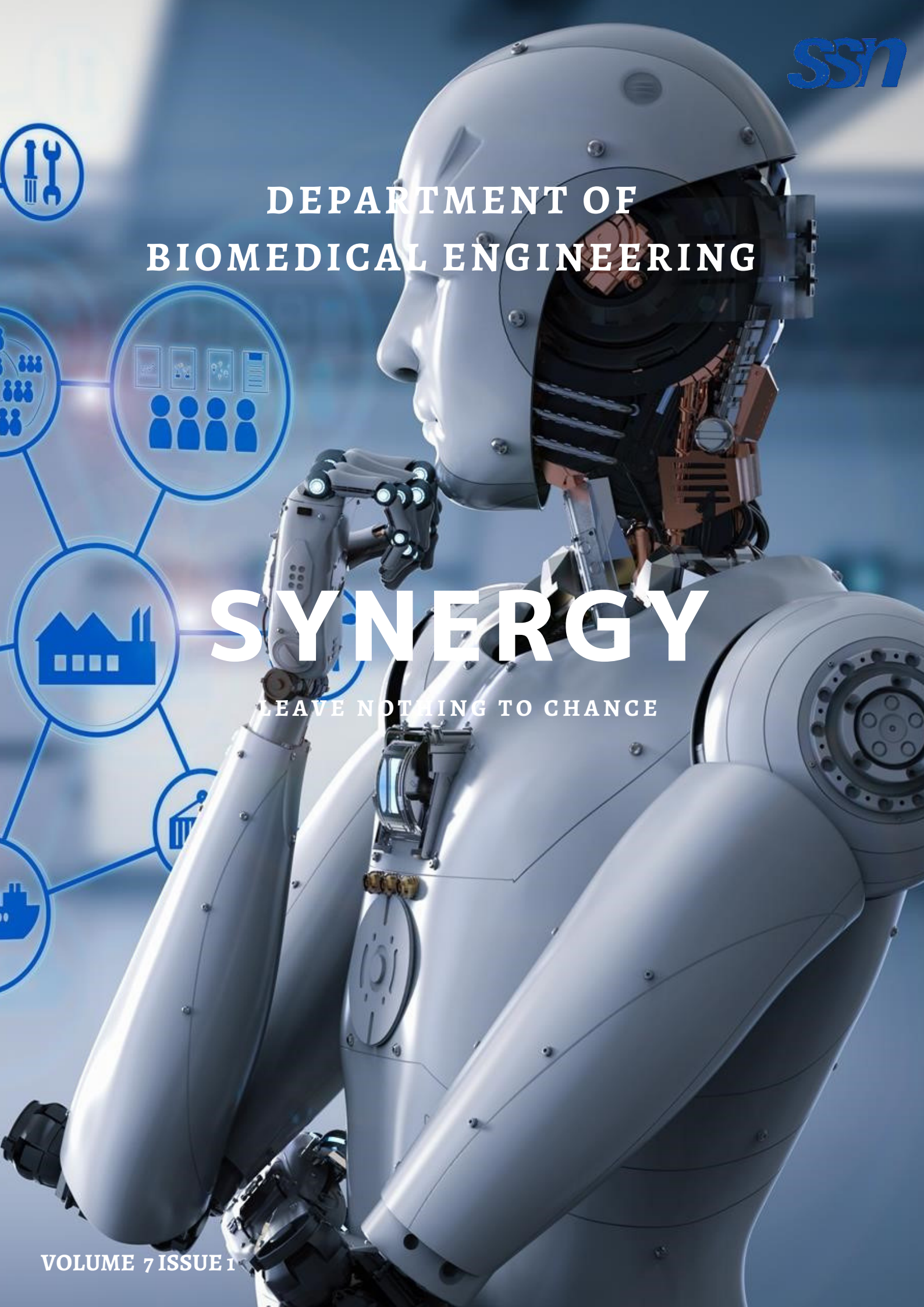


DEPARTMENT OF BIOMEDICAL ENGINEERING

SYNERGY

LEAVE NOTHING TO CHANCE

VOLUME 7 ISSUE 1

IN THIS ISSUE

FROM THE EDITORS' DESK

Welcome.

In this issue of BME Newsletter, we have an interesting line up of student and faculty achievements, conference details, various talk and articles. Also hearty congratulations to all the achievers! The department also witnessed several lectures for the students given by experts and they were inspirational. We're dedicating this issue to our students and faculty. We would also like to wish the students the best for their upcoming semester exams.

"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less."

-Marie Curie

To understanding. To success.

-Editorial Team

FROM THE HOD'S DESK

It gives me great pleasure to pen a few words as a prologue to our quarterly magazine "Synergy" that gives a platform to the teachers and students of sharing their creativity and new ideas with the world and will help in their overall development. The Department of Biomedical Engineering has recorded consistent improvement in its academic, research and placement performance.Through a nice blend of theoretical courses and projects, the department endows students with the ability to apply knowledge of science, mathematics and engineering to work effectively in multidisciplinary teams, provide leadership and technical expertise, and practice engineering with ethical approaches and concern for society and environment. I wish you all the best for your upcoming semester exams and a hearty congratulations to all the students who got placed in various companies.

Dr. A. Kavitha,
Prof & Head,
Department of Biomedical Engineering

CAMPUS UPDATES

Distinguished Alumni Award 2017

The Tribute 2018, an annual event organized by the alumni of SSN College of Engineering was hosted at the campus on 6th January, 2018. The event witnessed participation from over 800 alumni from across batches and programs.

Mr. Sivakumar Palaniswamy, an alumnus of batch 2011, Department of Biomedical Engineering, now the co-founder of NeoLight was felicitated with the Distinguished Alumni Award for his exceptional achievements as a student and as an entrepreneur. He was the winner of SSN Researcher Award, 2013 and won ASU Edson Award in 2014. He received Honor Alumni Award from Bill Clinton and was also awarded and recognized as "Medtechs Rising Star". His commendable works include design of a world class product "SmartCane" to empower the visually disabled and co-founding NeoLight, a start up with the sole motto being Empathy- driven innovation. In his much inspiring speech, he thanked the faculty and Head of Department of BME for their constant support and motivation and encouraged every student to grab every opportunity that comes in his or her way.

