AES Newsletter

August 2014
Volume 19, Issue 3

Inside this issue:

Send news for the web page www.aesociety.org to our new **Webmaster**

Jaka Cemazar
jaka@vt.edu

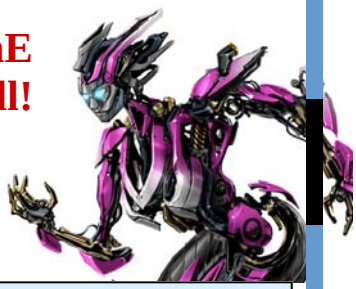
Send news for the newsletter to one of our **Co-Editors:**

Nancy Kendrick
nancy@kendricklabs.com
or
Victor M. Ugaz
ugaz@tamu.edu

Contact **Matt Hoelter, AES Executive Director,** with any questions
matt-aes@tds.net

AES-SciX & AES-AIChE meetings coming this fall!

Attend and Be Transformed!



OVERVIEW AND KEY EVENTS

- **Technical program** featuring topics including Microchip Electrophoresis and Related Applications, Electrophoresis and Droplets, Bioanalytical Dielectrophoresis, and Capillary Electrophoresis.
- **AES Mid Career Award** in recognition of Kevin Dorfman (Feature Article on Page 5)
- **Poster session** with student awards

IMPORTANT DEADLINE

- **September 5** - Advance registration deadline

More on page 2

ORGANIZERS

Alexandra Ros, Department of Chemistry and Biochemistry, Arizona State University

Edgar Goluch, Department of Chemical Engineering, Northeastern University

OVERVIEW AND KEY EVENTS

- **Technical program** - 12 oral sessions and a poster session with student awards
- **Lunch with Leaders, Member Banquet, Informal Networking Social**
- **AES Plenary and Award Sessions**
- **Video contest (NEW!)**
- **Special issue of *ELECTROPHORESIS***

More on pages 3-4

IMPORTANT DEADLINES

- **October 6** - Early bird registration deadline
- **October 27** - Late breaking poster submission deadline

ORGANIZERS

Cullen Buie, Department of Mechanical Engineering, MIT

Rodrigo Martinez-Duarte, Department of Mechanical Engineering, Clemson University

FACSS PRESENTS SCIX2014 THE GREAT SCIENTIFIC EXCHANGE

SciX Conference is a meeting hosted by The Federation of Analytical Chemistry and Spectroscopy Societies (FACSS) that focuses on analytical chemistry and related sciences. For the fifth year, AES Electrophoresis Society is co-organizing sessions with FACSS. This year, session topics include Microchip Electrophoresis and Related Applications, Electrophoresis and Droplets, Bioanalytical Dielectrophoresis, and Capillary Electrophoresis in addition to AES student poster, plenary, and award sessions.

Session organizers include Doug Gilman (Lousiana State University), Christopher Harrison (San Diego State University), Bryan Presley (Trianja Technologies), Tzu-Chiao Chao (University of Regina), Alexandra Ros (Arizona State University) and Edgar Goluch (Northeastern University). The organized sessions consist of invited speakers and contributed submission from the general submission pool. AES sessions at SciX are typically held on Monday and Tuesday of the conference, with a speaker's dinner on Monday night. **See the preliminary program** at: www.scixconference.org/program/preliminary-program.




2014 AES Mid-Career Award

Join us for a special symposium in honor of Professor Kevin Dorfman, Associate Professor of Chemical Engineering and Materials Science at the University of Minnesota, the recipient of the 2014 AES Mid-Career Award. This recognition is given for exceptional contributions to the field of electrophoresis, microfluidics, and related areas by an individual who is currently in the middle of his or her career.

Enjoy Kevin's feature article on page 5!

Networking Opportunities: The conference begins with a welcome mixer on Sunday evening. Monday night features a reception to foster interactions between academia and industry. On Wednesday evening, there will be a dinner party with a wild west theme. Numerous activities are planned for smaller groups throughout the week. The business office collects resumes and puts attendees in contact with companies that are recruiting at the conference.

