABOUT INDIAN INSTITUTE OF TECHNOLOGY BOMBAY (IIT BOMBAY)..........................................................8
ABOUT NANYANG INSTITUTE OF TECHNOLOGY IN HEALTH & MEDICINE (NITHM).................................8
GENERAL INFORMATION ...................................................................................................................................9
MAP OF NTU SINGAPORE ................................................................................................................................10
SYMPOSIUM PROGRAMME ................................................................................................................................11
 Monday, 6th March 2017 .........................................................................................................................................11
 Tuesday, 7th March 2017 .........................................................................................................................................12
 POSTER PRESENTATION LIST ............................................................................................................................13
CURRICULUM VITAESES OF INDIAN INSTITUTE OF TECHNOLOGY BOMBAY FACULTY ...............................15
 DEBJANI PAUL .......................................................................................................................................................16
 DHIRENDRA BAHADUR ..........................................................................................................................................17
 JAYESH BELLARE ....................................................................................................................................................18
 MARYAM SHOJAEI BAGHINI .................................................................................................................................19
 PRAKIRITI TAYALIA ...............................................................................................................................................20
 PRASANNA GANDHI ..............................................................................................................................................21
 RAHUL PURWAR .....................................................................................................................................................22
 ROHIT SRIVASTAVA ...............................................................................................................................................23
 SHAMIK SEN ..........................................................................................................................................................24
CURRICULUM VITAESES OF INDIAN INSTITUTE OF TECHNOLOGY BOMBAY STUDENTS ...............................25
 ANURADHA KUMARI ..............................................................................................................................................25
 ARCHANA SINGH ...................................................................................................................................................26
 ARPAN PRADHAN ..................................................................................................................................................27
 BHARADWAJ KOTAMARTHI ...................................................................................................................................28
 DEEPAK GUPTA ......................................................................................................................................................29
 EDNA GEORGE .......................................................................................................................................................30
 KAUSTUBH PAHARE ...............................................................................................................................................31
 RAJEET CHANDAN ..................................................................................................................................................32
 SAUMYA NIGAM .....................................................................................................................................................33
 VINAY SAINI ..........................................................................................................................................................34
 YOGESH SINGH ......................................................................................................................................................35
CURRICULUM VITAESES OF NTU SINGAPORE FACULTY ...............................................................................36
 BO LIEDEBERG ....................................................................................................................................................36
 DALTON TAY CHOR YONG ................................................................................................................................36

NTU NITHM- IITB Symposium| Healthcare and Medical Technologies II
Dear Delegates,

With an overarching aim of engaging Indian Universities and Institutes of higher learning, Nanyang Technological University (NTU) Singapore has embarked upon the “NTU – India Connect” program. The main mission of this program is to connect NTU and India by facilitating research collaborations between faculty and students of both NTU and Indian Institutes and Universities. The key initiatives of this program include support towards research internships lasting for 2-6 months, organization of joint symposia on topics of mutual interest, short-term faculty exchanges, seed funding for selected joint research programs, and joint PhD programs.

The present “NTU NITHM – IITB Symposium on “Healthcare and Medical Technologies II” is the follow-up of the first one held at IIT Bombay during September 2016. The uniqueness of this symposium is to have small group discussions on focused areas of research and also student-centric activities including poster presentations. The objective of this joint symposium is not only to bring academics and students of both IITB and NTU together but also to continue to build academic bridges between our two great institutions. I personally hope that through the participation in this symposium, both faculty and students from IITB and NTU will get to know each other academically and get benefited hugely through this enriching experience. I hope to see their sustained interest in organizing such a symposium year after year and continued participation of all of you. I would also like to see the increased participation of faculty and students in future symposia while scheduled activities for present symposium such as individual meetings, discussions and visit to laboratories would certainly help in bringing us to the next stage research collaborations, student and faculty exchanges and joint PhD students to name a few.

Thanks to all the participants for joining this symposium and making it a grand success.

Best Regards,

B.V.R. Chowdari
Dear Delegates,

I am delighted to know that Nanyang Institute of Technology in Health and Medicine (NITHM) & Indian Institute of Technology Bombay (IITB) are jointly organizing a workshop at Nanyang Technological University (NTU), Singapore from 6th to 7th March 2017. Joint symposium on Healthcare Technologies between IIT Bombay and NTU Singapore was organized first time (26 – 28 September 2016) in Indian Institute of Technology, Bombay. The basic and applied research carried out at both Institutes will benefit greatly from the symposium and workshop. I am sure the workshop, in addition to discussing the cutting edge research issues, will foster interactions between institutes for translational research and taking development forward to industries in commercialization of healthcare products.

I wish the NITHM-IITB workshop a grand success.

Best Regards,
Devang Khakhar
Dear Delegates,

I am delighted to welcome you to the Nanyang Institute of Technology in Health and Medicine (NITHM) & Indian Institute of Technology Bombay (IITB) jointly organized workshop at NTU, Singapore (6-7 March, 2017). This workshop enables graduate, postgraduate students, post doc fellows and scientists to pursue research collaboratively at IIT Bombay and NTU, Singapore. It will be helpful in developing a strong research interest and experiencing multicultural living, gaining a network of friends and a better research understanding of NTU, Singapore and IIT Bombay.

This workshop will look at developing joint initiatives in health and medical technologies and means to leverage the joint efforts for translating these ideas. In this workshop, we will have group discussion from multidisciplinary fields from IITB and NTU, Singapore. The main focus areas of this workshop are: Diagnostics and Imaging Sensor development, assays, microfluidics, imaging probes and particles, genomics/proteomics, EEE Signals and algorithms, EEG signals, sensor interfacing, signal processing and algorithms, biotelemetry, bioelectronics, circuitry, MAERobotics and rehabilitation Assistive technologies, integrated sensors and actuators, MSENanomedicine/Biomaterials Targeted delivery, theranostics, nanocages, artificial cells, electroactive adhesives, cells and cell-material interfaces.

I truly hope that our visit will be memorable and pleasant in NTU, Singapore which would finally be helpful in extending collaboration and exchange programs between IIT Bombay and NTU, Singapore.

Welcome to NITHM & IITB workshop (6-7 March, 2017) at NTU, Singapore.

Warm Regards,
Rohit
INTRODUCTION TO NTU SINGAPORE

Nanyang Technological University (NTU Singapore) is a young and research-intensive university on a rapid global rise. It has about 33,000 undergraduate and postgraduate students in the colleges of Engineering, Business, Science, Humanities, Arts, & Social Sciences, and an Interdisciplinary Graduate School. Its medical school, the Lee Kong Chian School of Medicine, is set up jointly with Imperial College London.

NTU is also home to world-class autonomous institutes – the National Institute of Education, S Rajaratnam School of International Studies, Earth Observatory of Singapore, and Singapore Centre on Environmental Life Sciences Engineering – and various leading research centres such as the Nanyang Environment & Water Research Institute (NEWRI), Energy Research Institute @ NTU (ERI@N) and the Institute on Asian Consumer Insight (ACI). NTU is a cosmopolitan university with more than 100 nationalities. Its main Yunnan Garden Campus has been named one of the Top 15 Most Beautiful in the World. NTU also has a campus in Novena, Singapore’s medical district. For more information, visit www.ntu.edu.sg.

ABOUT INTERDISCIPLINARY GRADUATE SCHOOL (IGS)

The Interdisciplinary Graduate School (IGS) focuses on the key research areas within NTU’s Peaks of Excellence in Sustainable Earth, Secure Community (previously known as New Media for AY2012-2015), Healthy Society (previously known as Future Healthcare for AY2013-2015) and Global Asia. Research in these areas span across different disciplines beyond the conventional school-based programmes. IGS leverages on professors from all the schools and colleges in NTU to undertake interdisciplinary research and to act as advisors for IGS PhD students.

With this approach, IGS aims to train a new generation of PhD students, who are exposed to an intensive seminar culture with ample interaction opportunities. This is in line with the best practices in leading overseas institutions. For more information, visit http://igs.ntu.edu.sg
IIT Bombay is recognised worldwide as a leader in the field of engineering education and research. Reputed for the outstanding calibre of students graduating from its undergraduate and postgraduate programmes, the institute attracts the best students from the country for its bachelor's, masters and doctoral programmes. Research and academic programmes at IIT Bombay are driven by outstanding faculty, many of whom are reputed for their research contributions internationally.

IIT Bombay also builds links with peer universities and institutes, both at the national and the international levels, to enhance research and enrich its educational programmes. Over the years, the institute has created a niche for its innovative short-term courses through continuing education and distance education programmes. For more information, visit http://www.iitb.ac.in/en.

Leveraging on NTU's engineering strengths in various schools and research centres as well as the medicine competences of the Lee Kong Chian School of Medicine, the Nanyang Institute of Technology in Health and Medicine (NITHM) is well poised to harness the synergistic effects of engineering and medicine. Through a multidisciplinary approach bringing together scientists, engineers, and clinicians to form a collaborative ecosystem to innovate new technologies that provide solutions to key problems in human health and medicine, NITHM provides an important platform to propel health engineering and technology research in NTU. It also gears up to collaborate with industry partners as it strives to create engineering-enabled solutions for the healthcare community in order to spur the growth of medical device industry. The main research thrusts of NITHM include Sensing & Diagnostics, Therapeutic Medical Devices, Nanomedicine, Tissue Engineering, System Biology & Medicine, Medical Imaging & Signal Analysis, Chemical Biology, Health Systems Complexity, and Skin Research. For more information, visit http://nithm.ntu.edu.sg
The NTU NITHM- IITB Symposium: Healthcare and Medical Technologies II will be held in Nanyang Technological University from 6th – 7th March 2017.

<table>
<thead>
<tr>
<th>DATE:</th>
<th>6TH – 7TH MARCH 2017</th>
</tr>
</thead>
</table>
| SYMPOSIUM VENUE: | Interdisciplinary Graduate School  
50 Nanyang Avenue, South Spine,  
Block S2 - B3a – 01  
Singapore 639798 |
| DRESS CODE: | Business Attire |
| FOR LOGISTICS: | Ms. Lena Tay  
Mobile: (+65) 9329 7071  
Office: (+65) 6592 3077  
Ms. Charmaine See  
Mobile: (+65) 9061 3418  
Office: (+65) 6592 7835 |
| STUDENT IN CHARGE | Abhijit Vijay Salvekar  
Mobile: (+65) 9350 5782  
Email: ABHIJITVO01@e.ntu.edu.sg  
Gopal Ammanath  
Mobile: (+65) 8450 4658  
Email: GOPAL003@e.ntu.edu.sg |
| FACULTY | Prof B.V.R. Chowdari  
Mobile: (+65) 9339 6979  
Email: chowdari@ntu.edu.sg  
Prof Bo Liedberg  
Mobile: (+65) 9018 24116  
Email: bliedberg@ntu.edu.sg |
| ACCOMMODATION: | Nanyang Executive Centre (NEC)  
60 Nanyang View  
Singapore 639673  
Telephone: +65 6790 6699/ 6790 6697  
Student Hostel  
Banyan Hall of Residence  
66 Nanyang Crescent  
Singapore 636960 |
| AIRPORT TRANSFER: | Airport transfer has been arranged from Changi Airport to NTU Singapore  
The student helpers will be holding placard with “NTU NITHM- IITB Symposium” on it at the arrival lobby after you exit.  
In case you can’t see the student helpers, you may contact Charmaine at (+65) 9061 3418. |
<table>
<thead>
<tr>
<th>Time</th>
<th>Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30 am</td>
<td>IITB Faculty Bus pick up from NEC Lobby</td>
</tr>
<tr>
<td>8.45 am</td>
<td>Registration &amp; Refreshments</td>
</tr>
<tr>
<td>9.00am – 9.10am</td>
<td>Opening Ceremony and brief introduction of NTU by Prof BVR Chowdari</td>
</tr>
<tr>
<td>9.10am – 9.15am</td>
<td>Welcome and Introduction of IGS by Prof Rohit Srivastava</td>
</tr>
<tr>
<td>9.15am – 9.45am</td>
<td>Welcome and Introduction of NITHM by Prof Russell Gruen</td>
</tr>
</tbody>
</table>

**Scientific Session | Chair by Prof Bo Liedberg**

<table>
<thead>
<tr>
<th>Time</th>
<th>Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.45am – 10.05am</td>
<td><strong>ASST PROF SANJAY HARESH CHOTIRMALL</strong>  UNDERSTANDING ASIAN RESPIRATORY DISEASE: TRANSLATIONAL RESPIRATORY RESEARCH AT LKCMEDICINE</td>
</tr>
<tr>
<td>10.05am – 10.25am</td>
<td><strong>PROF PRASANNA GANDHI</strong>  NATURE-INSPIRED, LITHOGRAPHY-LESS, SPONTANEOUS, MULTI-SCALE MANUFACTURING FOR BIOMEDICAL APPLICATIONS</td>
</tr>
<tr>
<td>10.25am – 10.45am</td>
<td><strong>ASST PROF DALTON TAY CHOR YONG</strong>  NANO-BIO INTERACTION: THE GOOD, THE BAD AND THE PECULIAR</td>
</tr>
<tr>
<td>10.45am – 11.00am</td>
<td><strong>COFFEE &amp; TEA BREAK</strong></td>
</tr>
<tr>
<td>11.00am – 11.20am</td>
<td><strong>ASST PROF RAHUL PURWAR</strong>  CAR-T CELL THERAPY: NEED FOR NOVEL TECHNOLOGIES FOR CELL EXPANSION</td>
</tr>
<tr>
<td>11.20am – 11.40pm</td>
<td><strong>ASSOC PROF TAN LAY POH</strong>  ENGINEERING CELL MICROENVIRONMENT</td>
</tr>
<tr>
<td>11.40am – 12.00pm</td>
<td>Briefing about break out activities by Prof Bo Liedberg</td>
</tr>
<tr>
<td>12.00pm – 1.00pm</td>
<td><strong>Lunch and Networking</strong></td>
</tr>
</tbody>
</table>

**FACULTY GROUP**

- 1.00pm – 1.20pm  Research Leads to break into small groups for discussion at their respective research labs
- 1.20pm – 1.30pm  Briefing by Abhijit
- 1.30pm – 3.30pm  Lab Visits (2 hours)
- 3.30pm – 5.00pm  Improve Your Presentation Skills by Dr Andrew Goh  
  Venue: North Spine, TR+22, Level 5. Use LIFT (NS4-4)

**STUDENT GROUP**

- Student Life by IGS Student, Vikram Shenoy
- Briefing by Abhijit
- Lab Visits (2 hours)
- Improve Your Presentation Skills by Dr Andrew Goh  
  Venue: North Spine, TR+22, Level 5. Use LIFT (NS4-4)

**Additional Activities**

- 5.00pm – 6.00pm  NTU North Spine Tour
- 6.15pm  Bus pick up from Administration Building to President’s Lodge
- 6.30pm  Cocktail Reception  
  Venue: President’s Lodge
- 7.00pm  Dinner hosted by Dean IGS, Prof Bo Liedberg  
  Venue: President’s Lodge
- 9.00pm  Bus pick up back to NEC and Hostel
## SYMPOSIUM PROGRAMME

