對外合作組織與機構動態報導

2017/11/3

HACKING THE BACTERIAL SOCIAL NETWORK

駭入細菌社交平臺

By Steve Koppes • October 24, 2017

Whenever we use our smartphones to check social media, we face loads of bacteria on the devices — even more than on toilet seats, according to a University of Arizona study. Those bacteria may have their own form of social network that, like Facebook, allows the single-cell creatures to attract and repel one another.

This insight stems from new research by U.S. Department of Energy (DOE) scientists who have determined the molecular structures of a highly specialized set of proteins. These proteins are

報告摘要(KEY INFORMATION)

1. 當我們使用智慧型手機確認社交平台的時候，我們接觸的是裝置上大量的細菌——「甚至比馬桶上更多」——亞利桑那大學研究。而其實，那些細菌可能也有他們自己的社交平台，像是臉書，讓單細胞生物之間展現吸引與互斥。
2. 2017 的年度歐盟咨文，在能源部分，重點放在如何完成能源共同體與對抗氣候變遷，而德法兩國的未來發展無疑具有關鍵影響力。本次德國大選梅克爾所領導的政黨票數仍未佔過半，未來組成聯合政府的過程與相關政策的協商值得外界注意。
3. 中俄對聯合國制裁北韓的行動採取相當保留的態度，但兩方在國安上又有利益上的衝突。目前俄方的外交態度尚未明朗，仍需持續觀察。
4. 目前，結合人腦與機器在某一程度已經可行，可有助提供基本視覺及改善帕金森氏症之症狀。但在所有案例中，最大的挑戰不在於要安裝的硬體，而在於如何解讀大腦要傳遞的訊息，以及如何與之對話。
5. 當半夜蚊子在耳畔嗡鳴時，一掌拍下或許可以帶給你安穩的睡眠，但如果你能簡單錄製一小段蚊子的嗡嗡聲並上傳平台，將能協助建立蚊子在全球的分布圖，有助於減少病媒蚊帶來的疾病，提升全球公共衛生水準。

used by a strain of *E. coli* bacteria to communicate and defend their turf.

The work could lead to new biomedical strategies for overcoming pathogenic bacteria that cause infectious diseases such as pneumonia and food-borne illnesses. It is the latest advance from a group of scientists at the DOE's Argonne National Laboratory; the University of California, Santa Barbara (UCSB); and the University of California, Irvine.

The work builds upon the 2005 discovery by UCSB researchers that the bacteria produce toxic proteins, which they can transfer to their neighbors through direct contact to either kill or control them, possibly to gain better access to nutrients. It plays out only in densely populated microbial communities through a process called contact-dependent growth inhibition (CDI).

"We are basically learning how the bacteria interact and communicate," said Andrzej Joachimiak, an Argonne Distinguished Scientist in the laboratory's Biosciences Division. "We have some ideas that we are trying to resolve, because the toxins may have different activities. They may affect different bacteria differently."

"These systems are found not only in soil and gut bacteria, but also in human pathogens," said Joachimiak, who also is a senior fellow at the University of Chicago's Computation Institute. "Some of these toxins of CDI systems are present in Pseudomonas aeruginosa, for example, which is involved in lung disease."

Joachimiak and 10 co-authors published their findings in the Sept. 29, 2017 issue of the journal Nucleic Acids Research.

The Argonne team obtained the molecular structures of proteins that belong to a three-part system of the NC101 strain of *E. coli*. The three parts consist of the CDI toxin, its immunity protein and its elongation factor. The latter, known as EF-Tu, is a protein that plays a key role in protein synthesis. Knowing the protein structures of all three parts helps scientists understand their function.

The discovery of the immunity protein has led scientists to suspect that the purpose of the system includes not only competition but also signaling, the process by which bacterial cells communicate with each other, as well as killing and controlling other bacteria.