"Opportunities come to us everyday. It's in our hands to identify and utilize them wisely", said Sivakumar.

On behalf of Department of BME, we thank our President Ms. Kala Vijayakumar and the management for honoring Mr. Sivakumar Palaniswamy, alumnus of the department. We wish all success in his future endeavors.

SSN Gets Autonomous Status

The University Grants Commission has granted autonomy to SSN College of Engineering for maintaining high academic standards. This was announced by the Minister of Human Resource Development, Shri.Prakash Javadekar at a media briefing in New Delhi on 20th March 2018. Shri.Javadekar said that the Government is striving to introduce a liberalized regime in the education sector and emphasis is on linking autonomy with quality.

The College will be free to set their own syllabus, hold examinations, carry out the evaluation as well as declare results. In this case, only the degree will be awarded by the respective university.

Annual Sports Day

SSN College of Engineering organized the 19th Annual Sports day on 29th March 2018 at its International Football stadium. Shri. Raman Vijayan, Former Indian Footballer was the chief guest for the function.

The 2nd year girls won the Overall Games Championship. The team was captained by C.Kezia Sharon of BME 2nd year.

The 2nd year boys won the Overall Athletics Championship. The team was captained by Subramanian of BME 2nd year.

Life Time Achievement Award

Dr. S.Salivahanan, Principal, SSN College of Engineering has been conferred with ISTE Tamilnadu & Pondicherry State “Life Time Achievement Award” by Indian Society of Technical Education (ISTE) associated with Ministry of Human Resources and Development, Government of India.

INSTINCTS 2K18

INSTINCTS 2018, one of the largest cultural festival/extravaganza in South India hosted by the students of SSN College of Engineering, was inaugurated by renowned actor Ulaganayagan Kamal Hassan, Mrs. Kala Vijayakumar President, SSN Institutions, Dr. S Salivahanan- Principal, SSN College of Engineering and Prof. B Srinivasan- Director, School of Management also graced the occasion. The festival aims to promote, the spirit of discovery and exploration of varied culture among today's youth and encourage them to the citizens of the world.

On the occasion, Kamal Hassan, said "I congratulate SSN for organizing the grand event instincts to promote arts and culture. The institutions like SSN which give equal importance to culture and arts along with academics ensure holistic development of its students. I met two alumni from SSN at Harvard and interactions with them and other students there helped me in shaping the ideas and policies for making Tamil Nadu a better place. I invite all students to take an oath to make Tamil Nadu a better Tamil Nadu. He further exhorted all students to be leaders and not followers and he will gladly follow them.

Mrs. Kala Vijayakumar, President, Institutions said "It is an honor to share the stage with Mr. Kamal Hassan on the inauguration of thirteen edition of Instincts.

SSN Scholarship Day

SSN Institutions, one of India's premier education institutions organized its 19th Annual Scholarship Day on Feburary 3, 2017. Hon'ble Justice CT Selvan, Chief Guest at the event and Mr.Suresh Sambandam, Founder- Orangescape Ltd, the Guest of Honour distributed Scholarships worth Rs.4 crore to around 540 students. Started in 1999, the SSN Scholarship Scheme has benefited over 7700 students till date and over Rs. 68 crore have been disbursed under various categories. Mr. R. Srinivasan, Chairman, SSN Institutions, Mrs. Kala Vijaykumar, President, SSNInstitutions, Dr. S. Salivahanan, Principal, SSN College of Engineering and Prof. B. Srinivasan, Director, SSN School of Management were also present.

SSN Institutions offers scholarships across various categories: Rural scholarships, Walk-in-walk-out scholarships, Sports scholarships, Music scholarships, Merit scholarships, Merit-cum-means scholarships and SSN Vidyagyan Scholarships.

Mrs. Kala Vijayakumar, President, SSN Institutions, said, "It is very gratifying to note that the culture of giving back to the society is successfully inculcated in our students. This is a prime example of spirals of inspiration that education can create. This comprehensive ideal of growth and transformation is a dire necessity for our country to grow competitively in the global arena."

DEPARTMENT UPDATES

ICBSII 2018

2018 IEEE Fourth International Conference on Biosignals, images and instrumentation, was organized by the Department of Biomedical Engineering and Centre for Healthcare technologies between 22nd and 24th March, 2017 which brought together scientists, engineers and researchers from various domains to interact and exchange ideas in biomedical field. The organizers of the conference were Dr. A. Kavitha Professor and Head/BME, Dr. S. Bagyaraj Asso.Prof/BME, Dr. V. Mahesh Asso.Prof/BME and Ms. M. Dhanalakshmi AP/BME.

Dr. Paul W-Brandt-Rauf, Distinguished professor and Dean, School of Biomedical Engineering, Drexel University, Philadelphia, USA graced the event as chief guest along with the guests of honor Dr. Sriram Balasubramanian, Professor, Drexel University and Dr. Dinesh Bhatia, Prof, North-Eastern Hill University, Shillong .
Expert keynote speakers Dr. Dinesh Bhatia Prof, North-Eastern Hill University, Shillong, Dr. G. Saraswathy, Scientist, CLRI, Chennai, Dr. Minimol, Professor, Govt. Model engineering college, Cochin and Dr. C. J. Ravishankar, Managing director, Sagitec healthcare and life sciences invited talks on wide range of topics. Research papers were received from diverse areas such as Physiological Modeling, Medical Imaging, Medical Robotics, Biomechanics, Biomedical Instrumentation and Nano-materials amounting to a total of 69 papers. After a rigorous review process by an expert review committee, 29 papers that displayed quality in idea and work were selected for final presentation at the conference.