**Tuesday, 7th March 2017**

<table>
<thead>
<tr>
<th>Time</th>
<th>Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30am</td>
<td><strong>IITB Faculty</strong>&lt;br&gt;Bus pick up from NEC Lobby to MSE, SCBE &amp; CBSS</td>
</tr>
<tr>
<td></td>
<td><strong>Refreshments for all students</strong></td>
</tr>
<tr>
<td>9.00am - 12.00pm</td>
<td><strong>FACULTY GROUP</strong>&lt;br&gt;Research Leads to break into small groups for discussion at their respective research labs</td>
</tr>
<tr>
<td>12.00pm - 1.00pm</td>
<td>Lunch and Networking</td>
</tr>
</tbody>
</table>

### Scientific Session | Chair by Prof Bo Liedberg

<table>
<thead>
<tr>
<th>Time</th>
<th>Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00pm – 3.00pm</td>
<td>Presentation of discussion outcome &amp; action plan</td>
</tr>
<tr>
<td>3.00pm – 3.30pm</td>
<td>Summary by Prof Bo Liedberg&lt;br&gt;Prof Rohit Srivastava</td>
</tr>
<tr>
<td>3.30pm – 5.30pm</td>
<td>Refreshments&lt;br&gt;31 Student Poster Presentations&lt;br&gt;Best Poster Prize</td>
</tr>
<tr>
<td>5.30pm</td>
<td>Bus pick up from IGS to NEC &amp; Hostel to unload</td>
</tr>
<tr>
<td>6.00pm</td>
<td>Bus to leave NTU</td>
</tr>
<tr>
<td>7.00pm</td>
<td>Dinner Farewell Reception hosted by Prof B.V.R Chowdari&lt;br&gt;Venue: Myra's @ The Stadium 2 Stadium Walk, #01-04 Indoor Stadium Waterfront Singapore 397691</td>
</tr>
<tr>
<td>9.00pm</td>
<td>Bus pick up back to NEC &amp; Hostel</td>
</tr>
</tbody>
</table>

### Diagnostics & Imaging

**Leads:**<br>Prof Bo Liedberg, MSE<br>Prof Eric Yap, LKCMedicine

### Robotics & Rehabilitation

**Leads:**<br>Prof Lorenzo Masia, MAE

### Signals & Algorithms

**Leads:**<br>Prof Justin Dauwels, EEE

### Nanomedicine & Biomaterials

**Leads:**<br>Prof Sierin Lim, SCBE<br>Prof Terry Steele, MSE
<table>
<thead>
<tr>
<th>Poster No</th>
<th>Name</th>
<th>Research Theme</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Abhijit Vijay Salvekar</td>
<td>Nanomedicine/Biomaterials</td>
<td>Shape Memory Polymer Devices: A New Medical Application</td>
</tr>
<tr>
<td>2</td>
<td>Amit Kumar Khan</td>
<td>Nanomedicine/Biomaterials</td>
<td>Site-Specific Photo-induced Conjugation of Tetrazoles to Modified and Native Proteins</td>
</tr>
<tr>
<td>3</td>
<td>Andreas Dickescheid</td>
<td>Nanomedicine/Biomaterials</td>
<td>Polymer-Drug Conjugates for Controlled Release of Hydrophilic Drugs</td>
</tr>
<tr>
<td>4</td>
<td>Antareep Sharma</td>
<td>Diagnostics and Imaging</td>
<td>Unconventional Platforms for Detection of Growth Hormone Doping in Sports</td>
</tr>
<tr>
<td>5</td>
<td>Antuvan Chris Wilson</td>
<td>Robotics and Rehabilitation</td>
<td>Human Motion Intention Detection using Myoelectric Interface for an Exoskeleton Device</td>
</tr>
<tr>
<td>6</td>
<td>Anuradha Kumari</td>
<td>Nanomedicine/Biomaterials</td>
<td>Overcoming Multidrug Resistance in EMT6/AR1 Cells Using Nanoformulation of a Combretastatin Analogue, C-12</td>
</tr>
<tr>
<td>7</td>
<td>Archana Singh</td>
<td>Nanomedicine/Biomaterials</td>
<td>Semi Synthetic 3D Matrices to Mimic and Study Normal and Pathological Conditions</td>
</tr>
<tr>
<td>8</td>
<td>Arpan Pradhan</td>
<td>Nanomedicine/Biomaterials</td>
<td>Formulation and Characterization of Griseofulvin Encapsulated Nanoliposome for Cancer Therapy</td>
</tr>
<tr>
<td>9</td>
<td>Arun Kumar Prabhakar</td>
<td>Nanomedicine/Biomaterials</td>
<td>Protein-free Pine Pollen Microcapsules for Molecular Loading</td>
</tr>
<tr>
<td>10</td>
<td>Ashish Kumar</td>
<td>Signals and Algorithms</td>
<td>NeuroBrowser - A Low-cost System to Enhance, Accelerate, and Automate EEG Interpretation</td>
</tr>
<tr>
<td>11</td>
<td>Betty Fan Yanliang</td>
<td>Nanomedicine/Biomaterials</td>
<td>Long-acting Sirolimus Microparticle Formulation and Its Antiproliferative Effect in Jurkat Cell</td>
</tr>
<tr>
<td>12</td>
<td>Bharadwaj Kotamarthi</td>
<td>Signals and Algorithms</td>
<td>Circuits and Systems for Wearable Healthcare</td>
</tr>
<tr>
<td>13</td>
<td>Deepak Gupta</td>
<td>Nanomedicine/Biomaterials</td>
<td>Customized Internal 3D Porosity in Grafts for Bone Tissue Engineering</td>
</tr>
<tr>
<td>14</td>
<td>Edna George</td>
<td>Nanomedicine/Biomaterials</td>
<td>Influence of Adhesion Anisotropy on Migration at Interfaces</td>
</tr>
<tr>
<td>15</td>
<td>Elham Bagheri</td>
<td>Signals and Algorithms</td>
<td>Epileptiform Transient Characteristics Underlying Expert Interrater Agreement and Predicting Expert Opinion in Interictal EEG Interpretation</td>
</tr>
<tr>
<td>16</td>
<td>Garima Goyal</td>
<td>Diagnostics and Imaging</td>
<td>Novel Assay Development for Detection of Proteases</td>
</tr>
<tr>
<td>17</td>
<td>Gopal Ammanath</td>
<td>Diagnostics and Imaging</td>
<td>Conjugated Polymer Assays for Detection of Proteases</td>
</tr>
<tr>
<td>18</td>
<td>Iuna Tsyrlneva</td>
<td>Diagnostics and Imaging</td>
<td>Development of QCM Platform for Detection of Heptapeptides as Biomarkers of Overtraining</td>
</tr>
<tr>
<td>19</td>
<td>Jing Jin (Dr)</td>
<td>Signals and Algorithms</td>
<td>NeuroBrowser - A Low-cost System to Enhance, Accelerate, and Automate EEG Interpretation</td>
</tr>
<tr>
<td>20</td>
<td>John Thomas</td>
<td>Signals and Algorithms</td>
<td>Epileptiform Spike Detection via Clustering-based Template Matching</td>
</tr>
<tr>
<td>21</td>
<td>Kaustubh Pahare</td>
<td>Diagnostics and Imaging</td>
<td>Lab on a Chip System</td>
</tr>
<tr>
<td>22</td>
<td>Lim Pei Qi</td>
<td>Nanomedicine/Biomaterials</td>
<td>Fabrication of Drug Nanocarriers Based on the Self-Assembly of Di-Block Co-Polymers</td>
</tr>
<tr>
<td>Poster No</td>
<td>Name</td>
<td>Research Theme</td>
<td>Title</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------</td>
<td>------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>Manisha Singh</td>
<td>Nanomedicine/Biomaterials</td>
<td>3D Printing of Electro-curing Nanocomposite Electrodes for Cardiac Tissue Generation</td>
</tr>
<tr>
<td>24</td>
<td>Michele Xiloyannis</td>
<td>Robotics and Rehabilitation</td>
<td>Design and Control of a Soft Exosuit to Assist Movements of the Upper Limbs in Activities of Daily Living</td>
</tr>
<tr>
<td>25</td>
<td>Nevena Klisara</td>
<td>Diagnostics and Imaging</td>
<td>Toxins Extraction and Detection from Complex Food Matrices</td>
</tr>
<tr>
<td>26</td>
<td>Prativa Das</td>
<td>Nanomedicine/Biomaterials</td>
<td>3D Electrospun Nanofiber as a Potential Scaffolding System for Liver Tissue Engineering</td>
</tr>
<tr>
<td>27</td>
<td>Rajeet Chandan</td>
<td>Diagnostics and Imaging</td>
<td>Nanoparticles for Therapeutic Applications</td>
</tr>
<tr>
<td>28</td>
<td>Saumya Nigam</td>
<td>Nanomedicine/Biomaterials</td>
<td>Dendrimer Functionalized Magnetic Nanoparticles: Smart Platforms for Dual Combinatorial Thermo-chemotherapy &amp; MR Imaging and Diagnostics</td>
</tr>
<tr>
<td>29</td>
<td>Wang Mengmeng</td>
<td>Diagnostics and Imaging</td>
<td>Quantitative Analysis of Angiogenesis in 3D Microfluidic Devices</td>
</tr>
<tr>
<td>30</td>
<td>Xie Chen</td>
<td>Signals and Algorithms</td>
<td>Electroencephalogram (EEG) Classification</td>
</tr>
<tr>
<td>31</td>
<td>Yogesh Singh (Dr)</td>
<td>Robotics and Rehabilitation</td>
<td>Micro-motion Platform</td>
</tr>
</tbody>
</table>

Legend:
Black – NTU Students
Green – IITB Student
CURRICULUM VITAES
Debjani Paul
Assistant Professor
Research Theme: Diagnostics and Imaging; Nanomedicine/Biomaterials
Dept of Biosciences and Bioengineering
IIT Bombay
E-mail: debjani.paul@iitb.ac.in

A RAdial Pillar Device (RAPID) for Continuous and Clogging-free Microparticle Separation

Short Bio
Debjani Paul received her Ph.D. in Physics (2005) from the Indian Institute of Science, Bangalore. She was a postdoctoral fellow in the Physical Chemistry Unit (UMR 168) of Curie Institute, Paris, from 2005-2007, where she developed new techniques to fabricate microfluidic chips using plastic substrates. As a Research Associate in the Electrical Engineering division, University of Cambridge (2007-2009), Debjani explored electrical biosensing techniques to detect interactions between proteins. She moved to the Biological and Soft Systems group in the Cavendish laboratory, University of Cambridge, in 2009 to study the biophysical mechanisms of phagocytosis in macrophages using microfluidics and live cell imaging techniques. She is currently an Assistant Professor in the Department of Biosciences and Bioengineering, IIT Bombay. Her research group in IIT Bombay uses microfluidic technology to build point-of-care diagnostic platforms. Some of the ongoing projects in her lab are: (1) developing a paperfluidic chip for tuberculosis screening by DNA amplification in low-resource settings, (2) detection of sickle cells in blood using a microfluidic chip integrated with a mobile microscope, and (3) identifying rare cells in blood using deformability cytometry. The projects are funded by DBT (Govt. of India), Bill and Melinda Gates Foundation, Tata Centre for Technology and Design, and the Wadhwani Research Centre for Bioengineering.

Abstract
This talk will describe the microfluidic particle enrichment device (RADial Pillar Device or RAPID) that combines the selectivity of dead-end filters with the clogging-free operation of cross-flow filters. RAPID can function without any reverse flow and operates continuously for several hours. The pillars are arranged in concentric circles around a central inlet for introducing the sample. Unlike a simple radial geometry, the pillars in successive rows are displaced by a pre-determined angle to strengthen the cross flow, and thereby avoid clogging of the device. We have demonstrated the proof of concept of our design principle by separating polystyrene beads of different sizes and enriching platelets from whole blood.
Nanohybrids for Cancer Theranostics

Short Bio
Dr. Dhirendra Bahadur is at present an emeritus fellow at the department of Metallurgical Engineering and Materials Science at IIT, Bombay. Before this, he was professor and institute chair professor for several years. Professor Bahadur present research interests are in the area of nanostructured oxide materials their hybrids, graphene and its composites, magnetic materials at nano scale and their applications particularly in cancer theranostics, drug stabilization and targeted delivery, water purification, photocatalysis and sensing. Professor Bahadur received medal of the materials research society of India, 1996, fellowship Royal Society London- INSA exchange program (1985) and MRSI-ICSC superconductivity and materials science annual prize for the year 2011. He was awarded the Govt of India 7th National Research award in Nano Science & Technology in 2013. He was awarded Fellow of Royal Society of Chemistry (FRSC) in 2015.He is coauthor/author of more than 350 publications in international journals and book chapters and five books and twelve patents.

Abstract
The deliberate design of nanohybrids for biological applications has been enabled by new advances in synthetic procedures through different soft chemistry routes. Such nanostructures when properly functionalized can be used as effective vehicles for biological entities in vivo.
A pH and thermo sensitive dual drug delivery system in dual therapy mode (Hyperthermia + chemotherapy) will be discussed. Nano particulates (MNPs) with different shapes, composites, hybrids, core shell structure and magnetic fluids have been developed by various soft chemical methods. Magnetic nanostructures with sufficient biocompatibility are the best candidates for several therapeutic and diagnostic applications such as treatment for cancer through hyperthermia, targeted and sustained drug delivery, as contrast agents and other bio sensing applications. We discuss here some of these aspects based on the work carried out in our laboratory. In addition, we discuss development of multifunctional magnetic hybrid nanostructures, which may be used for a combined therapeutic and diagnostic approach. For efficient delivery of magnetic nano particulates with drug to the diseased site, magnetic fluid based release systems will be discussed with different possibilities of thermo sensitive and pH sensitive hydrogels, liposomes and dendrimers as carrier. We will particularly emphasize some of our recent in vitro as well as in vivo results on lipid, dendrimer and hydrogel based nanohybrids with multifunctional capabilities. We have further investigated the synergistic effects of dual drug and dual therapy in vivo model in nude mice. The uptake of dual drug-lipid hybrid and regression of tumors were monitored through bioluminescence imaging post dual therapy combing hyperthermia with chemotherapy.
Nanostructured Materials for Healthcare: 3D Scaffolds, Hollow Fiber Membranes, and Nanomedicines Across Multiple Systems of Medicine

Short Bio

Dr. Jayesh Bellare is “Institute Chair Professor” of Chemical Engineering at the Indian Institute of Technology, Bombay. He has a keen interest in nanostructured materials for healthcare and biomedical devices. His research includes 3D scaffolds, hollow-fiber-membranes, stem-cell expansion, and nanomedicines across multiple systems of medicines (modern or allopathic, as well as traditional or Ayurvedic, and alternative, like Homeopathy). He is an expert in cryo-electron microscopy of soft nanomaterials. He is an elected Fellow of the National Academy of Science, India, the Indian National Academy of Engineering, and the Electron Microscopy Society of India.