"There are really only a few molecules of the toxin that get into the neighboring cell," said Karolina Michalska, a protein crystallographer at Argonne and co-lead author of the paper. "It's hard to estimate the real extent of the cell damage. That's why we were thinking it's not meant to kill, but rather to control and communicate."

The toxin can act on the transfer ribonucleic acid (tRNA) only under highly specific circumstances.

“This particular toxin acts on tRNA and it needs to be a very specific set of tRNA,” Michalska said. “This is the first case where we see the elongation factor as this extra component needed for the toxin to function.”

The Argonne team collected data on the protein structures using the Structural Biology Center’s beamline at the Advanced Photon Source (APS), a Department of Energy Office of Science User Facility. The APS is a third-generation light source, providing extremely bright X-rays that allow researchers to delve into the arrays of molecules within materials. Using this tool, researchers can characterize, or identify, biological proteins and inspect chemical processes at the nanoscale (one billionth of a meter).

Argonne’s research team also tapped the laboratory’s Advanced Protein Characterization Facility, which offers the nation’s most advanced technologies for studying new classes of proteins and protein complexes.

Other authors were Argonne’s Lucy Stols, a biochemical specialist; William Eschenfeldt, a molecular biologist; and Gyorgy Babnigg, a bioinformatician and molecular biologist.

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EU: STATE OF THE UNION ADDRESS OF THE EU, AND THE GERMAN ELECTION

歐盟觀察：年度歐盟咨文提及德國大選與能源發展

By Kei Shimogori

On September 13, European Commission President Jean-Claude Juncker delivered his annual speech on the State of the Union for 2017, and outlined high-priority policies for the coming year and his prospects for a deeper union of the EU by 2025. Regarding energy, he referred to the completion of the Energy Union in the context of completing the initiatives implemented so far. Further, as one of the five proposals of particular significance, he mentioned the fight against climate change, commented that "Set against the collapse of ambition in the United States, Europe will ensure we make our planet great again," and said that a proposal for reducing carbon dioxide in the transport area will be released soon. In his address, President Juncker indicated an agenda for “a more united, a stronger, a more democratic Europe”. This lists all the European Council and unofficial meetings and their agendas from now up to the end of March

2019 when Britain will officially leave the EU. Future energy and climate policies, including the future of the EURATOM (European Atomic Energy Community) Treaty, are planned to be discussed in the European parliament in around June 2018.

The cornerstones of the EU's future are without question Germany and France. In Germany, a federal election, which is held in principle just once every four years, was held on September 24. The election campaign focused on the center-right Christian Democratic Union (CDU)/Christian Social Union (CSU) and the center-left Social Democratic Party of Germany (SPD) which have taken turns in power in post-war Germany and which, being part of a grand coalition, could not present clear policy differences. The election was won by the ruling party led by Chancellor Merkel, with CDU/CSU winning 33% of the votes and SPD 20.5%, but the percentage of votes for the former was the lowest since 1949. In 2017, the focus of national elections in European countries has been the rise of ultra-right parties with anti-immigration and anti-EU policies. The equivalent party in Germany is Alternative for Germany (AfD), which so far has won seats in State Parliaments but not in the Bundestag, as elections had not been held. In this election, AfD won 12.6% of the votes and thus leapt to become the third-ranking party. With SPD reluctant to form a grand coalition with CDU/CSU, the negotiations for coalition will focus on smaller parties. However, as the smaller parties have very different policies from those of CDU/CSU, the coalition negotiations are expected to face difficulties.

However, the energy policy of Germany may not be affected so strongly by the election results. Germany is already pursuing an energy transition policy, and its policy to phase out nuclear power is set in law (the 13th Act to Amend the Atomic Energy Act). With all parties excluding AfD advocating increasing renewable energy and moving away from nuclear power, a great shift in energy policy is unlikely. One of the criticisms against Chancellor Merkel is not working hard enough on preventing air pollution due to her strong ties with the auto industry. Accordingly, the Chancellor established a 500 million-euro air pollution prevention fund on September 4, and also revealed plans to double the exhaust reduction budget in urban areas to 1 billion euros to avoid a ban on diesel vehicles in those areas. If Chancellor Merkel wins another term, it will be interesting to see how she demonstrates Germany's presence in the environment and climate areas in comparison with France.