Student Poster Session: AES is sponsoring a student/postdoc poster session at SciX. First place prize is $250 and Second place is $100. There are also numerous opportunities for students to receive discounted or free conference registration and travel reimbursements. Visit the awards section of the conference website for additional details.

Sponsorship Opportunities Available: visit www.aesociety.org/sponsors/conference.php to learn more!

Thanks to Our 2014 SciX Co-Organizers!!

Alexandra Ros
Assistant Professor
Chemistry & Biochemistry Dept
Arizona State University
Alexandra.Ros@asu.edu

Ed Goluch
DiPietro Assistant Professor
Chemical Engineering
Northeastern University
e.goluch@neu.edu

2014 AES ANNUAL MEETING IN ATLANTA

TECHNICAL PROGRAM AT A GLANCE

AES Members Receive Discounted Registration for the 2014 Annual Meeting!

Watch your email for a promo code to apply the member discount during your registration.

New members can obtain the promo code upon joining AES.

Visit the AES website for more information and detailed registration instructions.

http://www.aesociety.org/meetings/registration.php

All sessions will be held at the Marriott Marquis. The full program is available at: https://aiche.confex.com/aiche/2014/webprogram/T3.html.

Monday, November 17, 2014

8:30 am—11:00 am	**Advances in Electrophoretic Protein Separation & Analysis** (Marquis Ballroom C)
11:00 am—12:30 pm	**Lunch with Leaders** (Max Lager's Wood-Fired Grill & Brewery)
12:30 pm—3:00 pm	**Electrokinetics for Biosensing, and Biomedical Applications** (Marquis Ballroom C) **Electrokinetics for Self-Assembly** (Marquis Ballroom D)
3:15 pm - 5:45 pm	**Soft Matter Electrokinetics: Particles, Drops and Bubbles** (Marquis Ballroom C)
6:00 pm - 7:30 pm	**Poster Session and Award Presentations** (Marquis Ballroom C)

Tuesday, November 18, 2014

8:30 am—11:00 am	**Electrokinetics for Sample Preparation** (Marquis Ballroom C)
11:15 am—12:30 pm	**AES Business Meeting**
12:30 pm—3:00 pm	**Electrokinetics and Microfluidics in Bioanalytical Applications** (Marquis Ballroom C) **Nanoscale Electrokinetics** (Marquis Ballroom D)
3:15 pm-5:45 pm	**Plenary Session: AES Electrophoresis Society** (Marquis Ballroom C)
6:00 pm—10:00 pm	**Society Banquet** (Morton's Steakhouse)

Wednesday, November 19, 2014

8:30 am-11:00 am	**Electrokinetics: Advancing the Fundamentals** (Marquis Ballroom C)
12:30 pm-3:00 pm	**Electrokinetics in Nono-Polar Media** (Marquis Ballroom D) **Electroporation and Electrophysiology** (Marquis Ballroom C)
3:15 pm-5:45 pm	**Award Session of the AES Electrophoresis Society** (Marquis Ballroom C)
6:00 pm-7:00 pm	**Informal Networking Party**

Sponsorship opportunities are available for all events. Don't miss this unique opportunity to connect directly with our vibrant community. Visit www.aesociety.org/sponsors/conference.php to learn more!

AES Workshops at the 2014 Annual Meeting

An exciting slate of pre-conference workshops are under development, to be held immediately prior to the conference on Sunday, November 16. Please stay tuned, more details are coming soon!

Your Complete Guide to All Things AES in Atlanta

Note that we've changed the dates of some events to make them more accessible to everyone!

Lunch with Leaders

Monday, Nov 17, 11 am - 12:30 pm.
What: A friendly and informal opportunity for students to meet and mingle with leaders in the field over lunch.
Where: Max Lager's Wood-Fired Grill & Brewery
Cost: $15.

AES Business Meeting

Tuesday, Nov 18 , 11:15 am - 12:30 pm.
What: Want to get involved with AES? Interested in helping organize future meeting? Come join us at our annual business meeting and volunteer!
Where: TBA.
Cost: Free!