Abstract

Nanomedicines have proven their advantages in many modern medicinal molecules, where they often show significantly improved bioavailability and performance. We have developed expertise to deliver medicines through nanoparticles for retinal cancer directly through the eye. We use modern tools like cryo-electron microscopy to visualize wet samples. Using electron microscopy methods, together with other modern analytical methods like atomic spectroscopy, we show that traditional medicines like Ayurvedic ones, and alternative medicines like Homeopathic ones, also have nanoparticles in them. These nanoparticles show improved biological activity. In Homeopathic medicines, a controversy has existed regarding the high dilutions used (one part in 10 raised to 400 parts) during manufacture, which goes against Avogadro's number and the molecular basis of matter, ruling out the possibility of presence of any starting material of medicine in the highly diluted finished product. Because of this, the molecular basis of the medicinal action of the drug was always in doubt. Using electron microscopy, we show for the first time that nanocrystals of the starting materials are present in the final product despite the extremely high dilutions, and explain how. These studies in the materials science of various medicinal systems, could pave the way for new medicines and better health for all. Our work in nanobiocomposite materials like 3-D scaffolds, nanofibers and improved hollow fiber membranes helps expand stem cells, re-grow bone, make occlusion devices used to close holes in hearts, improve kidney dialysis, and thereby opens new avenues in regenerative medicine.
Maryam Shojaei Baghini is a Professor in the Department of Electrical Engineering, IIT-Bombay. Her current research interests include integrated circuits, systems and technologies for convenient biomedical devices with embedded energy harvesting, sensor-circuit interfacing, ambient noise and artefact tolerant wearable biomedical devices, biotelemetry and bio-signal processing. Her team of students have designed and tested more than 15 different CMOS test chips. She has published 180 papers in peer reviewed international journals and conferences. She is inventor/co-inventor of 6 granted US patents and 1 granted Indian patent. She has received 11 awards of which the recent one is IIT-Bombay impactful research award 2015.

Abstract
R&D in the area of wearable devices for health monitoring and rehabilitation has experienced tremendous growth in the recent years. Ultimately such devices must be affordable, miniaturized, energy autonomous, robust, safe and easy to use. This defines various themes of research in my group as well as in collaboration with other groups due to multidisciplinary nature of the work. We have developed and successfully tested various architectures of CMOS instrumentation amplifiers with extremely low noise performance and very low power dissipation for the interfacing with various sensors. We are also working on the novel ambient-noise (including EMI) tolerant instrumentation and efficient biosignal processing for de-noising and artifact removal. We also have also designed, developed and tested a full biotelemetry system using customized CMOS transmitter and receivers, which is also suitable for the implantable solutions. The developed system satisfies FCC recommendations. We would like to transfer and integrate all of our solutions to flexible platforms. Finally we also work on the integrated multi-source energy harvesting technologies and systems (e.g. RF energy, thermal energy, sun and light, vibration and available sources energy from human body) aiming for automatic charging and/or battery-less biomedical devices.
Abstract
Hydrogels have been used as synthetic mimics of extra cellular matrices. With varying surface properties, polymer content, composition and fabrication methods, various types of synthetic and semi-synthetic matrices have been developed in our lab. We have been able to modulate the stiffness, degradability, porosity and cell adhesion properties of the matrices through various synthesis, blending and polymerization strategies and have characterized them accordingly. Varying stiffness and cell adhesion has shown to affect the morphology of same cell type and have demonstrated differences in cell invasion, EMT (Epithelial to Mesenchymal Transition) behavior and angiogenesis processes when encapsulated in 3D in these matrices. Incorporation of a photodegradable component in the polymer backbone has been done to allow degradation of 3D matrices in a spatially and temporally controlled manner and study its effect on invasion and migration of cells in 3D. Further, we have modified the polymerization strategy to obtain macroporous scaffolds called cryogels for in vivo recruitment and in situ engineering of cells in immunotherapeutic applications. These scaffolds can also be used where cellular modification is required in a native environment of cells since ex vivo modification and their subsequent infusion leads to decrease in efficacy due to poor survival of infused cells (e.g. tissue regeneration, stem cell transplantation, adoptive T cell therapy). To summarize, our lab has developed multi faceted semi synthetic gel systems, which can be used for multiple applications including tissue engineering, drug delivery and immunotherapy.
Prasanna Gandhi
Professor
Research Theme: Nanomedicine/Biomaterials
Dept of Mechanical Engineering
IIT Bombay
E-mail: gandhi@iitb.ac.in

Nature-inspired, Lithography-less, Spontaneous, Multi-scale Manufacturing for Biomedical Applications

Short Bio
Dr. Prasanna Gandhi, Professor in mechanical engineering, is also Director of Suman Mashruwala Advanced Microengineering Laboratory. Prasanna's current research focuses on the area of polymer and ceramics 3D micro-printing, control of fluid instabilities for Spontaneous Multiscale Manufacturing (SMM), dynamics and control of ultra flexible mechanism systems for applications in micro-printing, micro-fluidics, medical robotics, products, and devices. He was pioneer in setting up non-VLSI based 3D digital microfabrication and characterisation facility in the Department of Mechanical Engineering. He has been researching the area of 3D microfabrication technology for more than 14 years and has successfully developed in-house technologies of Microstereolithography, Bulk lithography (BL), which have resulted in several publications and patents. More recently his group has developed a unified technology (Spontaneous Multi-scale Manufacturing (SMM)) for high-speed fabrication at multiple scales spanning micro, meso, meter using fluid instabilities. This technology effectively produces controlled 2.5D fractal and ordered structures that can be used in applications such as artificial respiration, artificial fish gill, capillary pumping, scaffolds, synthetic leaf, tissue engineering and so on. Among other honors, he is a recipient of 3rd rank in Mumbai university (B.E. 2004), Robert Lowry Patten Award at Rice (2000), BOYSCAST fellowship (2006) of Govt of India, Prof J.R.Issac fellowship (2006-2007), and Best faculty award (2008). More details on his publications can be found at http://www.me.iitb.ac.in/faculty/33/profile/

Abstract
The pursuit of mimicking complex biological systems has been a tireless effort with many successes but a daunting task ahead. A new perspective to engineer the very evident branched/tree-like shapes and intricate web of microfluidic channel in bio-systems is presented here. These structures are established to be more effective in the literature for mass transport applications. Control over Saffman-Taylor instability which otherwise randomly rearranges viscous fluid in a 'lifted Hele-Shaw cell' is exercised for the same. The proposed control employs anisotropies on cell plates, to shape a stretched fluid film into a network of ordered multiscale tree-like patterns and well defined webs/meshes mimicking various bio-systems. The proposed control produces in a robust and repeated fashion, structures which otherwise are completely non-characteristic to this process. Moreover spontaneous fabrication of families of wide variety of structures can be done over micro and very large scale in a period of few seconds. Thus the proposed method forms a solid foundation to a new pathway for engineering mulitscale structures for several scientific applications.
RAHUL PURWAR
Assistant Professor
Research Theme: Nanomedicine/Biomaterials
Dept of Biosciences and Bioengineering
IIT Bombay
E-mail: purwarrahull@iitb.ac.in

CAR-T Cell Therapy: Need for Novel Technologies for Cell Expansion

Short Bio
Dr. Rahul Purwar is an Assistant Professor and Group Leader of the Immuno-engineering lab at the Indian Institute of Technology Bombay (IIT Bombay). He pursued his PhD in Molecular Medicine at Hannover Medical School, Hannover, Germany (2006) and postdoctoral work at Harvard Medical School, USA. He has worked for an Oncology company, ImmunoGen Inc. Waltham, USA before returning to India. Prof. Purwar has published several high impact papers in reputed journals and has received several awards including the Melissa K. Bambino Memorial Award by The Skin Cancer Foundation, USA. Currently, Prof. Purwar laboratory is working on T cell engineering for cancer immunotherapy with focus on cellular therapy (CAR-T cell therapy).

Abstract
Cancer immunotherapy is an emerging and a transformative approach for the cancer treatment. Adoptive T cell therapy with engineered T cells (CAR-T cells) has demonstrated some remarkable responses in long-term remission of patients with advanced cancers including B cell-acute lymphocytic leukemia patients (B-ALL). Very recently, we have designed an anti-CD19 CAR, and generated CD19+CAR T cells from T cells of healthy subjects as well as relapsed/refractory B-ALL patients. Efficacy of CD19-CAR-T cells was examined by cytotoxicity assay using CD19+malignant B cell lines (Raji cells) and autologous B cells. CAR-T cells were able to kill majority of CD19+ autologous B cells or malignant B cells at very low effector to target ratio (E:T ratio). In addition, anti-CD19+CAR-T cells secreted high levels of IFN\(\gamma\) and IL-2. Although our pre-clinical data demonstrate the development of highly potent anti-CD19 CAR for subsequent use in clinical trials of CD19+B cell malignancies in relapsed/ refractory B-ALL, the major concern is the cost of engineered T cell expansion in human serum containing media in plastic dishes. We are highly interested in collaborating on developing a cost effective and robust T cell expansion protocol using novel technologies including biomaterials.
Affordable Point of Care Technologies

Short Bio
Dr. Rohit Srivastava is Professor and a Tata Innovation Fellow at IIT Bombay. His specialization lies in POC Diagnostic Devices, Orthopedic materials and Cancer Phothothermal therapy. He has been awarded the Vasvik Award 2013 for Biological Sciences and Technology. He has also been awarded the DBT Biotech Process and Product Commercialization awards 2014 as well as the OPPI Young Scientist Award 2014. Apart from this, he has been awarded with several prestigious awards/grants: Welcome Trusts Grant, GCE (Gate Foundation), GCE Canada, Global Innovation Grant and IMPRINT India.

Abstract
There is an increasing demand for accurate, efficient and cost-effective treatment methods and devices in critical care units. The main goal behind the research in Nanobios Lab at IIT Bombay relates to the development of biosensor assays and their integration into affordable Point-of-care diagnostic devices. Nanobios lab in collaboration with Biosense Technologies Pvt Ltd have already commercialized, “uChek” (http://uchek.in) - a low cost smartphone based urine dipstick reader which was designed, tested and deployed. uChek can interpret upto ten analytes in urine including glucose, bilirubin, ketones, proteins, urobilinogen, pH, SG, occult blood, leukocytes and nitrites. The accuracy of uChek was found to be comparable to commercially available semi-automated urinalysis instruments in laboratories with 100% of readings within +/- 1 color block. uChek was launched on 28 April 2013 in India and the United States and there are around 1000 uChek systems operational across the world.

Nanobios lab in collaboration with Biosense Technologies Pvt Ltd have also manufactured and commercialized “SuChek". Suchek is an indigenous, accurate, low-cost glucometer supported by the Indian Council of Medical Research. Suchek reagent strips are as accurate as conventional glucometers, at a fraction of the price. Along with the glucometer, the companion Suchek mobile application helps save, trend and analyze blood glucose levels at an individual level or track response to treatment at a community level. In another project, indigenous urinary albumin/creatinine ratio (ACR) test strips were made and were tested successfully. Creatinine test pad was also developed and made cheaper with improved resolution. Albumin test pads were also successfully developed with improvements than the present strips in the market. With present estimations, we can safely say that the cost of the strips would be reduced at least to one-third of the cost of present strips. Renal color mats are proposed, which can help the health workers of screening programs to record the patient data and help them educate the patients regarding ACR in chronic kidney diseases. Microneedles are being fabricated in the lab for delivery of vaccines and drugs. We believe effective care of the most hard-to-treat conditions requires approaches beyond simply taking medicine / applying patch. We are transforming how medicine is delivered and how people achieve their health goals through the convergence of optimized drug delivery, embedded sensor technology to monitor compliance, and connected and personalized behavioral support.

We believe that these are small steps towards “Make in India and Made in India” and a lot more needs to be done to educate everyone of the importance of making affordable point of care technologies in India.
Tuning ECM Properties for Renegerative Medicine & Tissue Engineering Applications

Short Bio
Dr. Shamik Sen is an Assistant Professor in the Department of Biosciences & Bioengineering, IIT-Bombay. His research focus is on understanding how physical interactions between cells and their extracellular matrix regulates cell behavior, with a focus on stem cell differentiation and cancer invasion. He aims to develop tissue engineering solutions for stem cell expansion/differentiation and scaffolds for wound healing applications.

Abstract
In vivo, cells reside in 3-dimensional environments where they actively interact with the extracellular matrix (ECM) and with other cells. A lot of attention has been focused on understanding the physicochemical cues encoded by the ECM that regulate cell behavior. Using a combination of cell biology and cell biophysics, we aim to understand the role of ECM stiffness, topography and dimensionality in directing cell phenotype. I will discuss how we are planning to utilized our understanding to develop tissue engineering scaffolds for regenerative medicine and wound healing applications.
ANURADHA KUMARI
PhD Student
Research Theme: Nanomedicine/Biomaterials
Dept of Biosciences and Bioengineering
IIT Bombay
E-mail: anuradha2530@iitb.ac.in

Overcoming Multidrug Resistance in EMT6/AR1 Cells Using Nanoformulation of a Combretastatin Analogue, C-12

Abstract
Development of chemoresistance to anticancer drugs after chemotherapy is very common in breast cancer patients. The treatment of drug resistant cancer becomes very difficult because of the narrow range of availability of anticancer drugs. We have developed a nanoformulation of a Combretastatin derivative which can very efficiently kill multi drug resistant breast cancer cell line (EMT6/AR1) cells compared to the free drug. Combretastatin is a natural stilbenoid phenol isolated from the Combretum caffrum. It is a well-known antiangiogenic and antivascular compound. It binds to the tubulin at the colchicine binding site of the β-subunit and causes microtubule depolymerization. C-12, a 2-aminoimidazole derivative of combretastatin has been found to be more cytotoxic than combretastatin (IC50 in MCF-7 cell line - 3 ± 2 nM and HeLa cell line - 10 ± 1 nM). However, the IC50 in EMT6/AR1, a multidrug resistant cell line, was found to be much higher i.e. 500 ± 173 nM. Since, EMT6/AR1 cell line shows multidrug resistant because of the overexpression of Pgp pumps, which pump out the drug molecules from the cell, we attempted to make a drug carrier to encapsulate C-12 to surpass the effect of these pumps. This nanoformulation was found to be much more effective in EMT6/AR1 cell line in terms of cytotoxicity (IC50 13.9 ± 1.9 nM), microtubule depolymerization and mitotic block. Interestingly, C-12 also decreased the rate of migration in highly invasive triple negative breast cancer cell line with IC50 18.5 ± 4.4 nM. In vitro, C-12 inhibited MAP-rich tubulin polymerization in a concentration-dependent manner, studied by light scattering and electron microscopy. We also determined the binding site of C-12 on tubulin by competitive binding assay with podophyllotoxin, a well-known anti-tubulin agent binding at colchicine site. All these results suggest that C-12 is a very potent derivative of combretastatin, which binds to the colchicine site, and its nanoformulation can be a promising solution in the treatment of multidrug resistant cancers.
Semi Synthetic 3D Matrices to Mimic and Study Normal and Pathological Conditions

Short Bio
Ms. Archana Singh is a PhD student in the Department of Biosciences and bioengineering department at IIT Bombay. She is working on semi-synthetic 3D matrices to study normal and pathological conditions. She has completed her bachelor’s degree in pharmacy from Delhi University. She received her M.Tech degree from IIT Kanpur.