Release of the conference proceedings by the dignitaries

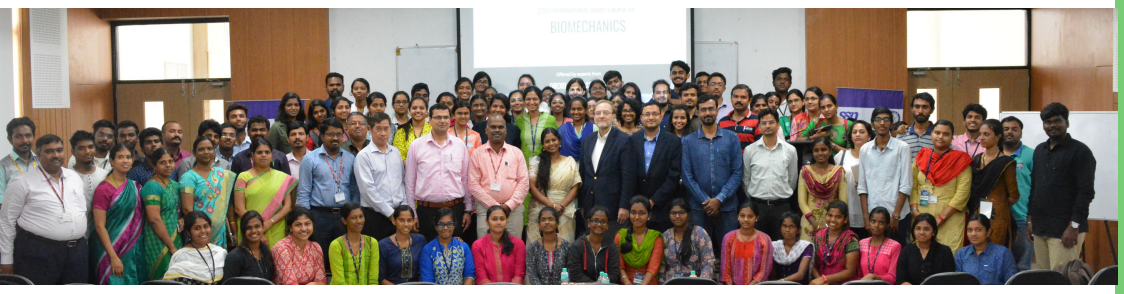
Dr. A. Kavitha presenting a bouquet to the chief guest Dr. Paul W-Brandt-Rauf, Distinguished professor and Dean, School of Biomedical Engineering, Drexel University, Philadelphia, USA

Ms. Kala Vijayakumar ,President, SSN Institutions, During a meeting with the delegate of Drexel University

BME faculty during the Conference

International Shortcourse On Biomechanics

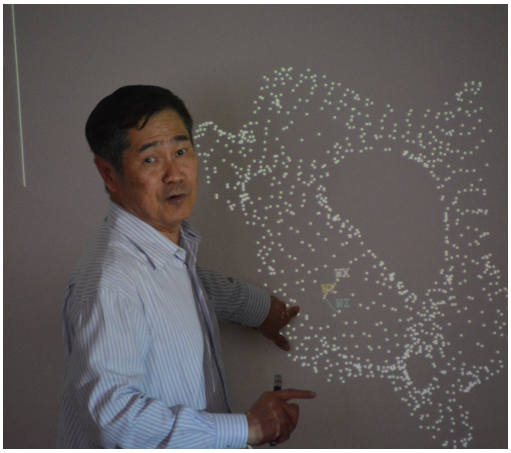
A three day short course on Biomechanics was jointly organized by the Department of Biomedical Engineering and Department of Mechanical Engineering from 19th to 21st March 2018. The main objective of the course was to enlighten the participants on the aspects of multiple areas in biomechanics and improve the perspective of product development based experimentation in Biomechanics. The resource persons were from Drexel University, USA and NTU, Singapore.



Participants of Biomechanics Shortcourse

International Shortcourse On Biomechanics

Release of Souvenir by Chief Guest



Dr. Teo Ee Chon,
Prof. NTU, Singapore

Dr. Sriram Balasubramanian,
Prof, Drexel University, USA

Hands on training given to participants

International Workshop On Biomechanics

Felicitating Dr. Sudhir Ganesan, Ortho spine Surgeon, Sri Ramachandra Medical Centre, Chennai

felicitating Mr. S. Nagarajan, Scientist-D, DEBEL (DRDO), Banglore

Autonomous Inspection Visit To BME Department

UGC expert committee visited our college on 23-24th February 2018 to access all the infrastructural facilities of our institution towards awarding autonomous status. During the visit the expert members visited our department laboratories and interacted with students who have displayed their project ideas.

UGC Expert Members Inspecting BME Lab Facilities

President Meeting With Students

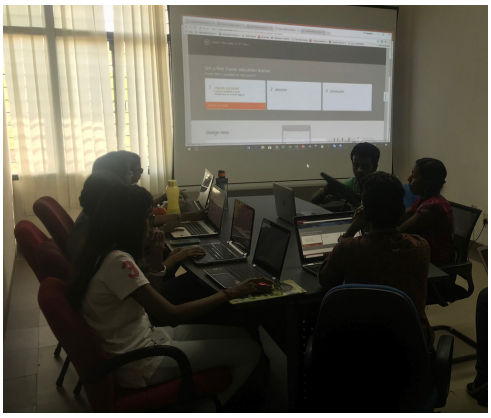
The President meeting with the students of BME department was held on 20th March, 2018. Ms. Kala Vijayakumar interacted with the students regarding recruitment, internal funding projects, cultural fests, workshop, etc.

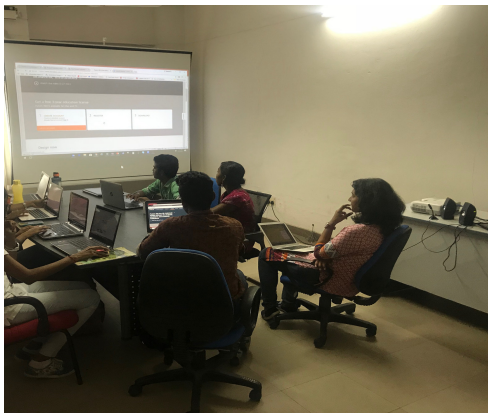
Research Day

SSN organized the 2nd edition of Research Day on 26th March 2018. Prof. Vikram Kumar, former Director of Solid State Physics Laborator y(SSPL-DRDO) and National Physical Laboratory (NPL-CSIR) was the chief guest for the occasion. Dr.A.Kavitha, HoD Biomedical department delivered the research activities report and the Faculty, research scholars of BME department were honoured with the award for various categories that includes Ph.D. Guidance, First-time Journal Publications in SSN ,Best Paper and Special Awards and Book Chapters by Faculty.

Online Webinar On Fusion Autodesk

Autodesk fusion 360 webinar given by Mr.Ramesh pudale, Autodesk India private ltd,MFG Account manager, Education was organised by Viswanath.S and Praveen kumar.G, IIIyr BME under the guidance of Dr.Vijay to inculcate a awareness about the future industrial requirements in the field of medical equipment,devices and prosthetics design and manufacturing using 3d modelling via Fusion 360 software. Training was given to understand basic sketching and modelling tools for getting started.It was an very interactive and a greater knowledge sharing session.