Informal Networking Party

Wednesday, Nov 19, 6:00 - 7:00 pm.
What: Join your AES colleagues for a chance to unwind after the conference with fun and informal fellowship.
Where: TBA.
Cost: Cash bar.

AES Poster Session

Monday, Nov 17, 6:00 - 7:30 pm.
What: Late-breaking contributions are welcome, and will be accepted until October 27th 2014 (email abstracts directly to the session chairs Blanca H. Lapizco-Encinas and Victor M. Ugaz). Awards will be presented to outstanding student posters.
Where: Marquis Ballroom C
Cost: Free, plus your poster might win!

AES Banquet

Tuesday, Nov 18, 6:00 - 9:00 pm.
What: Join us for an evening of food, fellowship, and our distinguished guest speaker: Neelam D. Ghiya, US Public Health Service Health Scientist/Training & Emergency Coordinator. Centers for Disease Control and Prevention (CDC).
Where: Morton's Steakhouse
Cost: $55/person.

New this year! AES Video Contest

Overview: This year, AES is pleased to sponsor a new video contest is designed to teach/inform members of the scientific community about an electrically-driven technique. Techniques can include well-established techniques, but novel techniques are highly encouraged. The video should contain enough information so that the technique is reproducible by a person with general scientific knowledge and access to the appropriate equipment.

Prizes: First place ($300 and 1 year AES student membership), second place ($200 and 1 year AES student membership), third place ($100 and 1 year AES student membership). Winners will be announced at the AES Banquet.

Eligibility: Any student member of AES Electrophoresis Society is eligible to enter (must be 18 years of age or older at the time of entry).

Check your email for additional details and submission instructions coming soon!

Special Proceedings Issue of *ELECTROPHORESIS*

AES is pleased to team again with the journal *ELECTROPHORESIS* to publish a special proceedings issue highlighting manuscripts associated with work presented at the Annual Meeting. We will follow an accelerated timeline with a manuscript submission deadline of December 8, 2014, and publication date in early second half of 2015. Please submit manuscripts electronically at: http://mc.manuscriptcentral.com/elpho indicating that they are intended for this special proceedings issue, or contact one of the editors directly (Blanca H. Lapizco-Encinas and Mark Hayes). All submissions will be subject to peer review in accordance with the standard journal policies. Additional information and directions for authors are available here.

Thanks to Our AES 2014 Meeting Co-Chairs!

Cullen Buie
Dept. of Mechanical Engineering
MIT
Email: crb@mit.edu

Rodrigo Martinez-Duarte
Dept. of Mechanical Engineering
Clemson University
Email: rodrigm@clemson.edu

Where are the theoretical plates in my electrophoresis system?

by Kevin Dorfman

Department of Chemical Engineering and Materials Science, University of Minnesota, dorfman@umn.edu,

http://research.cems.umn.edu/dorfman/

The membership of AES (and the field of electrophoresis in general) is populated by researchers with a wide range of backgrounds, from chemistry to physics to engineering. This diversity is one of the best parts of working on electrophoresis, as it brings many different skill sets to bear on our problems. However, the price we pay for working in an interdisciplinary field is the need to communicate concepts from one field to another. It has been my experience that the so-called "theoretical plate" of a separation column is by far the most arcane of the jargon that newcomers to the field need to learn, especially since electrophoresis systems do not actually have any physical plates! In particular, researchers who were not trained in the chemical sciences are rightly confused by this lingo: Where are these plates located? Why are you talking about how tall they are? The confusion is accentuated when discussing periodic microfluidic devices, where there is a tendency to associate each period of the pattern on the device with a plate.

In this report, I will explain the origin of the plate height and hopefully show you why it is a useful concept. The following text is based on a recent review paper (*Chem. Rev.* 2013, 113, 2584-2667) from my group on sizing long DNA. In this paper, we devoted one section to discussing standard analytical chemistry concepts in a language more commonly used by physical scientists and engineers. If you would like more information, in particular about the relationship between theoretical plates, resolution and detection schemes, I refer you to this review article.

