May/Jun 2018 • No. 246

ESA Newsletter

Electrostatics Society of America - The Friendly Society

President's Message

I love writing these messages in the month of July about our annual meetings. There are many good things to talk about. I am sure everyone attended the joint meeting has some good memories.

Our joint meetings are good examples of the benefits to having common forums for small societies like ours to gather in big groups. Attendees from around the world, representing 16 different countries, and five societies; the Electrostatics Society of America, the Institute of Electrostatic Japan (IEJ), the IEEE Industry Applications Society (IAS) Electrostatic Processes Committee (EPC), La Societé Francaise d'Electrostatique (SFE), and Electrohydrodynamics (EHD) met over three full days of technical sessions and social gatherings on Boston University (BU) Campus. Thank you Prof. Gerard Touchard, Prof. Akira Mizuno, Prof. Eric Moreau, Prof. Okubo and ESA executives and council members for your support.

Thanks to BU for giving us a great venue overlooking the Charles River. The efforts of the technical program chair, Shubho Banerjee, the conference general chair, Mark Horenstein, and the electrostatics demonstration chair, Kelly Robinson, are greatly appreciated for their excellent work. Thank you Mark for the fun filled presentations during the Banquet, and the help from your students, both at the registration desk and during the banquet demos.

Of course, the success of any conference depends on the participation from the attendees. Thank you everyone; keynote speakers, authors, invited and regular paper presenters, demo presenters, session chairs, judges and the audience for creating a rich scientific forum with a truly diverse international representation. As always, students' participation made us feel young at heart as they showed lots of enthusiasm and competition. Thanks to ESA, and Mystic Tan Inc., for sponsoring the student paper awards.

ESA has introduced two new awards; namely, the Rising Star Award recognizing significant contributions at an early stage of a career to the field of Electrostatics, and the Entrepreneurial Award recognizing companies and/or individuals that implement electrostatics-related technologies. This year these awards were given to David Go for the Rising Star Award and to Monroe Electronics Inc. and Mystic Tan Inc. for the ESA Entrepreneur Award. Thanks to our vice-president, Maciej Noras for coordinating all the work in the award process.

Satish Polisetty, graduate student from the University of Waterloo, and Al Seaver have done a great job in collecting and compiling the photos. Use the link *http://electrostatics.us/esa/2018/page_01.htm* and cherish your memories of 2018 meeting. If you happen to have more photos, please send them to my attention. We will include them on the ESA photo page that Al has been maintaining for everyone's benefits. Thank you Al.

Kelly Robinson, Bill Vosteen, and Mark Zaretsky will be organizing the 2019 ESA Annual Meeting in Rochester, NY. N. K. Kishore from the Indian Institute of Technology, Kharagpur, has kindly agreed to serve as our 2019 Technical Program Chair. Thank you all in advance.

Endless efforts of Steve Cooper our treasurer, Mark Zaretsky the newsletter editor, and the council's support along with support from many ESA members, are all much appreciated. Enjoy your summer.

For the Friendly Society
Shesha Jayaram, *shesha.jayaram@uwaterloo.ca*
President, Electrostatics Society of America

ESA Officers

President:

Shesha Jayaram, Univ. of Waterloo

Vice President and Awards Chair:

Maciej Noras, Univ. of North Carolina

Executive Council:

David Go, Univ. of Notre Dame

Poupak Mehrani, Univ. of Ottawa

Rajeswari Sundararajan, Purdue Univ.

Calendar

- 21th Conference of the Societe Francaise D'Electrostatique (SFE), August 29-31, 2018, Grenoble, France, *https://sfe2018.sciencesconf.org/?forward-action=index&forward-controller=index&lang=en* Contact: Nelly Bonifaci & Olivier LeSaint *sfe2018@sciencesconf.org*
- 2019 ESA Annual Meeting, June, 2019, Rochester, NY, USA, Contact: Kelly Robinson, *kelly.robinson@electrostaticanswers.com*

Current Events

Fish's Use of Electricity Might Shed Light on Human Illnesses

Deep in the night in muddy African rivers, a fish uses electrical charges to sense the world around it and communicate with other members of its species. Signaling in electrical spurts that last only a few tenths of a thousandth of a second allows the fish to navigate without letting predators know it is there. Now scientists have found that the evolutionary trick these fish use to make such brief discharges could provide new insights, with a bearing on treatments for diseases such as epilepsy.