Abstract
Cells are arranged in a complex microenvironment known as the extracellular matrix (ECM). To replicate this complex 3D microenvironment, artificially engineered matrices or scaffolds have been utilized to provide support for cell growth. Hydrogels closely mimic the ECM in their physical and mechanical properties. In our lab, we have developed hydrogel and cryogel systems made out of vinylic polymers namely polyethylene (glycol) diacrylate (PEGDA) and gelatin methacrylate (GELMA) which can undergo cross linking by photo or redox initiated free radical polymerization. While PEGDA is inert and non-degradable, GELMA has both cell adhesion and MMP sensitive degradable sites within the polymer backbone. Hence, a blend of varying compositions and molecular weights of PEGDA with GELMA enables us to develop a platform of hydrogels with varying stiffness and cell adhesive properties. Further, we have synthesized a photodegradable PEG based acrylate which upon crosslinking with PEGDA and/or GELMA allows us to manipulate degradability of the hydrogel in situ as well. These hydrogel systems are nano and microporous in nature. However, for cell infiltration and recruitment for tissue engineering and immunotherapy applications, we have developed cryogelation based macroporous systems.
Formulation and Characterization of Griseofulvin Encapsulated Nanoliposome for Cancer Therapy

Short Bio
Mr. Arpan Pradhan is currently pursuing his PhD degree at Indian Institute of Technology Bombay, India. He has done B.Tech in Biotechnology from West Bengal University of Technology, Kolkata, India. He has received M. Tech degree in Biotechnology from Birla Institute of Technology Mesra, Ranchi, India. His research interest focuses on thermosensitive drug delivery systems for cancer therapeutics.

Abstract
Griseofulvin (GF), an orally active antifungal drug, has been attracting considerable interest as a potential anticancer agent owing to its efficiency in inhibiting the proliferation of different types of cancer cells. However, its application is limited by its poor water solubility. Here we report the liposomal nanoformulation of griseofulvin for improving its solubility. Liposome nanoparticles are successfully synthesized using thin film hydration method and characterized using various physico-chemical techniques like TEM, SEM and DLS. These nanoparticles are unilamellar, spherical in shape with a hydrodynamic diameter of ~200 nm. The surface charge of these nanoparticles is -20± 2 mV measured by zeta potential. Griseofulvin (GF) is encapsulated into the liposome with a high encapsulation efficiency of 60± 5%. These nanoformulation retain its in vitro antiproliferative activity with similar IC50 value of free GF in MCF7, Huh7 and EMT6/AR1 cells. GF nanoformulation strongly depolymerizes mitotic microtubules in Huh7 cells. Further confocal microscopy images suggest these liposome nanoparticles are internalized in Huh7 cells in a time dependent manner.
Circuits and Systems for Wearable Healthcare

Short Bio
Mr. Bharadwaj Kotamarthi has graduated with B.Tech in Electronics and Communication Engineering from JNTU College of Engineering, Hyderabad, India. He is currently pursuing M.Tech in Department of Electrical Engineering, IIT Bombay with specialization in Microelectronics and VLSI. His research interest lie primarily in Circuits and Systems for wearable healthcare applications.

Abstract
In the recent years, there is a huge growth in the area of wearable systems for healthcare. These systems would require small form-factor and low power consumption for longer life-time without any compromise on reliability of the system. A telemetry system has been developed with such stringent conditions which can be used for communication of the bio-signals like ExG, PPG in MedRadio band which is the prescribed band for these applications. Another aspect of this work is architecture and design considerations for the Application Specific Integrated Circuit (ASIC) for Bio-impedance acquisition. Also, RF energy harvesting has been investigated for making the system energy autonomous which will increase the life-time of the system.
Customized Internal 3D Porosity in Grafts for Bone Tissue Engineering

Short Bio
Mr. Deepak has completed his bachelor’s degree from IIT-BHU Varanasi in the field of Chemical Engineering in 2014. He is currently pursuing his dual degree M.Tech & PhD from IIT Bombay in Chemical Engineering department. His research interest lie primarily in biomaterials, 3D printing and bone grafting.

Abstract
Bone is a dynamic and multifunctional organ which is capable of remodeling and healing capacities, however, due to limitation of certain intrinsic regeneration potential, surgical therapeutic intervention is required. The treatment of critical sized non-uniform bone defects often requires bone grafts or scaffolds. A scaffold serves as a framework and support which also provides sufficient space that facilitates the three-dimensional proliferation of cells and ingrowth of host tissues into the reconstruction site after transplantation. The porosity, pore size and pore interconnectivity are responsible for scaffold’s mechanical strength, degradation time, satisfactory cells and nutrient infiltration and most importantly the vascularity of the new tissue formed. It is important to note that the architecture of natural bone is such that the resulting porosity is highly graded or non-uniform in nature. In the work presented here, 3D printing technology has been used to address the challenge of incorporating customized variable porosity along with the appropriate interconnected micro-structural porous design into the scaffold. CT scan data was used to get the patient-specific customization of macro-scale scaffold geometry and 3D printing technique was used in a unique way in order to facilitate the variation of pore size and pore shape to change the porosity gradually thus achieving the required graded porosity. It allowed us to mimic the non-uniform internal porous structure of natural bone as well as to exactly match the size and shape of the bone defect. This approach is useful for any scaffolds of any shape and size ranging from small defects in periodontal and maxillofacial to large defects in long bones/orthopedics.
Influence of Adhesion Anisotropy on Migration at Interfaces

Short Bio
Ms. Edna George was exposed to the world of active research during her M.Tech. at Amrita Centre for Nanosciences, India where she worked towards developing scintillating nanomedicines for cancer imaging and therapy. After a few months, she joined Dr. Shamik Sen at IIT Bombay to pursue Ph.D. in Biomedical Engineering. Recently, she submitted her thesis on ‘Microenvironmental regulation of cell spreading and motility’ where she explored on how three important attributes of the ECM- topography, stiffness and dimensionality - can be engineered using synthetic/natural polymers to regulate two important cellular processes, namely cell spreading and motility, that are critical for cell function. Currently, she is translating a part of her research findings to develop tissue adhesives for wound healing.

Abstract
Cell migration is a complex process irrespective of the physiological and pathological conditions. The conventional 2D substrates fail to mimic the microenvironment that facilitates migration under in vivo conditions. Although cells can migrate at the interface of two different tissues of different extracellular matrix, the effect of biophysical cues that elicit such cell behaviour remains unexplored. Here, we tried to understand the migratory behaviour of cells in response to an anisotropic stimulus. In this study, we confined cells within matrices of varying adhesivity and mechanical properties to mimic cells migrating at tissue interfaces. Using GelMA as the cell adhesive substrate and gellan as the non-adhesive substrate with tunable mechanical properties, sandwich cultures were established to understand cell migration at the interface of these matrices. We observed that fibroblasts spread less with limited motility when sandwiched within adhesive substrates. When sandwiched within adhesion anisotropic substrates, fibroblasts remained well spread with spindle morphology similar to cells in vivo. Combination of GelMA and gellan at the ventral and dorsal side of cells created adhesion anisotropy that resulted in the cells to migrate faster when compared dorso-ventral adhesion stimulus. Additionally, as the gellan stiffness increased, cells migrated faster while cells at the interface of softest gellan resembled cell migration on 2D GelMA substrate. Taken together, these results suggest that under confinement adhesive anisotropy modulates cell migration which is dictated by the mechanical stiffness of the non-adhesive substrate.
Lab on a Chip System

Short Bio
Mr. Kaustubh Pahare has an undergraduate degree in Mechanical Engineering from Shri Shankarachaya College of Engineering and Technology, Bhilai (India) in 2015. He is currently pursuing a master’s degree in Biomedical Engineering from IIT Bombay. His research interests include microfluidic DNA amplification systems, robotics, biomechanics and point-of-care diagnostic devices.

Abstract
Lab on a chip type system has recently been of significant importance in the field of healthcare diagnosis. The fluidics and fabrication involved in the entire process are of great importance because this type of system can truly make point of care diagnostics very simple, effective and reliable. Currently, I am studying this system based on PCR-type reaction contexts. Molecular methods such as this can be especially useful for detecting low parasitemia levels due to their high sensitivity and their ability to recognize different malarial species and strains. This technique capitalizes on isolating ring-stage malaria parasites from blood containing WBCs and as low as 0.0005% of ring stage parasites can be detected reliably. Key advantages of micro-total analysis systems based on microfluidic technology is it promises small size and integrated sample handling within a single, automated device having low mass-production costs thus making healthcare truly available to all.
Nanoparticles for Therapeutic Applications

Short Bio
Mr. Rajeet completed his Master’s from IIT Bombay in 2011 after submitting his work on the development of drug delivery systems (DDS) for Acute Macular Degeneration (AMD). Being fascinated by the beauty of vast potential of delivery systems manifesting itself in therapeutics, Rajeet chose to pursue his doctoral research on DDSs under the supervision of Prof. Rinti Banerjee. Currently working on the development of trigger-responsive platform for cancer, he has successfully fabricated and tested ultrasound-responsive, drug loaded, bubble-liposome conjugated system for cancer therapeutics. In another study, he is working on the development and testing of nanoparticle platform for cancer immunotherapy.

Abstract
Trigger responsive act as platforms for site and disease specific drug delivery. Nanoparticles can be designed to respond to various types of triggers, internal triggers like change in pH, external-triggers like ultrasound and their combinations for enhanced control of site of action of the drugs. pH-responsive aerosol platforms have been designed for the delivery of hydrophobic drugs such as paclitaxel for the treatment of lung cancer. The aerosol formulation was tested in melanoma metastasis models and exhibited significantly low lung tumor burden. As another platform, ultrasound-responsive pro-apoptotic liposome-nanobubble conjugates were prepared and tested towards an image-guided external trigger-responsive platform for synergistic chemotherapy. The in vitro echogenicity study showed 7 fold enhancement in echogenic property as well as 9 fold increase in cellular uptake due to cavitation induced sonoporation. The conjugates caused significant regression of solid murine melanoma tumors when triggered using ultrasound. For viral infections, such as AIDS, a macrophage targeted liposome-cochleates conjugate platform for the delivery of different anti-HIV agents targeting the HIV reservoirs has been developed. Alternative non-invasive routes of delivery have also been explored. Lipo-polymeric nanoparticles allow oral delivery of paclitaxel and doxorubicin for treatment of breast cancer. Another route explored is the transdermal route in the form of fluidising nanoparticles loaded within cosmetics for nutrient delivery. For regional applications, liposome loaded in situ hydrogels for bladder cancer and nanocomposite scaffolds for bone and cartilage tissue engineering have been developed. For bone tissue engineering, injectable bioactive ceramic reinforced polymer scaffolds laded with drug-loaded liposomes were developed for enhanced repair of irregular fractures. Similarly, for cartilage tissue engineering, biomimetic injectable hydrogels composed of oxidised alginate were prepared and successfully integrated with the host goat patella tissue proving their potential as cell attracting adhesive matrix for neo-cartilage formation in the management and treatment of osteoarthritis. Applications of smart nanoparticles in diagnostic applications will also be discussed. The potential of such nanoparticle platforms for various healthcare applications will be the highlighted.
SAUMYA NIGAM
PhD Student
Research Theme: Diagnostics and Imaging; Nanomedicine/Biomaterials
Dept of Metallurgical Engineering and Materials Science
IIT Bombay
E-mail: saumya4884@gmail.com

Dendrimer Functionalized Magnetic Nanoparticles: Smart Platforms for Dual Combinatorial Thermo-chemotherapy & MR Imaging and Diagnostics

Short Bio
After completing her Bachelor’s degree in the field of biotechnology, Saumya stepped into the field of functional nanomaterials. Intrigued by the challenges posed by current clinical scenario of cancer therapy, she worked towards development of ‘smart’ delivery systems which could be used in both cancer therapeutics as well as diagnostics. She recently completed her PhD working for the development of peptidic dendrimer and their use for surface engineering of Fe3O4 nanoparticles and anchoring of therapeutic molecules. Apart from being used as delivery vehicles, these conjugate nanosystems also showed appreciable contrast performances in MR imaging. Her future research interests include the understanding and development of various functional nanomaterials which could be explored for improved therapeutics and their subsequent technology transfer to clinical settings.

Abstract
Various functional nanomaterials have been developed for improving the efficiency of therapeutic drugs used for treating cancer. Amongst various functional materials, magnetic nanomaterials have emerged as versatile nanosystems promising for the detection, diagnosis and treatment of cancers. Superparamagnetic iron oxide (Fe3O4) nanoparticles have been thoroughly investigated as drug delivery vectors, magnetic drug targeting agents, contrast agents in magnetic resonance imaging (MRI) and hyperthermia treatment of cancer. Dendrimers are another emerging class of functional nanomaterials which are hyper branched, mostly symmetrical polymers with repetitive branching units. The presence of multiple functional groups makes them ideal candidates for anchoring guest molecules and therefore, they are assessed as delivery vectors, MR imaging agents, stabilizers of molecules, catalysis, sensing etc. Thus, combining these two nanomaterials was expected to contribute towards the development of ‘smart’ and versatile nanosystems with desired properties. These conjugated nanosystems were thoroughly explored for improved cancer therapeutics (combinatorial thermo-chemotherapy) and diagnostics (MRI).
VINAY SAINI  
Post-doctoral Fellow  
Dept of Biosciences and Bioengineering  
IIT Bombay  
E-mail: drvinays14@gmail.com

Short Bio
Dr. Vinay Saini has been running R&D activities at Department of Biosciences and Bioengineering, IIT Bombay, Powai, Mumbai. He is running a startup company for providing solutions on pharmaceutical technology and promoting translational research. He got experience in Pharmaceutical Sciences and Biotechnology and worked on microparticulate adjuvanted vaccines against Hepatitis B (Single -shot) and Filariasis. He spent time in ETH, Zurich (2013) as an academic guest/visiting scientist. He completed his Ph.D. (Pharmaceutical Sciences: 2011) from Dr. Hari Singh Gour Centre University in collaboration with Div. of Parasitology, Central Drug Research Institute (CSIR-CDRI, Lucknow). Dr. Saini has secured two grants for developing TB Diagnostics (IMPRINT INDIA: INR 2.30 Cr) and TB Therapeutics (INR 2.0 Cr) with Prof. Rohit Srivastava. He has several collaborations with different pharma and biotech organizations (Indian, European and US institutes and companies).