LabView Workshop

A Three day hands on training on “LABVIEW: AN EFFECTIVE TOOL FOR ENGINEERS” was organized by the department of Biomedical Engineering in association with IEEE EMBS student branch, SSN College of Engineering between 27th and 29th of March, 2018 . This workshop concentrated on many of the industrial and as well as the practical applications of LABVIEW.

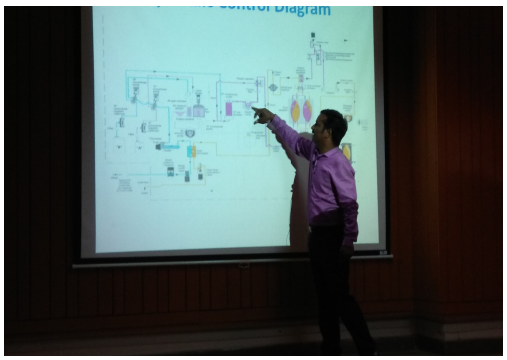
The workflow of labview was elaborated, so that the proceedings could be clearly mapped in mind. UG and PG STUDENTS along with some research scholars attended the workshop. Being a beginner’s class, all of the basics were explained frst.

Guest Lecture

"Hands On Training on Dialysis Machine"

Mr.K.Sudhakar, Manager,T.H.H Enterprises ,Chennai was invited as the resource person to give a one day hands on training on dialysis machine on 21st February 2018, which was held at the Department of Biomedical Engineering.

The workshop started aimed to delineate the need for Dialysis, types of Dialysis available and the electronic section description.Following the general presentation on dialysis, Hands on training with Baxter TINA Haemodialysis machine was given for the Final and Pre final year students of BME department.



"Radiation and its Therapeutic Techniques"

A Guest lecture was given by Prof. A.Kadiresan,Chief Physicist and Radiological Safety officer in the Biomedical Department on 2nd February 2018. The lecture started with general introduction to radiation and the history behind the radiation. A brief introduction about various radiological diagnostic equipment was given following which various therapeutic radiation techniques were discussed. Brachy therapy and TeleTherapy techniques and its procedure was presented. The cost of the machine and the location of the machine in various Chennai hospitals were also discussed.

Lab Visits

Inspire Camp- School Students

- The basic objectives of INSPIRE are to attract talented young students to undertake Science studies at an early stage and to help build the required critical human research & development base of our Nation.
- Students from schools visited our department as a part of INSPIRE CAMP on 25th Jan, 2018. They were demonstrated on facilities and equipments available in Biochemistry, Biomedical Instrumentation and Diagnostic and Therapeutic labs. Dr. S. Bagyaraj Asso.Prof/BME, Dr. R. Subashini AP/BME, Ms. K. Nirmala AP/BME, and Ms. B. Divya AP/BME co-ordinated the programme.

SSN III Year ECE

Third year ECE students doing Medical electronics course visited Biomedical Instrumentation lab and Diagnostic and Therapeutic lab on 16th Jan, 2018. They were demonstrated working of various Biomedical equipments. Ms. B. Divya, AP/BME co-ordinated the programme.

Guest Lecture

by Prof. Venkat Venkatraman

Centre for Healthcare Technologies and IEEE EMBS Student chapter of SSNCE jointly organised a guest lecture on, "Technology and Entrepreneurship", by Professor Venkat Venkatraman, Director, Scientific Operations, Impact Centre, University of Toronto on 3rd January 2018.

Prof. Venkat Venkatraman delivering the lecture

CHT Meeting With President

Centre for Healthcare Technologies research group meeting with the management was held on 14 th February 2018. Dr.A.Kavitha Head of BME and Co-ordinator of Centre for Healthcare Technologies research group presented research updates along with a proposed timeline of activities for the next 15 years.

FACULTY PARTICIPATIONS

Conference

- Meenachi. P, Subashini.R, AP/BME Tharika, Pavithra, Prasanna kumar, Balashanmugam have presented a paper titled " In vitro Evaluation of Biodegradable nHAP-Chitosan-Gelatin based Scaffold for Tissue Engineering Application"and published the paper in proceedings of International conference on Bioengineering on Health and Environment (ICBHE-2018), Sathyabama University , held on 8-10th January 2018.

- Meenachi. P, Subashini. R, AP/BME and A. K. Lakshminarayanan have presented a paper titled "Microstructure and in-vitro corrosion study of AZ31 Magnesium alloy by Friction Stir Processing" in International conference on Engineering Materials, Metallurgy and Manufacturing (ICEMMM 2018), SSN college of Engineering, on 15 February, 2018

- Dr. Vijay Jeyakumar Asso. Prof/BME acted as chair person for a paper presentation session on Signal and Image Processing track of the International Conference on Computer, Communication, and Signal Processing ICCCSP 2018, organized by the department of Information Technology, SSN College of Engineering on 23rd February, 2018

- Dr. B. Geethanjali Asso.Prof/BME was appointed as Technical Committee member for National Conference on Recent Trends in Biomedical Engineering (NCRTBE-18) organized by Department of Biomedical Engineering, SMK Fomra Institute of Technology, and the conference was held on 03rd March 2018.

FACULTY PARTICIPATIONS

Presentations

- Dr. S. Arun karthick, Asso.Prof/BME had presented his innovation titled "Multifunctional Nanocomposite Nanofibrous filter for aerosol filteration, chemical & biological filtration" in Patent committee meeting at Centre for Intellectual Property Rights (CIPR), Anna University, Chennai on 23rd January, 2018.

Publications

- B Geethanjali, Kanagasabai Adalarasu, Mohan Jagannath have published a paper on " Music Induced Emotion and Music Processing in the Brain– A Review" in Journal of Clinical and Diagnostic Research. 2018 January, Vol-12(1): VE01-VE03 .

- Bhuvaneshwari B & A. Kavitha have published a paper on " Assessment of Graph Metrics and Lateralization of Brain Connectivity in Progression of Alzheimer's Disease Using fMRI" in the International Journal of Software Science and Computational Intelligence, 9(4), 46-66.