In a new paper in the journal Current Biology, scientists led by a team at The University of Texas at Austin and Michigan State University outline how some fish, commonly referred to as baby whales, have developed a unique bioelectric security system that lets them produce incredibly fast and short pulses of electricity so they can communicate without jamming one another's signals, while also eluding the highly sensitive electric detection systems of predatory catfish.

In a specialized electric organ near the tail, weakly electric fish, like the baby whales, possess a protein that also exists in the hearts and muscles of humans. The electrical pulses generated through this protein, called the KCNA7 potassium ion channel, last just a few tenths of a thousandth of a second, and some electric fish have adapted to discriminate between timing differences in electrical discharges of less than 10 millionths of a second.

"Most fish cannot detect electric fields, but catfish sense them. The briefer electric fish can make their electric pulse, the more difficult it is for catfish to track them," said Harold Zakon, a professor in the departments of Integrative Biology and Neuroscience.

The team identified a negatively charged patch in the KCNA7 protein that allows the channel in the electric fish to open quickly and be more sensitive to voltage, allowing for the extremely brief discharges.

What scientists have learned about these fish, the electrical signals they use and how they evolved may help humans in the future by shedding light on how those same electrical pathways operate in conditions such as epilepsy, where electrical pulses in the brain and muscles cause seizures. The finding also may have implications for discoveries about migraines and some heart conditions.

"Mutations in potassium channels that make them too sensitive or not sensitive enough to electrical stimuli can lead to epilepsy or cardiac and muscle diseases," said Swapna Immani, first author of the paper and a research associate in neuroscience and integrative biology. "So understanding what controls the sensitivity of potassium channels to stimuli is important for health as well as a basic understanding of ion channels."

Previous understanding of the same protein was based on potassium channels in fruit flies, but researchers say this paper suggests that the particular region with the nega-

Brienomyrus brachyistius, commonly known as the baby whale *Michigan State University*

2019 Annual Meeting of the Electrostatics Society of America

Rochester, NY

June, 2019

The Electrostatics Society of America (ESA) invites papers in all scientific and technical areas involving electrostatics for the 2019 Annual Meeting of the ESA. Contributions range from fundamental physics and new developments in electrostatics to applications in industry, atmospheric and space sciences, medicine, energy and other fields.

Anticipated Technical Session Topics

- Breakdown phenomena and discharges
- Electrically-induced flows and electrokinetics
- Contact charging and triboelectric effects
- Charge motion and static dissipation
- Gas discharges and microplasmas
- Atmospheric and space applications
- Biological and medical applications
- Materials synthesis and processing
- Material delectric properties
- Measurements and instrumenation
- Safety and hazards

Conference information, including registration and lodging, will be updated and available at http://www.electrostatics.org

Student Presentation Competition

Presentations by undergraduate and graduate students are eligible for the Student Presentation Competition. Please indicate a student presenter when submitting the abstract.

Important Dates

January 1, 2019	*Abstract submission open*
March 1, 2019	*Abstract submission deadline*
March 15, 2019	*Notification of abstract acceptance*
May 3, 2019	*Early registration deadline*
May 17, 2019	*Final manuscript deadline*

Abstract Submission

Online submission at http://www.electrostatics.org

Contact Information

Organizing Committee

Kelly	Robinson	Electrostatic Answers	kelly.robinson@electrostaticanswers.com
Bill	Vosteen	Monroe Electronics	billv@monroe-electronics.com
Mark	Zaretsky	Eastman Kodak	mark.c.zaretsky@gmail.com

Technical Chair

Prof. N. K. Kishore, PhD (kishorenk@ieee.org)

Indian Institute of Technology, Kharagpur, India

About Rochester NY: On the southern shore of Lake Ontario in Western New York, Rochester (metro area population of just over 1 million) is New York's third most populous city. The University of Rochester and Rochester Institute of Technology have renowned research programs. Many important inventions and innovations originated in the Rochester area, which is the birthplace to Kodak, Xerox, Bausch & Lomb, Gleason, and Western Union.

tive patch might function differently in vertebrates.

Looking at the evolution of the specialized electric organ also can provide important windows into how genes change and express themselves. By studying unique or extreme abilities in the animal kingdom, much can be learned about the genetic basis of adaptations, the paper says.