Presently, his research focus areas are as follows:

- Development and characterization of aerosolized formulations against Tuberculosis.
- Development, Evaluation & Scale-UP of Non/Minimally-invasive & Low cost Rapid TB diagnostics.
- Malnutrition (Assessment and development of patient acceptable formulations)
- Formulations against MRSA and VRE.
- Mosquito repellant formulations.
Micro-motion Platform

Short Bio
Dr. Yogesh Singh graduated in Mechanical Engineering from Government College of Engineering, Jagdalpur, Chhattisgarh (India) in 2008. He received M. Tech degree in Machine Design from National Institute of Technology Rourkela, Odisha, India, in 2012. He got his PhD (Robotics and Control) from Indian Institute of Technology Indore, Madhya Pradesh (India) in 2016. He is currently working as a Postdoctoral fellow in the Discipline of Mechanical Engineering at Indian Institute of Technology Indore, Madhya Pradesh, India. His main research interests include kinematic and dynamic modelling of the robotic manipulator, parallel manipulator and nonlinear control of robotic systems. He has published more than 10 articles in top class journals and conference proceedings.

Abstract
Recent work proposed, a new family of planar parallel manipulators namely square shape/U-base planar parallel manipulator starting with an active prismatic joint on each limb is proposed. In order to identify the best configurations of this family, comparative kinematic and dynamic analyses are performed. The kinematic performance is quantified with the local performances indices namely stiffness, payload, manipulability, and isotropy. In overall, the research work shows the U-base planar parallel manipulators are superior alternatives to conventional motion stages for high speed, high rigidity, high precise positioning, and tracking applications.
Biomimetic Concepts in Nanoscale Sensing and Diagnostics

Short Bio
Bo Liedberg is professor of Materials Science at the School of Materials Science and Engineering (MSE), NTU. He joined NTU as a full faculty in 2012 after having spent three years as visiting professor at MSE (on leave from Linköping University, LiU, Sweden). Professor Liedberg has been involved in setting up a new, university wide, initiative on Biomimetic Sensor Science jointly with faculties at NTU, and he is currently the director of the Center for Biomimetic Sensor Science (CBSS). Professor Liedberg is also serving as the Dean of Interdisciplinary Graduate School.

Abstract
The present contribution discusses the use of synthetic polypeptides as a generic platform for the design of new functional nanoscale materials for bioanalytical and diagnostic applications. The concept is based on a novel set of de novo designed 42-mer helix-loop-helix peptides that fold into a functional four-helix bundle upon interaction with a complementary peptide. I discuss in this talk the development of switchable gold nanoparticle aggregates based on the above set of polypeptides, and their use as a potential platform for colorimetric “plasmonic” biosensing. Post functionalization of the peptides with small molecule ligands in a sequential and site selective manner furthermore can be used to turn them in to high-affinity recognition molecules “binders.” A few examples are demonstrated detection of Human Carbonic Anhydrase II (HCA II) and cardiac troponin I (cTnI), as well as for detection of matrix metalloproteinase 7 (MMP-7) and Botulinum toxin A. A few other on-going projects regarding the use of polymer vesicles, so-called polymersomes, for studies of enzymatic reactions in confinement are also highlighted. The focus is on couples bi-enzymatic reactions to mimic signal transduction between topologically tuned compartments.
Nano-bio Interaction: The Good, the Bad and the Peculiar

Short Bio
Dr. Dalton Tay received his B. Eng (1st Class Honors) and Ph.D. from the School of Materials Science and Engineering, Nanyang Technological University (NTU) in 2007 and 2012 respectively. His Ph.D. research focused on the development of novel micropatterned bio-polymeric surfaces to direct lineage specification of adult stem cells for regenerative medicine. In 2012, he joined the National University of Singapore (NUS) as a Lee Kuan Yew (LKY) postdoctoral fellow with the Department of Chemical and Biomolecular Engineering. During his post-doctoral tenure, he majored in the etiology of inorganic nanomaterials triggered biological responses within the framework of biosafety and nanotherapeutics. In addition, he has also developed several bio-inspired nano-micro biomaterials platform that could be applied for diagnostic and screening applications. He currently holds a joint Assistant Professorship with the School of Materials Science and Engineering and the School of Biological Sciences, NTU, Singapore.

Abstract
Understanding the interaction of engineered nano-scale materials (NMs) with the biological systems is a fundamental tenet in nanomedicine. It is well established that the physicochemical properties (i.e. material composition, size, surface charge, surface chemistries, shape, etc) of the NMs, plays a pivotal role in determining the biological effects, which can range from something that is deemed to be biologically inert to even a toxic outcome. However, in between the two ends of the spectrum also lies a plethora of often-neglected “peculiar” NMs induced biological responses. While the current problem-centric approach to the design of nanomedicine is a good starting point to apply nanotechnology to medicine, it is hardly sustainable because it is the undesirable side effects that derails the paths to clinical applications. Therefore, it is imperative that we refocused and take into account the generic properties of the NMs and their innate bio-nuances. In our lab, we are interested to understand and establish the design principles governing the structure-bioactivity relationship of bio-NMs for its safe implementation and unlock their full potential for nanomedicine. In this talk, I will present an over-arching view on the various nano-biological projects our lab has undertaken. Specifically, I will focus on the novel biological effects of TiO2, hydroxyapatite and SiO2 based NMs within the context of epithelial wound healing and endothelial barrier functions, and discuss how these overlooked bio-nuances can be exploited as novel nanomedicine strategies.
H-Man: A Portable and Low-cost Robot for Upper-limb Neuro-rehabilitation

Abstract
In the last decades more robotic manipulanda have been employed to investigate the effect of haptic environments on motor learning and rehabilitation. However, implementing complex haptic renderings can be challenging from technological and control perspectives. We propose a novel robot (H-Man) characterized by a mechanical design based on cabled differential transmission providing advantages over current robotic technology. The H-Man transmission translates to extremely simplified kinematics and homogenous dynamic properties, offering the possibility to generate haptic channels by passively blocking the mechanics, and eliminating stability concerns. We report results of experiments characterizing the performance of the device (haptic bandwidth, Z-width, and perceived impedance). We also present the results of a study investigating the influence of haptic channel compliance on motor learning in healthy individuals, which highlights the effects of channel compliance in enhancing proprioceptive information.

The generation of haptic channels to study motor redundancy is not easy for actual robots because of the needs of powerful actuation and complex real-time control implementation. The mechanical design of H-Man affords the possibility to promptly create haptic channels by mechanical stoppers (on one of the motors) without compromising the superior backdriveability and high isotropic manipulability. This paper presents a novel robotic device for motor control studies and robotic rehabilitation. The hardware was designed with specific emphasis on the mechanics that result in a system that is easy to control, homogeneous, and is intrinsically safe for use.
Pervasive Molecular Biology: Ultrafast And Low Cost PCR Amplification for DNA Diagnostics At The Point Of Need

Abstract
Despite significant advances made in the fields of molecular genetics, cell biology and genomics over recent decades, the technologies that have enabled such progress, such as DNA amplification, DNA sequencing and cell culture, have largely been restricted within laboratories, and for the most part (with exceptions such as blood glucose monitoring) have not been adopted at the point of care, and much less in low resource settings. In this talk, I will review my lab’s efforts over the past decade in developing a rapid low cost mobile DNA lab for the community, and discuss recent technological and social developments that seek to bridge this gap. The Polymerase Chain Reaction (PCR) is a core molecular biology procedure at the heart of many molecular genetic analyses, and DNA purification and thermocycling typically takes hours to complete in a molecular biology lab. We have integrated innovations in assay design, enzyme biochemistry and thermofluidics to achieve ultra-rapid sample lysis and thermocycling of standard volume reactions. The complete analysis from blood sample to end-point results through 35 amplification cycles can be performed under 5 min. Prototypes for rapid thermocycling that are suitable for various point-of-care settings have been made, covering a range of cost ($5-$500), power source, skill (manual to fully-automated) and usability (wireless smartphone interface) requirements. To facilitate dissemination and adoption among a wider range of end-users, these prototypes were fabricated using off-the-shelf consumer devices, components and methods commonly used by the amateur maker community. These rapid PCR protocols have been demonstrated with several fluorescent dye chemistries and for a variety of targets, including bacteria, human genomes and viral RNA. We have also developed and validated a rapid multiplex Reverse Transcription-PCR test for dengue RNA virus serotypes 1-4 using 2-dye Taqman probe chemistry and show that it is comparable with conventional RT-PCR assays in analytical sensitivity and specificity. We are currently developing more PCR assays for other tropical, infectious and genetic diseases, deploying mobile field labs in various community and rural settings, and exploring various upstream DNA enrichment procedures for other specimen types. We have been working to identify new gene targets in human, fungal, bacterial, viral and microbiome genomes that confer greater species specificity, improved disease predictability, enhanced sensitivity and improved accuracy, particularly by using tandem repeats and copy number variants in the genomes. There is also an opportunity to exploit other microfluidic separation and micro-optic analytical technologies for sorting cells, multiplexing assays and co-analyzing proteins/cells. Apart from molecular diagnostics at point-of-care, there is potential for low-cost PCR and molecular genetic uses in other fields such as education, agriculture, food and environmental sciences. It is envisioned that making DNA analysis as rapid, economical, simple and robust as lateral flow immunoassays will accelerate the exploitation of genomic technologies for ubiquitous application outside the laboratory.
Towards Automated Interpretation of EEG Signals

Abstract
The rapid rise in the number of emerging and re-emerging infectious diseases due to viral pathogens underscores a need for therapeutic approaches that target large classes of viruses using single drugs. To be effective, such “one for many” broad-spectrum antivirals must either interfere with the shared steps of biophysical or biochemical processes of viral entry (i.e., fusion inhibiting mechanisms) or disable disparate virions by targeting their common structural components (i.e., virocidal mechanisms). To this end, one obvious target is the lipid bilayer component of the viral envelope. Although derived from the host cell, the viral membrane differs from cellular membranes in many physical-chemical properties including chemical composition, curvature, and lateral fluidity as well as the absence of biogenic reparative capacity. These attributes are shared across a variety of different viruses rendering the viral membrane a discrete and susceptible target for developing broad-spectrum antivirals. Specifically, antiviral drug candidates can be designed that selectively alter the nanometer-scale viral envelope – without harming the larger host cell membrane –destabilizing its structural integrity and/or disrupting the ability of the virus to enter the host cell.

This talk presents broad-spectrum antiviral potential of two distinctly different classes of membrane-active antiviral drug candidates. First, using model membranes we show how a peptide derived from the hepatitis C virus nonstructural protein NS5A, acquires a broad-spectrum virocidal activity by disrupting model viral membranes in a size- and composition-dependent manner. Second, we demonstrate the ability of a a class of synthetic membrane-active amphiphiles in stabilizing positive curvatures, which inhibit viral entry.
Robot Aided Rehabilitation For Stroke And Design of Assistive Upper Limb Exosuit

Short Bio
Lorenzo Masia is Assistant Professor at the School of Mechanical & Aerospace Engineering (MAE) at Nanyang Technological University (NTU) of Singapore since August 2013. He graduated in Mechanical Engineering at “Sapienza” University of Rome with Biomedical Curriculum in 2003, and in 2007 he accomplished his PhD in “Mechanical Measurement for Engineering” at the University of Padua with the Thesis “Design and Characterization of a Modular Robot for Hand Rehabilitation”. During his PhD he was visiting student at the Mechanical Engineering Dept. of the Massachusetts Institute of Technology (MIT) (from Jan-2005 to Dec 2006) working at the Newman Lab for Biomechanics and Human Rehabilitation. Under the supervision of Dr. Hermano Igo Krebs and Prof. Neville Hogan, he designed the first prototype of InMotion Hand Robot for hand motor restoration, a modular device now commercialized by Interactive Motion Technology Inc.(Cambridge, MA).

Abstract
Human Machine Interaction (HMI) has advanced the range of possibilities in manipulation tasks, providing additional empowering instruments for a wide spectrum of novel applications from Ergonomics (remotely operated systems or minimally invasive surgery MIS) to Clinical Rehabilitation (Robot Aided Rehabilitation). After a short introduction on broadly used control schemes in HMI, I will briefly discuss the robotic solutions designed and developed in my previous experiences: driving through experiments for characterization of residual motor functions in stroke patients to better address rehabilitation strategies by using opportunely designed haptic devices. A special emphasis will be dedicated to proprioceptive impairment: loss of proprioception is likely to affect in a significant manner the capacity of stroke patients to recover functionality of the upper limb; clinical assessment methods currently in use are rather crude, with a low level of reliability and a limited capacity to discriminate the relevant features of the deficits. I will illustrate a new technique based on robotic technology, with the goal of providing a reliable, accurate, and quantitative evaluation of kinesthetic acuity which can be integrated in rehabilitation protocols. The second part of the presentation will be on a new concept for actuation that combines an elastically compliant composite structure with conventional electromechanical elements. In recent years, compliant actuation technology have been increasingly developed and employed in the new fields of robotic rehabilitation, haptics and wearable exoskeletons: devices where safety, limitation of peak forces and gentle interaction are extremely important. To date, several examples of robotic applications have been designed to address the demanding needs of these disciplines that require compliance in actuation and manipulation: gentle interaction with human in the loop. However, in some cases, control performance is not fully satisfied due to lack of accuracy of robotic system models, unmodeled nonlinearities, complex friction as well as actuator dynamics. In such cases, estimating the inverse dynamics model from collected data will provide an interesting alternative to achieve both compliant control and high tracking quality. In my talk I would like to introduce a new approach in wearable exosuits for upper limb assistance, based on composite materials and introducing a new algorithm which can learn an unknown system model from measured data using localization approach combined with Extreme Learning Machine.
Self-Assembled Molecules as Artificial Cell Membranes

Short Bio
Dr. Madhavan Nallani obtained his Ph.D. on polymer vesicles with membrane proteins as nano-reactors at the Jacobs University in Bremen, Germany. He did his post-doc on block copolymer self-assemblies at the Radboud University Nijmegen, The Netherlands. He was working at the Institute of Materials Research and Engineering (A*STARE) in Singapore as Principal Investigator for bio-mimetic membranes and commercialized the technology through a spin-off company ACM Biolabs. He is currently an Assistant Professor at the School of Materials Science and Engineering, Nanyang Technological University and CEO of ACM Biolabs Pte. Ltd

Abstract
The formation of synthetic membrane compartments is a useful tool to dissect the physical principles underlying the function of biological cells. For such compartments, advances in polymer chemistry have been proven to be extremely useful. As an example, amphiphilic block co-polymers can be used instead of lipids to form self-assembled bilayer vesicles (i.e., polymersomes), the stability of which allows excellent control over vesicle structure and the encapsulation of molecules. Taking cues from self-assembly processes in nature, we attempt to mimic natural complexity in a controlled manner. The resulting structures could eventually be exploited for applications in health and consumer care.