- Geethanjali Balasubramanian, Adalarasu Kanagasabai, Jagannath Mohan, N.P. Guhan Seshadri ; “Music induced emotion using wavelet packet decomposition—An EEG study”, in the Journal Biomedical Signal Processing and Control, Volume 42, 2018.

Guest talk

- Dr. Vijay Jeyakumar, Asso.Prof/BME had given a guest lecture on “Recent Trends in Medical Instrumentation” organized by the department of Electronics and Communication Engineering, Vickram College of Engineering, Enathi, Sivagangai on 20th January, 2018.
- Dr. S. Bagyaraj, Asso. Prof/BME delivered a Guest Lecture on “Medical Electronics and it Recent Applications” in St. Joseph’s College of Engineering, Chennai on 16th February, 2018.

Dr.S.Bagyaraj , Asso. Prof. delivering lecture

Dr.J.Vijay,Asso.Prof. Delivering lecture

STTP/FDP/Training

- Mrs. M. Dhanalakshmi, AP/BME attended a Winter school on "Speech and Audio Processing" organized by Centre for Linguistic science and technology at IIT Guwahati on 19th-22nd January, 2018
- Dr. S. Bagyaraj Asso. Prof/BME and Dr. Vijay Jeyakumar Asso. Prof/BME attended the Special Technical Lecture on “MEMS and Smart Devices and Systems in Engineering and Medicine” delivered by Dr. Vijay K. Varadan, Co-founded Nanowear , Professor, Pennsylvania State University, USA , Department of Chemistry, Anna University, Chennai, organised by IEEE Madras Section on 8th February, 2018.
- Ms Divya. B, AP/BME, attended One-Day Workshop on "IoT-Enabled Computer Vision and Analytics (ICVA 2018), organized by Department of Information Technology, SSN College of Engineering on 2nd March, 2018.

Faculty Activities

- Dr. A. Kavitha, Prof & Head/BME conducted the Synopsis meeting of her full time research scholar Ms. C. Sandhya at IITM on 2nd January, 2018 in BME seminar hall, SSNCE.

- Dr. L. Suganthi, Asso.Prof/BME, conducted first DC meeting for her Ph.D. scholar Mrs. R.Anandha Praba 0n 22nd January, 2018 in the Department of Biomedical Engineering

- Dr. A. Kavitha, Prof & Head/BME conducted the first DC meeting of her part time research scholar Ms. B. Divya, Asst. Prof. / BME on 4th January, 2018 in BME seminar hall, SSNCE.

- Dr. Vijay Jeyakumar, Asso.Prof/BME has been invited to review the manuscript titled “Hand Gesture Recognition Suitable for Wearable Devices using Flexible Epidermal Tactile Sensor Array” submitted to the Journal of Electrical Engineering and Technology

- Dr. Vijay Jeyakumar, Asso.Prof/BME has been invited to review the manuscript titled “Kernel extreme learning machine application in prediction of bond strength between EBR FRP and concrete substrate” submitted to the Journal of Neural computing and Applications (Springer).

- Dr. Vijay Jeyakumar Asso. Prof/BME has been invited to review the manuscript titled “Steganographic approach to Enhance the Data Security in Public Cloud” submitted to the journal International Journal of Computer Aided Engineering and Technology (Inderscience Publisher).

- Dr. Vijay Jeyakumar Asso. Prof/BME has been invited to review the manuscript titled “Designing an Online Patient Record Platform for Namibian Health Sector," which has been submitted to the International Journal of E-Health and Medical Communications (IJEHMC).

Faculty Activities

- Dr. A. Kavitha Prof & Head/ BME attended the Board of studies meeting at Anna University, Chennai on 7th March, 2018.

- Dr. V. Mahesh Asso.Prof/ BME conducted viva voce for his Part-time research scholar Ms. K. Sumathi for her thesis titled “Investigations on enhancing carotid ultrasound image boundary using intensity and phase based level set” at BME Seminar hall, SSNCE on 16th March, 2018.

- Dr. J. Vijay, Asso.Prof/ BME has been elevated to the senior member of IEEE.

- Final year BME students P.Maharani, M.Kirthika, P.B.Srivathsan have received a sum of Rs. 10000/- from TANSCST as students project funding for the project titled “Design of an automated infusion pump using the Neuro-Fuzzy controller" under the guidance of Dr. J. Vijay, Asso.Prof/ BME

Faculty Activities

CLRI Visit

Dr. S. Bagyaraj Asso. Prof/BME had a discussion with Dr.G.Saraswathy, Scientist, Shoe & Product Design Centre (SPDC) CSIR-CLRI Gait lab with UG project students M. Abhinaya, S. Deepika and Kertana. S, regarding Data acquisition from diabetic patients for their project titled "Measurement of Gait and Vital Parameters using Wearable Insole System".

Faculty Outing

Faculty day outing along with their family members was organized on 3rd February 2018 by SSN Institution at Chariot Beach Resort, Mahabalipuram.

BME FACULTY WITH THEIR FAMILY MEMBERS DURING FACULTY DAY OUTING

Student Achievements

- Ms. M. Ruba. M, II year BME have been selected as a recipient of the WeTech Qualcomm Global Scholars Award 2018. The Award covers a Scholarship of $2500 and a five-month virtual one-on-one mentorship placement with Qualcomm professional from March 2018 to July 2018.
- Final year BME students P.Maharani, M.Kirthika, P.B.Srivathsan have received a sum of Rs. 10000/- from TANSCST as students project funding for the project titled “Design of an automated infusion pump using the Neuro-Fuzzy controller" under the guidance of Dr. J. Vijay, Asso.Prof/BME.

Smart India Hackathon

A team of six students from third year BME Department have been selected to present their proposal on 'Non invasive early diagnosis of retinal ischaemia' at the second stage of Smart India Hackathon Hardware edition 2018

Student Placement Details

Philips

- Deepika
- Meena Nisha M
- Nagavarshini

Alumni Updates

- Mr. S. Shivakumar, Co-Founder and CEO, Neolight, an alumnus of SSN interacted with U.G & P.G students of BME on Innovative solutions for treating Jaundice in Neonates.