"The take-home message of our project is that strange animals like weakly electric fish can give very deep insights into nature, sometimes with important biomedical consequences," said Jason Gallant, assistant professor of integrative biology at Michigan State University and a researcher on the project. "We discovered something at first blush that would seem like an idiosyncrasy of the biology of electric fish, which is always exciting but lacks broad applicability. Because of the relaxed evolutionary constraints on this important potassium channel in electric fish, which don't have to follow the same rules normally imposed by nervous system or muscle, the tinkering of natural selection has revealed a physical 'rule' that we suspect governs potassium channels more broadly."

(from *https://news.utexas.edu/2018/06/21/fish-s-use-of-electricity-may-shed-light-on-human-illnesses*)

Engineer Creates New Design for Ultra-Thin Capacitive Sensors

Rachael Flores

As part of ongoing acoustic research at Binghamton University, Distinguished Professor Ron Miles has created a workable sensor with the least possible resistance to motion. The thin and flexible sensor is ideal for sensing sounds because it can move with the airflow made by even the softest noises and addresses issues with accelerometers, microphones and many other similar sensors.

Miles made headway with acoustic sensors in 2017 by using spider silk dipped in gold as a thin, flexible sensor to make a microphone with remarkably flat frequency response. This sensor incorporated a magnet in order to convert the silk motion into an electronic signal.

As an alternative to using a magnet, Miles set out to create a capacitive sensor. Instead of needing a magnet, a capacitive sensor requires a voltage added to it via electrodes. Two billion capacitive microphones are produced every year but making them both small and effective comes with some challenges. His new platform provides a way to detect the motion of extremely thin fibers or films by sensing changes in an electric field without the use of a magnet.

It hasn't previously been feasible to use capacitive sensing on extremely flexible, thin materials because they've needed to resist electrostatic forces that can either damage them or impede their movement. "Researchers want the sensor to move with small forces from sound, without being affected by the electrostatic forces," Miles said.

In this most recent work, Miles has found a design that allows the thin, flexible sensor – which could be spider silk or any other material just as thin – to swing above two fixed electrodes. Because the sensor is at a 90-degree angle from the electrodes, the electrostatic forces don't affect its movement.

This is a critical part of the design because the sensors need to have a high bias voltage – the voltage required for a device to operate – to be effective since the sensitivity of the sensor increases with a high bias voltage. This design means that capacitive sensors, like the ones used in smartphones, can be both smaller and more efficient.

Miles said the unique design also provides a few other benefits important in various applications. "The way the sensor is designed now means that it has a nearly constant potential energy but can also return to its equilibrium after large motions."

(from *https://www.binghamton.edu/news/story/1196/engineer-creates-new-design-for-ultra-thin-capacitive-sensors*)

Electrospun sodium titanate speeds up the purification of nuclear waste water

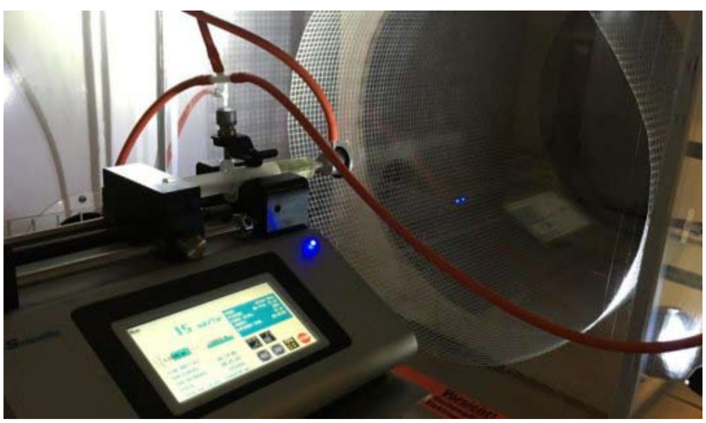
With the help of this new method, waste water can be treated faster than before, and the environmentally positive aspect is that the process leaves less solid radioactive waste.

The properties of electrospun sodium titanate are equal to those of commercially produced ion-exchange materials. "The advantages of electrospun materials are due to the kinetics, i.e. reaction speed, of ion exchange," says Risto Koivula, a scientist in the research group Ion Exchange for Nuclear Waste Treatment and for Recycling at the Department of Chemistry at the University of Helsinki. Synthetic sodium titanate is known as an effective remover of strontium, and granular sodium titanate is used in industrial quantities.

The purging method based on ion exchange was originally developed by Jukka Lehto and Risto Harjula from the University of Helsinki. At present, granular sodium titanate is used to purify e.g. the waste water from the Fukushima nuclear disaster. As it is run through an ion exchanger loaded into column, the radio-active strontium in the water is changed into sodium. When the ion exchange capacity is filled, the filtering material has to be switched out. This leaves some solid radio-active waste. "Since less electrospun material is needed from the start of the process, the radio-active waste requiring a permanent repository will also fit in a smaller space," says Koivula.