In this talk I would like to present such self-assembled structures and their interactions with proteins and active cargo, an area that is at the interface of research and product development.
Understanding Asian Respiratory Disease: Translational Respiratory Research at LKCMedicine

Short Bio
Assistant Professor Sanjay H. Chotirmall graduated from the Royal College of Surgeons in Ireland (RCSI) with an honours degree and the colleges’ gold medal in Microbiology. After attaining memberships from the Royal College of Physicians of Ireland (MRCPI) and the United Kingdom (MRCP UK), he certified as a specialist in Respiratory and Critical Care Medicine. His translational work has led to high impact publications in the American Journal of Respiratory and Critical Care Medicine (AJRCCM) and the New England Journal of Medicine (NEJM). Dr Chotirmall has to date been awarded the Royal Academy of Medicine of Ireland (RAMI) Doctor award on two occasions (2010 & 2013), the Irish Thoracic Society Award (2011), the Dublin Center for Clinical Research (DCCR) Young Investigator Award (2011), the MMI-CSFP Medal (2011), the Royal College of Physicians William Stokes Award for research (2010) and the American Thoracic Societies International Award (2009). Having published over 60 peer-reviewed papers in the translational respiratory arena, he remains as an active member of the International Society of Human and Animal Mycology (ISHAM) working group for fungal infection; a key member of the Long Range Planning Committee (LRPC) of the European Respiratory Society (ERS); and, a member of the Annual Congress program committee for the American Thoracic Society (ATS). Asst Prof. Chotirmall is Section Editor at the journal BMC Pulmonary Medicine where he leads a team of Associate Editors under the ‘Infectious, Rare and Idiopathic Pulmonary Disease’ section. He has similar editorial roles at PLOS One and Respirology and recently returned home to Singapore to join NTU and established the translational respiratory research group at LKCMedicine in late-2015.

Abstract
Assistant Professor Chotirmall has established a Translational Respiratory Research Group at LKCMedicine that focuses on understanding Aspergillus and Pseudomonas pulmonary infection in the context of chronic inflammatory respiratory disease affecting Asian populations. In this talk, the unique features of respiratory disease in Singapore will be discussed and the focus of his laboratory described. Work performed on fungi such as Aspergillus in the setting of bronchiectasis, a permanent irreversible dilatation of the airway will be presented. His group’s detection of a novel Asian respiratory microbiome will be outlined in addition to biomarker discovery in severe asthma with fungal sensitization through immunophenotyping. An unexplained ‘gender gap’ is observed in pulmonary infection where gender and specifically sex hormones can influence patient outcomes. His group has investigated the microbial endocrinology of Pseudomonas aeruginosa using a translational patient orientated approach. We have shown that estrogen, the major female sex hormone promotes Pseudomonas colonization and mucoid conversion in the lung. Since relocating to Singapore, this work has been further extended with observations of Pseudomonas motility changes upon exposure to male and female sex hormones, which likely have implications for its pathogenesis, persistence and signalling mechanisms within the chronically infected lung.
Protein Cages as Theranostic Agent Carriers

Abstract
Protein cages can be engineered to tailor its function as carriers for therapeutic and diagnostic agents. They are formed by self-assembly of multiple subunits forming hollow spherical cage structures of nanometer size. Due to their proteinaceous nature, the protein cages allow facile modifications on its internal and external surfaces, as well as the subunit interfaces. Modifications on the internal and the external surfaces allow conjugation of small molecule drugs or contrast agent and targeting ligands, respectively. The subunit interaction is of special interest in engineering controlled release property onto the protein cage. In this work, we present two protein cage representatives: Ferritin from Archaeoglobus fulgidus formed by 24 subunits and E2 from Bacillus stearothermophilus formed by 60 subunits.
Nanomaterials in Medicine- A Report Card in 2016 What have we done well? What can we do better?

Short Bio
Dr. Subbu Venkatraman obtained his Bachelor’s and Master’s degrees from India, then a PhD in Polymer Science from Carnegie-Mellon University, Pittsburgh. Following a post-doctoral fellowship at University of Pittsburgh, he was hired into the R&D organization of Raychem Corporation in California. He then went on to specialize in drug delivery research at two leading biotech companies, ALZA Corporation and Cygnus Therapeutics, before joining NTU in 2000. He is the author of over 200 manuscripts, 25 patents and another 15 patent applications worldwide. From these publications, he has a citation count of over 3500, with an h-index of 30. He is also the co-founder of three companies, Amaranth Medical, Peregrine Ophthalmic and AdComp Therapeutics, specializing in therapeutic medical devices and drug delivery products. Recently, he was awarded the Singapore President’s Technology Award for his work on Nanomedicine for glaucoma, Singapore’s highest award. He also won the Nanyang Award for Innovation in 2012, on the strength of his patented work on cardiovascular implants.

Abstract
This talk surveys the evolution of nanomaterial applications in Medicine. There are four medical technologies that are impacted by Nanomaterials: ex vivo diagnostics, drug/gene delivery, tissue engineering, and in vivo imaging. The importance of nanomaterials varies across these 4 technologies. Innovations in these technologies are also sporadic, and commercial success has not lived up to expectations. The rate of translation of Nanomedicinal products where nanomaterials play a key role is low. Of roughly 2000 patented applications, only about 10% have led to clinical trials, and even fewer have resulted in an approved product. Indeed several companies have gone bankrupt whose technology was based on nanoparticles, and I will explore why this has happened. Where have we done well? I will examine the progress made in 3 categories (ex vivo diagnostics, targetted delivery in cancer, and nano-therapeutics) and point out examples of success and failure, and what materials scientists and engineers can do better to translate Nanomedicine ideas to the patient. I will use two case studies to illustrate translation within the academic context-one involving nanoliposomes for glaucoma management, and another for selective inhibition of scar-tissue formation using layer-by-layer nanoparticles.
TAN LAY POH
Associate Professor
Research Theme: Nanomedicine/Biomaterials
School of Materials Science and Engineering
NTU Singapore
E-mail: LPTan@ntu.edu.sg

Engineering Cell Microenvironment

Short Bio
A/Prof Tan Lay Poh is an Assoc Prof in the School of Materials Science and Engineering, NTU. Her current research interests are in tissue engineering and engineering cell microenvironment to modulate cellular behavior.

Abstract
Material surface is an important and versatile avenue for manipulation of cell-material interaction which eventually leads to modulation of cellular behavior. Here, we study on various material properties to modulate cellular behavior, particularly surface patterning. In one of our work, we micropatterned ECM lanes on the material surface to induce cardiomyogenesis of human mesenchymal stem cells (hMSCs). We further translate this into 3D scaffolds to engineer cardiac patches to reconstitute the infarcted myocardium and enhance cardiac functions. In this study, we tested the hypothesis of a topographically engineered scaffold surface to induce specific differentiation of the hMSCs. It was found that the channels that were created on this fiber spun mats were able to accommodate cells and then guide the cells to differentiate into myogenic lineage. Furthermore, the porosity of the scaffold supports cell survival and such patch could be layered up to 5 layers without compromising cell survival. Apart from this cardiac patch development, other areas of tissue engineering will be shared in this talk as well.
Abstract
Instant curing adhesives typically fall within three categories, being activated by either light heat, or chemical means. These curing strategies limit applications to specific substrates and can only be activated under limited certain conditions. A significant need exists for adhesives that allow for manipulation and subsequent adhesive activation in wet or low temperature surfaces. Herein, we present the development of an instant curing adhesive through photo- or low voltage activation.

The photocuring and electrocuring bioadhesives are synthesized by grafting carbene precursors on dendrimers to form viscous liquids. The adhesives are activated at low UV intensites or voltages, allowing tunable viscoelastic properties, as polymer crosslinking is immediately terminated when the stimulus was discontinued. Thus, crosslinking initiation and propagation are observed to be stimulus and time dependent, enabling tuning of both material properties, drug delivery and adhesive strength. Adhesion bond strengths and drug delivery properties on a variety of natural and synthetic substrates, activated through various currents and polymer backbones will be presented.
Multifunctional Polymeric Nanostructures for Cancer Imaging and Therapy

Short Bio
Dr. Mingfeng Wang is currently an Assistant Professor in the School of Chemical and Biomedical Engineering at Nanyang Technological University, Singapore. He received his BSc degree in Chemistry at Jilin University in 2001, followed by his MSc degree in Polymer Chemistry and Physics under the supervision of Prof. Xi Zhang. In 2004, he joined Prof. Mitchell A. Winnik's group at the University of Toronto and obtained his PhD degree in Polymer Chemistry and Materials in 2009. Then he was awarded with a Postdoctoral Fellowship supported by the Natural Sciences and Engineering Research Council of Canada (NSERC), and moved to Prof. Fred Wudl’s group at the University of California, Santa Barbara. His current research focuses on polymeric and supramolecular materials with bioinspired structures and advanced functions for energy sustainability and nanomedicines.

Abstract
Nanoparticles (NPs) with integrated functionalities of targeting, therapy, imaging contrast and biocompatibility have shown promising opportunities for improved disease diagnosis and therapy. Several types of NP-based drug delivery systems based on liposomes and block copolymer micelles have been approved for clinical use in cancer therapy. However, NP-based drug delivery systems approved in clinical use to date only carry therapeutic drugs, while lacking imaging-contrast agents that are essential for reliable diagnosis of cancers, particularly for those in the early stage. In this talk, I will present our recent efforts towards multifunctional nanoparticles for applications in cancer imaging and therapy. Specifically, we have developed highly fluorescent and biodegradable polymeric nanoparticles that exhibited significantly enhanced photostability compared to commercial organic dyes and quantum dots in cell and tissue imaging. In addition, a new photothermal agent based on colloidal nanoparticles formed by a narrow-bandgap benzobisthiadiazole derivative showed high near-infrared photothermal conversion efficiency and robust photostability for cancer imaging and therapy. I will also present our efforts of developing new unimolecular micelles with well-defined structures and robust stability for effective delivery of anticancer drugs.
ABHIJIT VIJAY SALVEKAR
PhD Student
Research Theme: Nanomedicine/Biomaterials
Interdisciplinary Graduate School
Nanyang Institute of Technology in Health & Medicine (NITHM)
NTU Singapore
E-mail: ABHIJITV001@e.ntu.edu.sg

Shape Memory Polymer Devices: A New Medical Application

Short Bio
Abhijit Vijay Salvekar is currently a 4th year PhD student at the Interdisciplinary Graduate School, Nanyang Technological University Singapore. His PhD research focus is shape memory polymers and biomaterials for biomedical applications. His research interest includes structure-property relationships in polymers, rheology of polymers, polymer processing and characterization, therapeutic medical devices. Abhijit holds a B.Tech from Pune University, India and M.Tech from Delhi Technological University, India.

Abstract
The shape memory effect (SME), involves the pre-programming the material into an initial shape, then into a second shape outside the body, and finally recovering the initial shape inside the body. The two materials classes that exhibit shape memory are Shape Memory Alloys (SMA) such as Nitinol and Shape Memory Polymers (SMP). Despite the obvious advantages of the Shape Memory Effect (SME), only a few products have actually been approved as implanted devices. The SME in polymers have not been sufficiently exploited for medical applications.

My research work is focused on novel application of SME, using a fully biodegradable polymer system. The application is the minimally-invasive deployment of an embolic plug for enhancing localization of chemotherapeutic drugs to treat liver cancer.

Liver cancer has the second highest mortality rate worldwide and is highly prevalent in Asia. At least 70% of the liver cancer patients are inoperable and are treated with palliative Transarterial Chemoembolization (TACE) or Selective Internal Radiation Therapy (SIRT). In TACE and SIRT the hepatic artery is embolized following delivery of the chemotherapeutic agents. Repeat procedures are effective, so patency of the hepatic arteries needs to be restored before the next treatment.

In this work we report on a fully biodegradable radiopaque shape memory polymer-hydrogel composite which can be delivered to the target in a low profile temporary shape. Upon contact with the body fluid at target location it will self-expand to the fully functional shape, giving perfect occlusion in less than two minutes. In-vitro performance of the device was evaluated in peristaltic flow models at different flow rates and different sizes of tubing. In-vivo performance of the device was assessed in a rabbit model for feasibility of deployment, duration and degree of occlusion. The results demonstrate that the SME concept works well in this application. The results demonstrated that the prototypes were visible under fluoroscopy and complete vascular occlusion occurred in less than 2 minutes in vivo.
Site-Specific Photo-induced Conjugation of Tetrazoles to Modified and Native Proteins

Abstract
Bio-orthogonal chemistry has been widely used for conjugation of polymer molecules to proteins. Here, we demonstrate the conjugation of polyethylene glycol (PEG) to bovine beta-lactoglobulin (BLG) by photo-induced cyclo-addition of tetrazole-appended PEG and allyl-modified BLG. During the course of the investigation, a significant side-reaction was found to occur for the conjugation of PEG-tetrazole to native BLG. Further exploration of the underlying chemistry reveals that the presence of a tryptophan residue is sufficient for conjugation of tetrazole-modified molecules.

Polymer-Drug Conjugates for Controlled Release of Hydrophilic Drugs

Short Bio
Andreas Dickescheid started his career in “Boehringer Ingelheim”, a pharmaceutical company from Germany with 47,500 employees worldwide (2015), by doing an apprenticeship (2005 – 2008) as a “Chemical Laboratory Technician” at the age of 16 years. Followed (from 2008 onwards) by various positions in Boehringer Ingelheim with the main focus on the development and validation of analytical methods for new solid drug applications, providing analytical support for transfer, evaluation and validation of pharmaceutical production processes, the transfers of analytical methods worldwide, as well as troubleshooting and evaluation of deviations in pharmaceutical production and laboratory. Along with his full-time work, he studied his a-level and bachelor’s degree (chemical engineering) in part-time, supported by scholarships from Boehringer Ingelheim and the German government.

Abstract
In the following study, a system for the sustained release of the polar drug Ganciclovir was developed, by coupling it to a polymer backbone, using an amino acid linker. Since there is currently no sustained delivery medication available, this novel drug delivery system for Ganciclovir (the current gold standard) could innovate the treatment of cytomegalovirus (CMV), which infects approximately 30 % to 90 % of the world population, and can cause blindness in patients with CMV Retinitis.

So far, a way of synthesizing the mentioned polymer drug conjugate with 38.2 % (w/w) drug loading was developed, which delivers the product in a very high quality with < 0.2 % individual process related impurities or degradation products and only 0.3 % free drug. The analytical methods for the characterization were developed and applied, and the first release experiments were performed. The preliminary results in Phosphate Buffered Saline (PBS) pH 7.4 at 37°C showed a very linear release (r² > 0.99) with very slow release rates of 0.01 % per hour, which would lead to a complete release within approximately 1 year. The sink conditions during those experiments were met and confirmed by testing in a 5 times larger volume and by adding of 0.01 % Tween 20 as surfactant. Also the pH dependent behavior of the release, as it could be applied by encapsulation the polymer drug conjugate into PLGA was studied and showed a more sustained and linear release of 0.004 % per hour at pH 6, 0.003 % per hour at pH 5 and 0.0025 % per hour at pH 4.
Unconventional Platforms for Detection of Growth Hormone Doping in Sports

Short Bio
Antareep is a 1st year PhD student working on point-of-care biosensors for detection of substance abuse in sports. His principle area is Growth Hormone and IGF-1 detection. Being a Materials Engineer, he focuses on the platform development aspect of the project.