Let us begin our discussion with the standard approach in analytical chemistry, following the explanation by J.C. Giddings in his classic book Unified Separation Sciences (Wiley, 1991). This is a practical approach where we simply treat the theoretical plate height H as a definition

$$H = 2D/U \qquad (1)$$

where D is the effective diffusivity of the analyte and U is its average velocity. In heterogeneous media, which is typically the case in electrophoresis, the molecular diffusivity and local convective velocity will depend on the position of the analyte within the device. For example, a cell moving through a dielectrophoretic trapping device will obviously have a different local velocity in the interstices of the device than when it is trapped. The effective diffusivity and velocity appearing in Equation (1) are thus suitable average values of these quantities during the transport through the device, taking into account the inhomogeneities (and accompanying Taylor-Aris dispersion). The exact definition of these averages is a bit subtle, but the practical approach ignores the math and just lets nature do the averaging for us in the form of the electropherogram. If we have a separation device of some length L, then the average velocity of the analyte is

$$U = L/t \qquad (2)$$

where t is the residence time inside the device (i.e., the elapsed time between the start of the separation and acquisition of the electropherogram). The effective diffusivity is normally approximated by the width (variance) of the band when it exits the device,

$$\sigma^2 = 2Dt \qquad (3)$$

The latter equation assumes that all band broadening is due to the transport in the device, neglecting effects due to the injection and detection processes.

Equations (1)-(3) provide an unambiguous way to compute the plate height

$$H = \sigma^2/L \qquad (4)$$

as the ratio of the variance of the peak width relative to the distance traveled in the device. In the separations literature, it is quite common to refer to the number of theoretical plates, N. If the device is of length L and each plate is of height H, then the number of such plates is

$$N = L/H = L^2/\sigma^2 \qquad (5)$$

We thus see that the number of theoretical plates is just a way to report a dimensionless (inverse) amount of band broadening per unit length in the device. A large number of plates indicates very small band broadening, and vice versa. This is the utility of the plate height in separation sciences. However, if you were not trained as an analytical chemist, you may be wondering why we bother with the terms "plate height" and "number of theoretical plates" in electrophoresis; after all, electrophoresis devices do not have any plates. Indeed, we could just call the number of theoretical plates the inverse band broadening per unit length.

The terms plate height and the number of theoretical plates have their origin in equilibrium chemical separations, such as distillation. Fig. 1a is a typical schematic

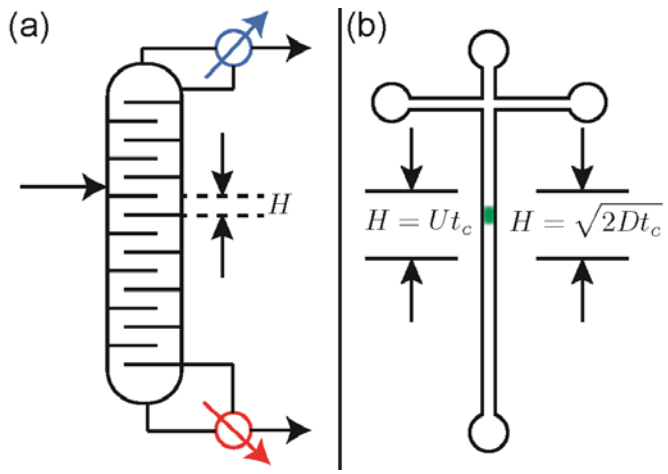


Figure 1. Correspondence between (a) the theoretical plate of height *H* in a distillation column and (b) the theoretical plate in an electrophoretic separation device with average velocity *U* and effective diffusivity *D*. Adapted with permission from K.D. Dorfman, S.B. King, D.W. Olson, J.D.P. Thomas and D.R. Tree, "Beyond Gel Electrophoresis: Microfluidic Separations, Fluorescence Burst Analysis, and DNA Stretching," *Chem. Rev*. 2013, 113, 2584-2667. Copyright 2013 American Chemical Society.