The electrospinning equipment at the University of Helsinki was developed and built in the centre of excellence for atomic layer deposition, led by Mikko Ritala. The researchers successfully tried this quite simple method for working sodium titanate into fibre. Koivula's team studied the ion exchange features of fibre produced this way and found it worked like the commercially produced ones.

(from *https://www.sciencedaily.com/releases/2018/06/180627160411.htm*)



The jet erupting from the end of the needle elongates into a fiber, and the ethanol and acetic acid used as solvents will evaporate. The fibers are collected on the grounded grid at the end of the cylinder forming a nonwoven white sheet like a silk paper. Lastly, the fibres collected from the grid will be burned in air to remove organic polymer. Credit: *Riitta-Leena Inki*

When Spiders Go Airborne, It's Electric — Literally

Nell Greenfieldboyce

Many spiders fly long distances by riding "balloons" of silk, and a new study suggests that they're propelled by more than just the wind. Electric fields at strengths found in nature can also trigger the spiders' ballooning behavior. And electrostatic forces can lift up the spiders even when the air is still, according to a newly published report in the journal Current Biology.

Ballooning spiders have long fascinated scientists because they fly high — they've been found more than 2 miles up — and far. These spiders land on ships in the middle of the ocean, and they're often the first colonizers of new volcanic islands, says Erica Morley of the University of Bristol. "Although they don't have wings, they're actually pretty good at flying," says Morley. She explains that a spider will go to a high branch on a tree or to the top of a tall blade of grass and stand on tiptoe with its abdomen pointing up. It then releases long strands of silk and becomes airborne.

Curiously, Morley says, spiders balloon only when the winds are very low, like a light breeze. And some larger spiders manage to get up in the air even when it seems like there's not enough wind to make that happen. Scientists also wonder what triggers mass ballooning events — when thousands of spiders suddenly take to the air. All of those are hints that spiders rely on something more than just the wind. What's more, ballooning silk is made of lots of strands that are released at the same time, "and these sort of splay out, as though there's a repulsive force present," Morley says.

The idea that atmospheric electric fields might affect flying spiders has been around since the 1800s, but until now, there's been no evidence that spiders could detect or use them. Morley and her colleague Daniel Robert got interested in this after reading a recent paper that showed electrostatic spider flight was theoretically possible. "There wasn't actually any empirical data to support or dispel this hypothesis so that's what we tackled," Morley notes.

They rigged up a box with two metal plates, one on the top and one on the bottom. The top plate was connected to a voltage, and the bottom one was electrically grounded. "So between the two plates was an electric field," says Morley. "And the spiders were then put in this electric field, and we could switch it on and off and look at changes in their behavior." The spiders reacted when the electric field was switched on. "They try to balloon. They perform this tiptoeing behavior, and try to balloon," Morley says. "I was delighted when I saw them responding. It's very surprising. It needs a lot more investigation."

Some spiders even became airborne in the lab. "And you can change their altitude by switching the electric field on and off," Morley adds. "If they manage to become airborne, and you switch the electric field off, they will then slowly fall. And then you can switch it back on again and they will rise. So you can see that this electric field is providing enough force to lift them against gravity."

She says there's a lot more work that needs to be done to see how this plays out in a natural environment, and how this relates to their use of wind. "Wherever there's an electric field in the spider's natural environment," she says, "there is also likely to be some air movement.".

(from *https://www.npr.org/2018/07/05/626123698/when-spiders-go-airborne-it-s-electric-literally*)

Electrostatics
Society of America

30 Shalimar Drive
Rochester, NY 14618

ESA Information

ESA Home Page: *http://www.electrostatics.org*

Shesha Jayaram
ESA President
Dep't. of Elect. & Comp. Eng.
Univ. of Waterloo
Waterloo, Ontario
CANADA N2L 3G1
(519)888-4567, x35337
shesha.jayaram@uwaterloo.ca

Steve Cooper
Secretary/Treasurer
540 Morton Rd.
Athens, GA 30605
(706)255-5518
sandscooper1@gmail.com

Mark Zaretsky
Newsletter Editor
30 Shalimar Drive
Rochester, NY 14618
(585)588-6351
mark.zaretsky@kodak.com

2019 ESA Annual Meeting
June 2019
Rochester, NY, USA