- Shradha Srinivasan, an alumnus of Department of BME has been offered a position of a Research Associate in Image Analysis at Juno Therapeutics in Boston.

- Vinutha Sampath, an alumnus of Department of BME has been offered JRF position at DRDO, Bangalore

- Irfan, an alumnus of Department of BME is currently currently doing a PhD at the University of Twente in the Netherlands studying movement and feedback after Stroke. He is now working on a second design of a prosthetic arm for a Dutch child who is missing his lower arm, which would work with EMG signals from the deltoid muscles. He has a channel in youtube in the name Irfan Mohamed.
- LINK:https://www.youtube.com/watch?v=ATT-y5HCFMA&feature=youtu.be

Alumni Updates

Rathish is an alumnus of Department of BME and an article about him has featured in the AAMI website :
http://www.aami.org/productspublications/articledetail.aspx?ItemNumber=5647

Tech World

An Uncle's Heart Restarts and a Biomed's Career Is Born

Ratish Kumar Mohan is a biomedical engineering supervisor at Hospital Sisters Mission Outreach, a medical surplus recovery organization in Springfield, IL.

During a serious illness, families want the best care for their loved ones—the best doctors, the best nurses, and the best biomedical equipment. In the intensive care unit, for example, families find comfort in the beeps and the graphs of monitors that signal a loved one's stable vital signs. As a 12-year-old boy growing up in India, I was intrigued by stories of the machine that restarted my uncle's heart and restored him to life. From this early age, I knew that I would enjoy a career in healthcare, and my interest in math and mechanics led me to study biomedical engineering.

Hospitals in India typically invest in large biomedical teams that are challenged with keeping expenses low by extending the usable life of costly equipment. As a new biomedical engineer working for Sri Ramachandra Medical Center, a multispecialty hospital in Chennai, India, I learned the importance of appropriate use and regular maintenance, and I became adept at repairing older equipment. At the time, I did not know that my future would include a warehouse of used, and yet useful, medical equipment and the opportunity to advocate for user training and maintenance.

Following my work in Chennai, I moved to the United States to complete a master's degree in biomedical engineering at the University of Texas at Dallas. I was then faced with an unusual choice: move into a corporate or hospital setting or accept the challenge of working with a nonprofit organization that provides biomedical equipment to hospitals serving the poor around the world. I chose the opportunity offered by Hospital Sisters Mission Outreach, which serves 89 countries around the world.

My first adventure with the organization was an August 2017 trip to Togo with representatives from the Ole Miss chapter of Engineers Without Borders and Rotary International. During planning discussions in Springfield with Eric Lohse, an ophthalmologist and vice chair of the Mission Outreach Board of Directors, and Abram Wodome, the clinical lead for Grace Hospital in Vogan, Togo, we identified the supplies and equipment that would be sent in the first 40-foot container. One of the specialties of the hospital is eye care, so Mission Outreach pulled a number of relevant items from its inventory, including Marco slit lamps, a Zeiss surgical microscope, and a Bausch and Lomb phacoemulsification (phaco) machine.

Prior to my trip to Togo, Dr. Lohse and I attended Bausch and Lomb Millennium Phaco application training. Subsequently, the phaco machine was tested in our biomedical shop in Springfield, along with all of the other items selected from the inventory. We also assessed the need to convert the voltage of all the donated items in Togo and sent transformers and plug adapters in the container, which saved time during the installation process.

While in Togo, I set up and installed the equipment shipped by Mission Outreach, including vital signs monitors, infant warmers, incubators, and ultrasounds. I also assessed the equipment provided by other donors and unfortunately found that 90% of this equipment was nonfunctional and without reference manuals.

Ratish Kumar Mohan (right) checks a colleague's vital signs using equipment donated to Grace Hospital in Vogan, Togo.

This experience highlighted for me how biomedical equipment can be a blessing or a curse for hospitals in low-resource countries. Decades of poor donation practices have resulted in graveyards of discarded equipment that was sent without repairs or without investigating whether the equipment could be used. In recent years, the World Health Organization, Engineering World Health, USAID, and others have spotlighted the need for donation standards and follow-up support.

At Mission Outreach, we are adopting a learning collaborative model that will allow more accurate budgeting and equipment acquisition for hospitals in low-resources countries and establish equipment maintenance plans. We are also looking to bring innovative strategies to lend remote biomedical support through the Looksee.do platform, which enables equipment experts from anywhere in the world to help technicians in the most remote and poorly connected areas operate, maintain, and fix medical equipment at a fraction of the cost and with reduced downtime.

3D Printing Better Soft Robots

Any Star Wars geek can tell you—often in excruciating detail—how the franchise's resident metal trash can on wheels, R2-D2, survived fried electronics, deep space adventure, and blaster fire with aplomb. Yet, outside the realm of science fiction, traditional robots with their metal joints and electrical motors do not fare well in unpredictable environments. This has led some researchers to suggest that cell-based, soft robots could do better, overcoming the limitations of traditional robotic hardware.

"Such cell-based robots have more degrees of freedom," said Collin Kaufman, a graduate student in neuroengineering who builds biological robots, or biobots, at the Beckman Institute at the University of Illinois, Urbana-Champaign. "They can move in more directions in 3D space than traditional robots. They're much more adaptable to the world around them. And they can be less susceptible to damage when they encounter things like radiation, oil spills, or water, too."

While the research is still early, Kaufman's work combining biological muscles with structural frames could open up new possibilities for robots and perhaps new types of prosthetics as well.

Several laboratories have come up with fascinating examples of the biobot concept. In 2012, bioengineers at Caltech unveiled a jellyfish-based biohybrid robot powered by cardiac muscle. With the telltale ga-gung of the heartbeat, the small device propelled itself through water with exquisite precision.

Harvard University's Wyss Institute showcased a more sophisticated heart-cell powered robotic stingray in 2016. Stretched over a gold exoskeleton, the bot also swims with a regulated frequency. Since then, other prototypes, mimicking the mechanics of everything from sperm to inchworms, have appeared in the scientific literature. But Kaufman, hoping to create more useful autonomous devices, wanted to develop something more complex.