of a staged distillation column that you would encounter in a standard chemical engineering undergraduate text. Such a column literally consists of a number of perforated plates, arranged vertically so that the fluid is actuated by gravity. The liquid in the column drains from the top-to-bottom, while gas bubbles rise up the column through the perforations in the plates. In an ideal distillation column, the gas bubbling through a given plate reaches equilibrium with the liquid in that plate, which is the maximum possible separation per plate. If this is the case, then we can readily compute the number of such plates required to achieve a given separation. (This calculation is called the McCabe-Thiele method.) Real distillation columns do not achieve equilibrium on each plate, since the fluids move faster than the (infinite) time required to equilibrate. As a result, the output from the McCabe-Thiele calculation is referred to as the number of "theoretical plates" and provides a lower bound on the actual number of plates and thus the total height of the distillation column.

What is the connection between the theoretical plates in a distillation column and a separation device? As we see in Figure 1b, instead of starting from the definition of the plate height in Equation (1), let us instead think of the plate height *H* as the distance where diffusive and convective transport are balanced. Electrophoresis is a non-equilibrium separation method, so another way to think about the concept is that the plate height corresponds to the distance over which diffusion could smear out the sample and thus "equilibrate" it. In other words, during the time

$$t_c = H/U \qquad (6)$$

required for an analyte to be convected a distance *H*, the analyte would also diffuse a distance

$$H = (2Dt_c)^{1/2} \qquad (7)$$

It is easy to see that Equations (6)-(7) lead to Equation (1).

While the operational definition of the plate height in Equations (1)-(4) is the standard way to introduce the concept in analytical chemistry, I prefer the alternate derivation in Equations (6) and (7) because it makes the connection to equilibrium separations clear and answers the two questions we posed at the outset. First, the theoretical plate in an electrophoresis system is just as "real" as the theoretical plate in a distillation column; neither one exists, but they provide a convenient way to quantify the separation process. Second, the connection to distillation also explains why we talk about the plate "height" in electrophoresis even though gravity normally plays no role in electrophoretic separations.

AES Congratulates Kevin Dorfman
Recipient of the 2014 AES Mid-Career Award

Kevin Dorfman received his Ph.D. in chemical engineering from MIT in 2002, working with Howard Brenner. From 2002 - 2005, he was an HFSP postdoctoral fellow with Jean-Louis Viovy at Institut Curie in Paris, France. Since joining the faculty in the Department of Chemical Engineering and Materials Science at the University of Minnesota in 2006, Kevin has become internationally recognized as a leading figure in the area of electrophoretic techniques for DNA separations. In addition to numerous publications, including seminal reviews, Kevin's accomplishments have been recognized by awards including the Allan P. Colburn Award of the AICHE (2012), Borja Award of the University of Minnesota (2012), Dreyfus Teacher-Scholar Award (2010), DARPA Young Faculty Award (2009), Packard Fellowship (2007), NSF CAREER Award (2007), Dreyfus New Faculty Award (2006), HFSP Career Development Award (2006).

To learn more about Kevin's research, check out a recent interview with him at http://goo.gl/KkdN52.

The Trailing Zone by Victor M. Ugaz

A column highlighting broader perspectives and observations about science and the lives of those who pursue it.

Living My Dream

It happened again last night. I had the same dream that I've experienced as long as I can remember. It unfolds like this. I'm attempting to do some kind of manual task. Like push the buttons to change television channels on a remote control, ride a bicycle, or run away from an approaching wall of water barreling down my street (last night's dream). Regardless of the scenario, I have the solution to the problem easily within my grasp. I only have do to is one simple thing. No problem, right?

But when I reach out to try to perform this task, I simply can't do it. There is no communication between my brain and the rest of my body. The signal is being sent to push the button, turn the handlebars, or run away. But the message never reaches its destination, leaving me helplessly stuck and unable to do anything.

I have thought about this dream for many years, analyzing it from all angles in hopes of extracting some meaning. But I recently realized that it isn't a dream at all. It's my life. And I've found that this is best understood by considering the following example.