Abstract
Recombinant Growth Hormone (GH) is widely believed to have performance enhancing effects in athletes and hence is used as a doping agent. Although, GH and its secretagogues are banned by the world anti-doping agency (WADA), the challenges associated to GH doping detection have caused very few such cases to come to light over the years. GH has a short half-life, fluctuating secretion, similarity with endogenous form and low urinary excretion. There are two WADA approved tests currently: the isoform test, dealing with the difference in nature of recombinant and endogenous forms; and the biomarkers test, which exploits the effect of GH on increased levels of IGF-I and Collagen III synthesis in blood. These tests are effective but have their limitations as well, and this has resulted in widespread research on methods to either improve or replace the existing tests. This is a review where we briefly look at such existing or developing technologies which have not yet been fully explored but have a potential of not just improving the sensitivity of detection but would also provide cost effectiveness. Aptamer based sensors, commonly called ‘aptasensors’, which can involve detection using Surface Enhanced Raman Spectroscopy (SERS) or Surface Plasmon Resonance (SPR) maps; development of non-invasive techniques to detect low abundance biomarkers from urine; point-of-care platforms like stack-pad devices; electronic sensing using field effect transistor (FET) based devices; and development of mass spectroscopic methods to achieve the desired sensitivity, are some of the areas we would focus on.
Human Motion Intention Detection using Myoelectric Interface for an Exoskeleton Device

Short Bio
Chris Wilson Antuvan graduated with his bachelor’s degree in Mechanical Engineering from University of Kerala, India, in 2011. He joined Arizona State University in Fall 2011 for the Master of Science (MS) program in Mechanical Engineering. During his tenure, he was a Graduate Research Assistant at Human Oriented Robotics and Control Lab at ASU, and successfully defended his thesis on the title ‘Electromyogram (EMG)-based Robot Control Interfaces: Beyond Decoding’. He is currently enrolled in the PhD program at the School of Mechanical and Aerospace Engineering at Nanyang Technological University under the supervision of Prof. Lorenzo Masia, where he will be working on interfacing humans with upper limb orthotic device (exoskeleton). His main research interests include Rehabilitation Robotics, Human Robot Interactions, Orthotics and Control Systems.

Abstract
Myoelectric signals are rich sources of information about human movement control. They are also easily accessible, making them appealing for controlling devices like prosthetics, orthotics, and exoskeletons. However, the variability of the EMG signal and required processing time make it difficult to design a myoelectric control system for real-time use by multiple subjects. Such a system would have to be a) robust to EMG signal changes between subjects, and b) quickly and accurately process incoming EMG data to determine intended motion.

Feature extraction techniques help in characterizing underlying structure in the EMG signal. Muscle synergy based features help in simplifying dimensionality of control, and are considered to be more robust to signal variations. Another important aspect in a myoelectrically controlled devices is the learning capability and speed of performance for online decoding. Extreme learning machine (ELM) is a relatively new supervised learning algorithm, and the learning rates are significantly higher than the traditional back-propagation based learning machines, and it provides an efficient solution to generalized feed-forward networks.

The drawback of pattern recognition algorithms is that the decoding is sequential: meaning that the decoder can only predict one output at a time, even if the subject is performing more than one movement simultaneously. Simultaneous movements are a natural and efficient way by which humans perform activities of daily living, and as such it is important to incorporate this aspect into myoelectric-based motion decoding. We propose a unique classification strategy designed to incorporate simultaneous decoding of motions involving wrist (wrist flexion/extension) and hand (hand open/close).

Modulation of stiffness provides a great deal of advantage in the way humans interact with the environment, and is very important in successfully performing activities of daily living. In the context of human-machine interactions, stiffness control could provide a safer interaction, especially when dealing with unpredictable environment. We propose a user-modulated stiffness and position control for the wrist flexion/extension degree of freedom while physically coupled to a haptic device.
Protein-free Pine Pollen Microcapsules for Molecular Loading

Short Bio
Arum is 4th year PhD student in IGS working on “Pine pollen for oral delivery applications”. He did his Masters in Biomedical Engineering from IITB where he did my final year project in the field of Nanomedicine titled: “Polymerosomes for Cancer Theranostics”. My bachelors was in Biotechnology (Jeppiaar Engineering College, Anna University). He is interested in the field of healthcare where he feel he can make a difference.

Abstract
Pine pollen is a widely used natural product in traditional medicine. It is composed of a microstructure that contains a sporoplasmic central cavity and two empty air sac compartments. Such features lend excellent potential for encapsulating materials, especially in the context of preparing protein-free sporopollenin exine capsules (SECs). While SECs have been formed from other pollen species, there have been no reports of pine pollen SECs that include detailed characterization analysis. Herein, we systematically evaluated acidic processing methods in order to produce clean, intact pine pollen SECs, and analysed the resulting microcapsules morphologically and chemically. Morphological properties of the SECs were analysed by scanning electron microscopy (SEM) and dynamic imaging particle analysis (DIPA), whereas sporoplasmic removal was evaluated chemically by CHN elemental analysis and visualized using confocal laser scanning microscopy (CLSM). It was identified that 5-hour acidolysis with phosphoric acid at 70 °C yielded an optimal balance of high protein removal and preservation of original microcapsule architecture. At the same time, it was observed that specimen breakage caused by treatment occurs mainly at the central cavity-air sac junction, leaving individual compartments preserved. Both intact pine pollen SECs and individual compartments thereof are suitable for microencapsulation, as verified by protein loading experiments. Our findings outline a successful strategy to prepare pine pollen SECs and demonstrate for the first time that SECs can be prepared from multi-compartment pine pollen capsules as well as fragments thereof, opening the door to more flexible processing approaches towards utilizing protein-free pollen microcapsules in industrial applications.
NeuroBrowser - A Low-cost System to Enhance, Accelerate, and Automate EEG Interpretation

Short Bio
Ashish Kumar received his bachelor degree in computer science from Cochin University of Science & Technology in 2010. Now, he is pursuing PhD in computer science from Nanyang Technological University in Singapore. He is working in LILY lab, which is a NTU-UBC collaboration for the Excellence in Active Living for the Elderly. His research focuses on the design of computing technologies that help the elderly enjoy an active and independent lifestyle. His research interest includes Wandering pattern in dementia, patterns recognition, deep learning, and artificial intelligence.

Abstract
The aim of this study was to develop and validate a robust algorithm for indoor and outdoor wandering pattern detection and to analyze the relationship of these patterns to other clinical measures. Much of the previous work in this area addressed the measurement of wandering indoors or outdoors and to the best of our knowledge, there has not been a unified algorithm proposed which can deal with both scenarios. We present a novel grid-based layout representation strategy to identify the patterns, which is applicable to both indoor and outdoor scenarios. The algorithm is sufficiently robust to identify interleaving and hybrid patterns and performed with identification accuracy of 90% on a real-world sample.
Long-acting Sirolimus Microparticle Formulation and Its Antiproliferative Effect in Jurkat Cell

Short Bio
Fan Yanliang, Betty is a 4th year PhD student in Interdisciplinary Graduate School under the supervision of Professor Loo Say Chye Joachim, Professor Per-Olof Berggren and Assistant Professor Yusuf Ali. She graduated with a Bachelor's (Hons.) degree in Science (Chemistry and Biochemistry). Upon graduation, she worked in 3M Healthcare for 3 years as a formulation chemist. After completion of several formulation development projects, she returned to NTU to pursue more knowledge and skills in R&D. Her research focus is to formulate sustained drug delivery systems using biodegradable polymers for the application in diabetes treatment. Her PhD work is a collaboration with 2 disciplinary: Materials and Medicine. Her research interest include polymers, drug delivery, encapsulation, islet transplantation, diabetes.

Abstract
Spurred by advancements in transplantation surgical techniques, immunosuppressive regiments are increasingly prevalent in medicine today. The clinically used immunosuppressive drugs, such as cyclosporine, tacrolimus and sirolimus, are high in potency, molecular weight and hydrophobicity. Such nature imposes challenges to effective delivery. Frequently, excessive sirolimus is administered clinically, leading to negative side effects and undesirable cytotoxicity. To reduce drug dosage, side effects and dosing frequency, there is a critical need to develop more efficient sirolimus delivery system for long-term effect and tunable efficacy. In this study, long-acting sirolimus microparticle (MP) was developed using poly (lactic-co-glycolic) acid (PLGA) polymer to meet the minimum dosage with controllable duration, and preserve it from rapid degradation for up to 30 days. To evaluate the long-acting efficacy of sirolimus MP, the antiproliferative potential was characterized using human lymphocyte cell (Jurkat) using WST-8 cell counting kit (CCK) for cell viability assay. Incubation of sirolimus MP and lymphocyte cells clearly demonstrated its long-term antiproliferative effect, which is important for clinical application, such as long-term immunosuppression at local site, primary and metastatic tumor growth inhibition over time and enhancing autophagy as potential treatment for Alzheimer’s disease.
Epileptiform Transient Characteristics
Underlying Expert Interrater Agreement and
Predicting Expert Opinion in Interictal EEG Interpretation

Short Bio
Elham Bagheri is a Ph.D. Student working under supervision of Assoc. Prof. Justin Dauwels. She obtained SINGA scholarship and started her post-graduate study in August 2014. She has received her undergraduate degree in Biomedical Engineering (Bioelectric) from Amirkabir University of Technology in Iran. Her research interests include computational neuroscience, machine learning and computational intelligence.

Abstract
The presence of epileptiform transients (ETs) in the electroencephalogram (EEG) is a key finding in the medical workup of a patient with suspected epilepsy. However, interrater agreement (IRA) regarding the presence of ETs is imperfect. An improved understanding of which ET attributes mediate expert IRA might help in improving automatic ET detection algorithms. We set out to determine which attributes of ETs predict expert agreement. ETs were annotated on a 5-point scale by 18 clinical neurophysiologists (EEGers) within 200 30-second EEG segments from recordings of 200 patients. 5538 features were extracted, including wavelet coefficients, morphological features, signal energy, nonlinear energy operator response, electrode location, and short time Fourier transform features. Feature selection was performed by applying elastic net regression and expert opinion was predicted by applying support vector regression (SVR), with and without the feature selection procedure and with and without several types of signal normalization. Multiple types of features were useful for predicting expert annotations, but particular types of wavelet features performed best. As the size of the group of EEGers used to train the models was increased, performance of the models leveled off at a group size of around 11, which suggests a “wisdom of the crowd” effect. In addition, we were able to predict scores given to an event by experts using the set of selected features and the fitted SVR model.
Novel Assay Development for Detection of Proteases

Short Bio
Garima Goyal completed her Bachelors in Engineering in Biotechnology from Panjab University, Chandigarh. She pursued her interest in the field of Bio-nanotechnology during her Masters in Science (Research) at Department of Biochemical Engineering and Biotechnology, IIT Delhi, New Delhi. She is currently a first year Ph.D. student at IGS-NNIN, NTU, with her project focusing on assay development for detection and characterization of proteases.

Abstract
MMP (Matrix Metalloproteinases) and ADAM (A Disintegrin and Metalloproteinase) belongs to a broad family of Metzincins. These are calcium dependent zinc containing proteases, involved in degrading extracellular matrix proteins hence, play a significant role on cell behavior. These have been found to be involved in numerous different pathological conditions, such as metastasis and arthritis, e.g. MMP-7 and ADAM 17 are up-regulated in many type of cancers like lung cancer, gastric cancer, colorectal cancer, breast cancer and bladder cancer. Currently, novel methods for early diagnosis of such pathological conditions involve the detection of metalloproteinases (biomarkers). Our work focuses on development of colorimetric assays such that these are simple, cheap, rapid, specific and sensitive to have applications in field test and resource limited countries. Our group is exploring the colorimetric detection of the targets based on molecularly triggered aggregation of gold nanoparticles.
Conjugated Polymer Assays for Sensing Applications

Short Bio
Gopal Ammanath is currently a 3rd year PhD student in Interdisciplinary Graduate School working under the supervision of Prof. Bo Liedberg. His PhD research is to develop point of care assays using conjugated polymers for biomedical applications. He has received his Bachelor’s Degree in Electrical and Electronics Engineering from Amrita University, India and Master's Degree in Biomedical Engineering from NTU. His research interests include biosensors, point of care diagnostics and microfluidics.

Abstract
Conjugated polymers (CP) such as polythiophene (PT) and polydiacetylene (PDA) have attracted significant interest in areas such as light-emitting diodes, field-effect transistors and biosensors relying on delocalized π electrons along their conjugated backbone that yield unique optical and electronic properties. The optical properties of CP could be varied with external stimuli such as temperature, solvent or pH change, electric field and interaction with other molecules that may induce chirality in the supramolecular structure, subsequently changing the conjugation length of CP. The optical transitions of CP are due to the conformational alternations in backbone of the polymer that increase or reduce the effective conjugation length leading to red or blue shift, respectively, of UV–vis absorption maximum. A colorimetric paper-based assay using CP as luminescent reporters is proposed for applications such as bio-sensing, drinking water monitoring and gas-sensing.
Short Bio
Iuna is currently working on projects in sports chemistry and biosensors development, aiming to help athletes overcome fatigue and demonstrate the highest performance and exploring visual and electrochemical methods of detection of specific biomarkers.

Abstract
Overtraining is being recognized as a serious problem in athletics which results in low performance and physiological maladaptation affecting the health of sportsmen. A range of biomarkers is currently used for controlling the training conditions of sportsmen, but most of them have their specific drawbacks. Variation of biomarkers concentrations in saliva can be the evidence of plethora of other maladies. Recently, the ratio of two salivary heptapeptides (GGHPPPP and ESPSLIA) was proposed as an adequate indicator for overtraining. Being non-threshold compounds, they appear in saliva of only overtrained athletes, making detection of overtraining very specific. Here we report about optimization of peptides extraction from spiked saliva that was performed by ultrafiltration using a 3kDa membrane and the presence of the two peptides was confirmed by both method of standards addition controlled by HPLC/UV and by MALDI/ToF. We propose to employ a Quartz Crystal Microbalance (QCM) platform for detection of the peptides in salivary extract collected from sportsmen. Specific antibodies raised against the two peptides were used as recognition molecules in a competitive assay format. Conjugation chemistry of peptide linking to the surface of gold chip was developed. The effect of linkers and blockers of different nature was investigated. Extracts of spiked saliva were tested for specificity and accuracy of detection of heptapeptides.
JING JIN
Research Fellow
Research Theme: Signals and Algorithms
School of Electrical and Electronic Engineering
NTU Singapore
E-mail: jingjin@ntu.edu.sg

NeuroBrowser - A Low-cost System to Enhance, Accelerate, and Automate EEG Interpretation

Short Bio
Dr. Jing Jin is a research fellow in Dauwels Lab at Nanyang Technological University (NTU). She received her Bachelor and PhD degrees in Biomedical Engineering from Nanyang Technological University (NTU). Her research interests include digital signal processing, machine learning and computational neuroscience. Besides software development, her current projects are to develop robust general-purpose spike detectors.