“Cardiac muscle beats at an intrinsic frequency,” he explains. “It’s a constant beating and hard to modulate, and that’s useful for some types of movement. But if we want to achieve complex motor control, movements like walking, jumping, or eating an ice cream cone, you need to think beyond cardiac muscle and think about muscle tissue. We wanted to create a motile biological machine based on skeletal muscle.”

Humans are able to move when muscle fibers extend and contract, spurred by the activation of specialized neurons. To create such a biological machine, Kaufman and colleagues created a U-shaped skeleton out of hydrogel using 3D printing technologies and then seeded it with muscle cells that wrapped around it like a rubber band.

The researchers then laid an intact spinal cord from a rat to control the device. When the neurons in the spinal cord are activated, that rubber band of muscle cells contracts, slithering the skeleton forward a bit like an inchworm.

It may sound fairly simple butut Kaufman says that developing a working prototype posed a series of biological and engineering challenges that were overcome only after a lot of trial and error.

“We needed a skeleton with the appropriate stiffness, so when the muscle contracts, it can move it forward without breaking the frame,” Kaufman says. “We had an idea of how much force muscle can generate, but creating something that would bend with the movement but not break was a challenge.

“That’s where the 3D printing was invaluable. We knew that we’d have to iterate and change the design as we went,” he adds. “Our first few attempts were far too stiff—more like bone, really—and didn’t allow the flection we needed. By just changing a few cross-linkers, we could manipulate the stiffness pretty easily.”

Another challenge was seeding the muscle tissue on to the skeleton. At first, the muscle cells would not stick. “Muscle has multiple developmental stages,” Kaufman says. “If you just try to put the cells on the skeleton, they slide right off. We had to find a way to make the cells stick.

"So we turned to biology and asked, ‘How does Mother Nature do this?’ And she helps those muscles stick by this goop called the extracellular matrix. We fabricated our own extracellular matrix gel using collagen. And by doing so, we were able to get the whole thing to compact around the skeleton the way we needed it to.”

Kaufman presented the first working prototype, all 6 mm of it, at Neuroscience 2017, the annual meeting for the Society for Neuroscience. But he’s excited to continue working on this biobot, with its cell-based soft approach, and find new ways to increase its complexity and autonomy—by layering multiple muscles on their skeleton and finding ways to have them work together.

“Don’t get me wrong, traditional robots are doing some impressive things,” he says “But I think these kind of biobots, in many ways, are the future. They will be able to go to places and do things that metal robots can’t. This fusion of biology and engineering is pushing us forward into the realm of science fiction. Except, it’s not fiction. It’s real. And it’s really exciting.

Putting Skin in the Game

Not satisfied with in vitro models for studying skin disorders, researchers at the University of Pennsylvania leveraged advances in tissue engineering and the development of microfluidic chips to mimic human skin structure. The bioreactor they developed will be used as a platform for studying the role of mechanical stretch in keloid disease and scarring of the skin.

Existing models for skin lack its physical components, such as defined vascular networks and mechanical stretch, says Megan Farrell, a bioengineering postdoctoral fellow in the Biologically Inspired Engineering Systems Laboratory (BIOLines) at the University of Pennsylvania. The one she designed, dubbed "skin on a chip," produced multilayered tissue with physiological spatial arrangement that resembles the epidermis and its vascular system. She then mimicked skin stretching by integrating the model with a computer-controlled mechanical actuation system.

“There aren’t many micro-engineered skin models,” says Dongeun Huh, BIOLines principal investigator. “What we were looking to achieve is to make a model more realistic, to resemble in vitro skin more closely.”

In a paper recently published in Stem Cell Reviews and Reports, Dutch researchers reviewed the types and availability of in vitro skin models and microfluidic devices. “Skin disease modeling, substance testing, and ultimately personalized medicine would be enabled by an ideal in vitro 3D skin model containing vasculature, immune cells and appendages,” they wrote. “Until now, full-thickness skin models based on primary cells were most common, even available commercially. Commercial models have limited physiological relevance for risk assessment and testing mode of action of novel actives.”

Farrell's differs from previous versions because of its multiple layers. The upper and lower channels are separated by a 10-micrometer membrane with a 10-micormeter porosity. The upper channel was seeded with epidermal cells, human adult keratinocytes. Dermal fibroblast cells were cultured in hydrogel in the lower channel. Human umbilical vein endothelial cells were also cultured and added to the dermal, or bottom, layer. Two flanking channels run along the gel channel for access and feeding the cultures.

"It is a fairly sophisticated model, especially when you compare it to what [private] companies sell," says Huh. "Ours offers the unique capability to culture and create a number of cells. It may be unique because it creates a vascular structure."

Farrell says it typically takes about three weeks to grow and differentiate skin cells on her chip. Researchers found that after the cells were grown and stabilized, they began to stratify and form the physical properties of human skin. Researchers exposed the upper layer of epithelial cells to air and found they dramatically changed shape and function. "They became stratified and changed their biochemical process," Huh says.