Imagine the favorite thing you like to eat. You've loved this dish your whole life, so much so that you decide to train to become a chef so that you can prepare it yourself. You spend years studying the culinary arts, dedicating your life to understanding flavors, cooking styles, and techniques. You spend time working with renowned master chefs so that you can develop the skills to put these elements together in new and interesting ways. Finally, after you've completed all this training, you are ready to open your own restaurant so that you can share the food you love so much with the world.

But things do not go exactly as you envisioned. It turns out that running a restaurant is a huge job that involves much more than just cooking. In fact, you aren't able to spend a lot of time actually cooking because you need to worry about many other things like serving the customers, ordering the groceries, keeping the equipment running, promoting the business. It quickly becomes clear that the only way to realize your vision is through the hands of others.

But nobody is as passionate as you are about the dishes you like to cook. No one shares exactly the same vision as you do about how they should be prepared. Often, others don't even realize the depth of training and experience you have. They brush aside your suggestions and try things you know aren't likely to work. But over time your perspective begins to change, you realize that the visions and skills of those working with you can lead to new directions...things that you would never have thought of on your own. Sometimes these directions are disastrous failures, but more often they turn out to be incredibly interesting and exciting. There is still frustration in not being able to exactly prepare the dishes you envision, but new and different culinary creations emerge that are equally beautiful.

After thinking about this example, I realized that my dream isn't a dream at all. It is my life. And that this experience, at the same time fulfilling and frustrating, is something uniquely shared by those of us fortunate enough to be able to carve out a living as scientists.

Victor M. Ugaz (ugaz@tamu.edu) is an Associate Professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University. Comments and suggestions are welcome.

Upcoming Elections

Please submit nominations by September 30th!!

The officers and council of the AES Electrophoresis Society invite nominations for the following positions (self nominations are encouraged):

- **Councilors:** This is a three-year position. **Four** Councilor positions will be open this year, two from completion of existing terms (see below) and two stipulated by the new constitution. The recent growth of the society has warranted increasing the councilor number from six to eight. Responsibilities of the position are: to participate in all teleconferences (once per month), serve on one committee (sponsorship, membership, or ad-hoc), and contribute as needed based on individual contacts or ideas. Councilors are also encouraged, but certainly not required, to participate as meeting co-organizers.

- **2016 AES Annual Meeting Co-organizers:** This is a one-year position held jointly by two individuals. These individuals are responsible, with the assistance of the council, for arranging session chairs who field calls for papers, organizing contributions into sessions, and developing an outstanding three-day schedule. These individuals are the key contacts coordinating with AIChE for all co-programming duties. They oversee the entire annual meeting experience.

- **2015 AES-SciX Meeting Co-organizer:** This one-year position has similar duties as the annual meeting, but co-programs with a SciX representative performing all of the duties discussed above.

Nominations should include full name, contact information, photo, and affiliation accompanied by a 50 to 100 word statement introducing yourself to the membership, commenting on why you would be good for the position, what you would do to move AES forward, as well as ideas to advance electrophoretic applications. Nominations will be posted online and in the Fall newsletter to aid with member voting.

The nomination phase will close September 30th. Please send nominations to Mark Hayes, AES President (MHayes@asu.edu). The nominees and their statements will be posted online at www.aesociety.org/about_us/nominations.php. Online membership voting for the Councilors will be open until Friday, October 31st. The elected individuals will assume their positions at the board meeting at the Annual Meeting, Tuesday, Nov 18th in Atlanta, GA.

AES Bylaws are available at http://www.aesociety.org/about_us/bylaws.php. Feel free to contact any of the board members at http://www.aesociety.org/about_us/council.php with any questions.

Many thanks to our two Councilors whose 3-year terms end in November 2014.

Yolanda Fintschenko
Director, Business Development
LabSmith, Inc
Livermore, CA
yfintschenko@labsmith.com

Edgar Goluch
Chemical Engineering Dept
Northeastern University
Boston, MA
e.goluch@neu.edu