Abstract
Diagnosis and management of epilepsy, sleep disorders and myriad of other neuropsychiatric diseases rely on analysis of neurophysiological signals such as the electroencephalogram (EEG). Conventional EEG interpretation relies on visual inspection by specialized physicians or neurologists at high cost and with limited availability. As the duration of EEG may range from 30 minutes to weeks generating terabytes of data, the visual review can be tedious and highly time consuming. Due to expert shortage, neurologists have to work in multiple hospitals, and are required to be present on the site of recording to access the EEG for interpretation. The EEG is passed forward either through removable media by EEG technologists or in-situ, thereby making it extremely inconvenient.

Although software that attempts to improve efficiency of neurologists through automatic detection of EEG abnormalities associated with epilepsy (such as epileptiform spikes) is available in the market, none have been validated and therefore not trusted by majority of the neurologists. The lack of statistical validation stems from the dearth of expert-annotated database of spikes. Alternatively, hospitals and Clinics may also use outsourced EEG reading services from providers located in US and Europe. However, these services come at a very high cost, as a result of which very few hospitals avail such services. Hence, there is an urgent need for a low-cost system to enhance, accelerate, and automate neurophysiological test such as EEG interpretation. In order to address such clinical needs of convenience, clinical validation, remote access and time savings associated with EEG interpretation, we have developed a cloud-based software named NeuroBrowser (NB). The current implementation of NB is semi-automated, and performs rapid waveform annotation based on similarity search.
Epileptiform Spike Detection via Clustering-based Template Matching

Short Bio
John Thomas is a PhD student at Dauwels Lab at Nanyang Technological University (NTU). He received his Bachelor degree from National Institute of Technology, Calicut in the year 2014. His research interests include machine learning, data mining, and computational neuroscience. Currently, he is developing spike-based detector systems for the diagnosis of epilepsy.

Abstract
Interictal epileptiform spikes are the key diagnostic biomarkers for epilepsy. The spike waveforms vary vastly among epilepsy patients, and also for the same patient across time. The clinical gold standard of spike detection is visual inspection performed by neurologists. This is a tedious, time consuming and expert-centered process. In addition to this, a standard quantitative definition of spikes is not available. Therefore, the diagnosis of epilepsy based on spikes predominantly depends on the experience and expertise of the experts. The development of automated spike detection systems is necessary to provide a faster and more reliable diagnosis of epilepsy. Spike detection based on a single algorithm is not effective enough to provide a reliable system. Each method has its own pros and cons. Developing an ensemble classifier system will provide more reliability to the detection process. In this research, we develop stacked ensemble classifier with different classification algorithms such as decision trees, artificial neural networks, template matching, etc. The ultimate outcome is predicted by a combiner algorithm that accumulates the predictions of the individual classifiers.

Currently, the classifier systems based on template matching has been developed. The extraction of a high-quality template library is crucial for the development of a template matching system. We developed a template library by applying a clustering system to the spike database obtained from Massachusetts General Hospital (MGH), Boston. A quantitative definition for spikes is derived by studying the various morphological characteristics of the templates. Moreover, this study is also aimed at quantizing the number of spike morphologies. Our affinity propagation-based template matching system with a combination of spike and non-spike templates is shown to outperform the other conventional template matching spike detectors with an area-under-curve (AUC) of 0.953.
Exercise Effects on Glucose Regulation in Humans

Short Bio
Lee Shuen Yee is a 2nd year PhD student in Lee Kong Chian School of Medicine under the supervision of Associate Professor Fabian Lim and Associate Professor Eric Yap. She graduated with a BSc (Hons) degree in Sports and Exercise Science from Loughborough University in UK. Her research interest and PhD work include exercise modalities and interventions on metabolic health and glucose regulation.

Abstract
In Singapore, the prevalence of diabetes in adults (20-79 years) is a striking 10.53%, which ranks us as the second-highest proportion of diabetics among developed nations, according a report in 2015, by the international diabetes federation. There is evidence to suggest that physical activity reduces all-cause mortality, improves glucose control and insulin sensitivity, via mechanisms such as increased expression and translocation of GLUT 4 transporters in the plasma membrane and increased glycolytic and oxidative enzymes. Currently, fasting and 2h glucose concentrations during an Oral Glucose Tolerance Test (OGTT) is used for the diagnosis of Type 2 Diabetes or to capture heightened risk of glucose dysregulation. However, there is a need to find novel biomarkers to identify early metabolic risk abnormalities. In this study, we looked at the profile of glucose response curve during an OGTT, to determine if there is a difference in glucose regulation between active and sedentary individuals, as indicated by the glucose response profile.
Short Bio
Pei Qi received her B. Eng in Material Science and Engineering from NTU in 2015. She is currently a 1st year PhD student with the NTU-Northwestern Institute for Nanomedicine programme and is under the supervision of Professor Subbu Venkatraman.

Abstract
Drug delivery refers to the way a pharmaceutical compound is administered to achieve or even enhance the therapeutic effect of a drug. The system does this by tuning the encapsulation, release profile, absorption, distribution and elimination of the drug, which can result in better therapeutic efficacy and safety. Currently, there is research being carried out on drug delivery systems. In particular, polymeric systems have garnered widespread interest as drug carriers; the ability to control the structures of synthetic polymers in order to tailor their properties makes them extremely versatile materials. In this project, amphiphilic di-block co-polymers consisting of a hydrophilic and a hydrophobic block will be explored. These self-assembling polymers can associate and exhibit a wide range of structures, which can be exploited for drug delivery purposes. More specifically, how the fabrication methods and type of polymer used affect the final morphology of the nanocarriers will be investigated. A thorough understanding of the self-assembling process and the factors that govern it is important as it allows appropriate fabrication processes to be designed to achieve a specific morphology desired.
3D Printing of Electro-curing Nanocomposite Electrodes for Cardiac Tissue Generation

Short Bio
Manisha obtained her Bachelor’s degree in Biomedical Engineering in 2014. As a first step in her line of interest, on being awarded an Indian National Academy of Engineers fellowship, she took the opportunity to work on Computer Screen Photo-assisted Technique and NI-LabVIEW to realize the functions of a spectrophotometer at a low cost in Indian Institute of Technology, Delhi. She worked as a trainee in All India Institute of Medical Sciences, New Delhi while pursuing her Masters in Biomedical Engineering from Indian Institute of Technology, Banaras Hindu University, India. She joined the laboratory of Terry W.J. Steele at NTU in July 2016 for her PhD.

Abstract
Current ischemic heart disease therapies have limited capacity for repair of cardiac tissue after a heart attack. A major technical gap in this area of regenerative medicine is the design of structurally defined bioactive material scaffolds that can localize and support stem cell viability, differentiation, and establishment of functional connections to the host tissue. To address these needs, aim is to design and formulate 3D printed tissue scaffolds incorporating 1) conductive graphene electrodes 2) electro-curing nanocomposites, and 3) marrow-derived stem cells towards implantable heart patches.

To achieve all the aims, Rheometry analysis of PAMAM-g-diazirine electrocuring nanocomposites at different voltage using 3D printed interdigitated graphene electrodes from Northwestern has been done. Shear adhesion failure assessment has also been done against ex- vivo swine aortas where electrocuring bioadhesive was activated using 3D printed interdigitated electrodes at different voltages before undergoing shear adhesive failure testing. Cohesive failure was seen and preliminary data shows some promising results. Also, the results obtained so far suggest that the curing parameters can tune both the adhesive bonding and material properties.
Design and Control of a Soft Exosuit to Assist Movements of the Upper Limbs in Activities of Daily Living

Short Bio
Michele Xiloyannis graduate with a bachelor degree at University of Pisa and a Masters in Biomedical Engineering from Imperial College London. His research interests, under the direction of Dr Lorenzo Masia, focuses on the mechanical design, characterization and control of a novel generation of soft and power-efficient exosuits to assist and augment human motor performances.

Abstract
The development of a portable assistive device to aid patients affected by neuromuscular disorders has been the ultimate goal of assistive robots since the late 1960s. Despite significant advances in last decades, traditional rigid exoskeletons are constrained by limited portability, safety, ergonomics, autonomy and, most of all, cost. In this study, we present the design and control of a soft, textile-based exosuit for assisting elbow flexion/extension and hand open/close. We have developed and characterized two independent actuator modules for the elbow and hand respectively.

Both actuators drive a set of artificial tendons, routed through the exosuit along specific load paths, which apply torques to the human joints by means of anchor points.

Key features in our design are under-actuation and the use of electromagnetic clutches to unload the motors during static posture. These two aspects, along with the use of 3d printed components and off-the-shelf fabric materials, contribute to cut down the power requirements, mass and overall cost of the system, making it a more likely candidate for daily use and enlarging its target population. Low level control is accomplished by a computationally efficient machine learning algorithm that derives the system's model from sensory data, ensuring high tracking accuracy despite of the uncertainties deriving from its soft architecture.

The resulting system is a low-profile, affordable and wearable exosuit designed to intuitively assist the wearer in activities of daily living.
Toxins Extraction and Detection from Complex Food Matrices

Short Bio
Nevena Klisara is currently working on detection of bacterial toxins and contaminants from food. Elaboration of extraction procedures and designing of biosensors’ platforms are part of her PhD project. Her background is also in organic chemistry and microbiology.

Abstract
Herein, we are focusing on extraction of proteases from diverse sources which isolation might be demanding and difficult due to their nature, in terms of their structure, molecular weight, solubility and stability, the vast difference in abundance and the association with heterogeneities of samples. Therefore, sample preparation leading to the removal of interfering compounds (mainly lipids, nucleic acids, phenolic compounds, carbohydrates, proteolytic and oxidative enzymes, and pigments) is crucial. Accordingly, the modifications and proteolysis of proteins and peptides by the commonly adopted technique such as liquid-liquid extraction, solid phase extraction, solid supported liquid extraction, solid phase micro-extraction and QuEChERS technique must be avoided by optimizing the mentioned techniques. Furthermore, state of the art sampling, extraction and biosensor technologies will be combined to develop prototype assays and/or devices for onsite detection of the toxin in contaminated food products.
3D Electrospun Nanofiber as a Potential Scaffolding System for Liver Tissue Engineering

Abstract
Hepatocellular carcinoma is the fifth most common type of cancer reported in industrialized countries. Liver transplantation is the best available solution for end-stage liver cancer, but it faces a limitation of organ donors. Hepatocytes transplantation can be a potential alternative for the whole organ transplantation approach. However, 2D in vitro environment is inadequate to maintain the viability and functionality of the hepatocytes. Liver extracellular matrix (ECM) is a 3D fibrous network, which provides dimensional stability to the organ and maintains functionality of the hepatocytes. We hypothesize that synthetic random 3D fibrous scaffolds with optimum porosity can mimic the native ECM of the liver. These synthetic 3D scaffolds we believe would provide a more physiologically mimicking environment for the hepatocytes when compared to a 2D culture in vitro. 3D random fibrous scaffolds from Poly (lactic-co-glycolic) acid (PLGA) were fabricated using electrospinning. These fibrous scaffolds were modified with native ECM proteins like collagen-I and fibronectin through chemisorption method to impart biological cues for cell adhesion, proliferation, and to create a native ECM like environment. HUH 7.5 cells, a hepatocellular carcinoma cell line was used as a model liver cell to study the cell supportability of the unmodified and ECM modified PLGA scaffolds.
Quantitative Analysis of Angiogenesis in 3D Microfluidic Devices

Short Bio
Mengmeng is a postgraduate student in EEE, NTU Singapore. She received her undergraduate degree in Chemical and Biomolecular Engineering from NTU in 2011. She is developing automated image processing tools to quantitatively analyze the time-lapse microscopy images from 3D angiogenic experiments.

Abstract
Angiogenesis, the growth of new blood vessels from existing vessels, is a critical step in cancer invasion. Better understanding of angiogenic mechanism is required to develop effective antiangiogenic therapies for cancer treatment. During angiogenesis, endothelial cells (ECs) specialize into tip cells to sense the angiogenic stimuli through filopodia and stalk cells to form solid vessels. We cultured angiogenic vessels in 3D microfluidic devices and observed the sprouting process under phase contrast microscopy daily. We developed automated image analysis systems to track ECs migration and vascular formation from these experimental time-lapse phase contrast images. The proposed automated multi-cell tracking system consists of preprocessing to obtain binary angiogenic vessel shape, cell detection to label EC candidates, and multiple hypothesis Kalman filtering to associate and track the detected cell candidates over time sequences. It generates cell migration trajectories and cell proliferation histories. The proposed automated vessel formation tracking system first preprocesses the experimental images, then applies a distance transform and an augmented fast marching method in skeletonization, and finally implements the Hungarian method in branch tracking. It provides numerical vessel information and distinguishes tip and stalk cells. These systems enable biologists to quantitatively compare the influence of different growth factors and generate numerical models for angiogenesis prediction.
**XIE CHEN**  
PhD Student  
Research Theme: Signals and Algorithms  
School of Electrical and Electronic Engineering  
NTU Singapore  
E-mail: XIEC0005@e.ntu.edu.sg

---

**Electroencephalogram (EEG) Classification**

**Short Bio**  
Xie Chen is a PhD student in School of Electrical & Electronic Engineering at Nanyang Technological University (NTU). He received his Bachelor degree in Engineering from Nanyang Technological University (NTU). His research interests include machine learning, computational intelligence and computational neuroscience. His current project is to ensemble the outputs from classifiers and make decision for EEG signal analysis.

**Abstract**  
Epilepsy refers to a group of chronic brain disorders which is characterized by recurrent seizures. The mainstay of diagnosis of epilepsy is to find the occurrence of interictal epileptiform discharges (also commonly known as “spikes”) in patient’s electroencephalogram (EEG). The presence of spikes predicts seizure recurrence and allows a physician to make a confident diagnosis of epilepsy and to prescribe appropriate treatment. In current clinical practice, visual inspection remains to be the gold standard for EEG interpretation, which is tedious and time-consuming. Subjectivity is hard to avoid, and the inter-expert agreement on spike detection can be very low. Therefore, there’s a great need for automation to assist EEG interpretation.

For diagnosis purpose, instead of detecting every single spike in a very high cost (time and computational), to label the entire EEG as “having spikes” or “spike-free” does possess greater value in clinical practice. In this project, we’re going to apply ensemble learning techniques to classify EEG in a binary manner. An ensemble decision-making system can be obtained by gathering information from a set of trained models, such as feature-based background rejection, template-based spike clustering, and boosting (cascades of simple one-stop classifiers). By properly designing and tuning the system, the ensemble performance could be optimized.