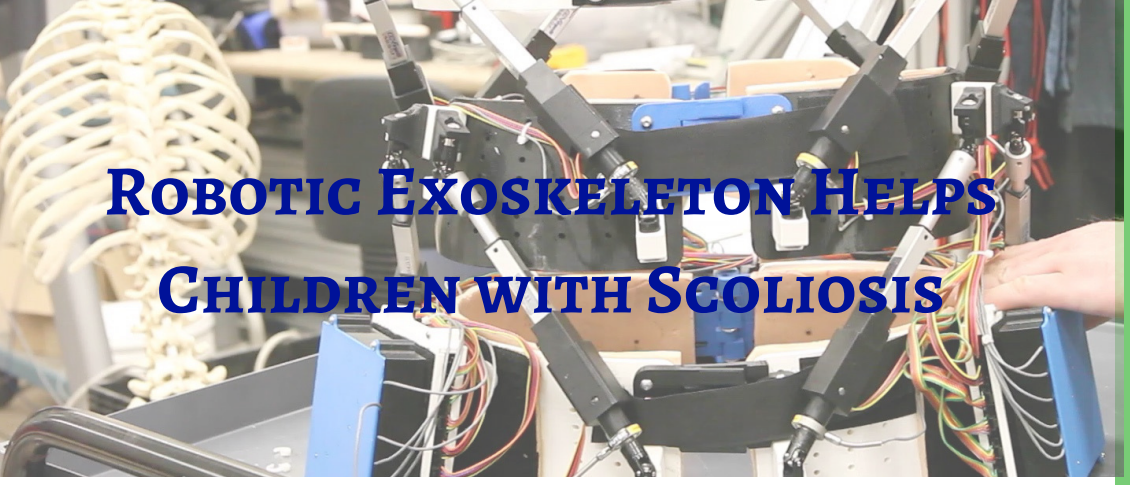
She was also successful in mimicking skin stretching through the creation and integration of a mechanical bioreactor, which includes a motorized mechanical arm with a custom-designed holder, or gripper, that grabs onto the chip. It moves in lateral directions, basically pulling the entire device, and is controlled through computer code written by Farrell.

The device measures linear strain and was applied in the range of 5 percent to 15 percent, to mimic the mechanical motion and strain of skin tissue. Researchers were able to quantify tissue deformation —cell elongation—in the epidermal and dermal layers using image-based analysis.

Replicating strain at the cellular level is important for the next step, furthering research into keloid disease, a rare and incurable disease where scar tissue grows extensively over a wound. The tissue forms fibrous, hard growths called keloids and are often much larger than the original wound. They are not life-threatening but are often a cosmetic concern, especially if they appear on the face or an area of high visibility. But they can be painful and lesions often develop in areas of high mechanical tension, such as the chest, shoulder and back, suggesting that keloid cells respond differently to mechanical stress, says Huh.

Animal models and cells are commonly used in research, but work on keloid disease is limited because it is found only in humans. There are no animal models on which to base research.

This microfluidic device offers a new platform for gaining knowledge of the disease and its progression, Huh says. For the next step, Farrell is working to obtain keloid cells from patients and grow them in the device. After replicating the mechanoresponsiveness of keloid cells to dynamic stretch, the UPenn team will try to determine if strain-induced effects can be mitigated. That would open up research into treatment of the formation of keloid lesions.



Robotic Exoskeleton Helps Children with Scoliosis

Children who wear spine braces could gain more wiggle room if a new exoskeleton design proves successful. Each year, 30,000 children use spine braces to treat scoliosis, a sideways curvature of the spine. Most of these users are middle-school and high-school girls who wear the braces under their clothes.

Spine braces work by applying counter-pressure on the spine's curvature. This prevents the spine from bending further as the child grows and eliminates the for need corrective surgery as adults.

The new exoskeleton spine brace promises to offer users more mobility and comfort, while the device's control system modulates corrective pressure on the torso in real time. The project is part of a larger scientific effort to develop more lifelike exoskeleton designs.

Conventional braces are typically made of a rigid, two-part plastic shell that fits around the child's hips and torso and is tightened by a series of belts. By locking the upper body in place, the braces limit movement. Children must typically wear them 12 to 16 hours per day.

Those braces are stiff, heavy, and uncomfortable. The solution proposed by Sunil K. Agrawal, principal investigator of Columbia University's Robotics and Rehabilitation Lab (ROAR), was to build an exoskeleton that used robotic technology to adjust to patient movements and permit more flexibility.

Agrawal developed the dynamic robotic spine exoskeleton (RoSE) in collaboration with researchers from Columbia University Medical Center and Bucknell University. Patients who tested it were able to achieve more than 75 percent of their natural torso range while standing, walking, putting on clothes, eating and other daily activities.

The initial RoSE prototype consisted of three rings that encircle the patient's torso. One was fixed on the hips, while the other two, at abdomen and chest level, moved. These movable rings were manipulated by linear actuators that gave them six degrees of freedom relative to one another as well as to the fixed third ring. This enabled the rings to adjust their orientation and relative stiffness, providing added support so users could flex their torso more naturally. Onboard sensors record force and ring-motion data, which are transmitted to a microcomputer that monitored and adjusted the brace.

Unfortunately, RoSE had some shortcomings. Its rigid linear actuators had problems with shock loads from sudden movements and casual impacts with walls, doors, and furniture. Second, its motors were always on in order to apply force to the spine. Those motors also required heavy batteries that limited operating time.

These issues prompted Agrawal and two doctoral students, Chawin Ophaswongse and Rosemarie Murray, to design a better actuator. The result solves both the power and shock load issues by incorporating springs into the linear actuators.

In earlier RoSE prototypes, each motor drove a linear actuator that changed the position of an adjacent ring and determined its stiffness. The motor, linear actuator, and rings were rigidly attached in a series.

The new design includes a linear spring inside each actuator, so that movements of the actuator also apply and release force on the spring. One immediate benefit is that the compliant spring functions as a shock absorber if the robot accidentally hits something, protecting the exoskeleton.

It also turns out, thanks to the team's modeling, that it is easier to control actuator output forces by using the springs to provide a further layer of sensor data. Measurements of each spring's length are transmitted to an onboard microcomputer, whose algorithm calculates the forces and orientations of each ring in real time. The microcomputer sends instructions to the controller, which can more precisely and adaptively increase or lessen ring stiffness and orientation.

The motors in this system provide variable instead of continuous pressure, which lowers energy use and could allow the system to use smaller batteries.

"With six springs in a three-ring device, you will have a six-dimensional springiness or stiffness at the cross-section level," says Agrawal. "You can target and adjust corrective pressure on the torso that is adapted to each user's spine condition. If the wearer has an unusual curvature in a certain direction you can stiffen in that direction."

Agrawal anticipates that springs will be added to actuators in future generations of RoSE, allowing young people with scoliosis to stretch and flex more naturally as they grow and change.

"The robotic devices that interact with humans must be softer and more compliant, and with this design, we can help users with a novel application to correct the upper body and modulate posture," he says.