RUSSIA: RUSSIA UNDER A SPOTLIGHT AMID THE NORTH KOREAN CRISIS

俄國觀察：北韓危機籠罩下的俄國備受關注

By Li Zhidong

On September 4, a summit meeting of five emerging economies, namely Brazil, Russia, India, China, and South Africa (the BRICS), was held in Xiamen in Fujian Province, China. On the next day, the 5th, a meeting of "BRICS Plus" was held, joined by the BRICS leaders plus the leaders of Mexico, Egypt, Tajikistan, Guinea and Thailand. This BRICS summit marked the ninth, with the member countries taking turns in hosting it, but the meeting of "BRICS Plus" was the first, and came about at China's initiative.

In both meetings, President Xi Jinping stressed the importance of a deeper BRICS partnership and stronger ties between the BRICS and developing countries in global governance. In both the BRICS Leaders Xiamen Declaration adopted on the 4th and the presidential statement on the "BRICS Plus" dialogue issued by the host country on the 5th, the leaders emphasized the importance of an open global economy and a free trade regime, and clearly opposed protectionism. Regarding the prevention of global warming, positioning climate change as a common challenge for the international community, the leaders called on countries to adhere to the principle of equity, common but differentiated responsibilities, and respective capabilities, and to fully implement the Paris Agreement. The leaders also stated that developed countries need to ramp up financial assistance and technological and capacity building support for developing countries. All these messages strongly reflect China's stance toward global governance.

The BRICS Xiamen conference thus closed successfully for China, but for the Xi leadership which is heading into the five-yearly National Congress of the Communist Party of China (the 19th) in October, a foreign affairs problem remains, namely the issue regarding the development of nuclear and missile technology in North Korea.

China's stance on North Korea has three principles: (1) Denuclearization of the Korean Peninsula, (2) maintaining peace and stability, and (3) peaceful resolution through dialogue and discussion. To achieve these, China is calling for a "double suspension," demanding that North Korea suspend its nuclear and missile activities in exchange for the suspension of US-South Korea military exercises, while also pursuing a "dual-track" approach of denuclearizing the peninsula on the one hand and establishing a mechanism for peace and stability on the other. However, North

Korea conducted a nuclear experiment on the 3rd, the day before the Xiamen Summit. China immediately released a Foreign Ministry statement expressing resolute opposition and strong condemnation, and voted in support of additional sanctions against North Korea at the UN Security Council. By supporting the strict additional sanctions, which are likely to slash petroleum product exports to North Korea by 30% and ban textile imports from the country which, combined with existing sanctions, will cut imports from the country by more than 90%, China expressed its firm resolve to denuclearize the peninsula. In a speech at the UN General Assembly and a meeting with the Foreign Minister of South Korea, Foreign Minister Wang Yi stated that China will take all measures, including reinforced control of smuggling between China and North Korea, to fully implement the UN resolution. China also called on both the US and North Korea to exercise self-restraint, again emphasizing the need to stick to dialogue and negotiation to solve this issue.

As a result, the government's efforts for denuclearizing the Korean Peninsula are welcome, while some think that China should prepare itself for a military emergency on the Korean Peninsula. For example, Jia Qingguo, Professor of the School of International Studies of Peking University, argues that China should prepare for a possible armed conflict in the Peninsula and start talks with the US, South Korea, and others on the management of North Korea's nuclear weapons, immigration measures, and reestablishment of a political system after the current regime collapses, as well as the removal of the Terminal High Altitude Area Defense (THAAD) missile system from South Korea.

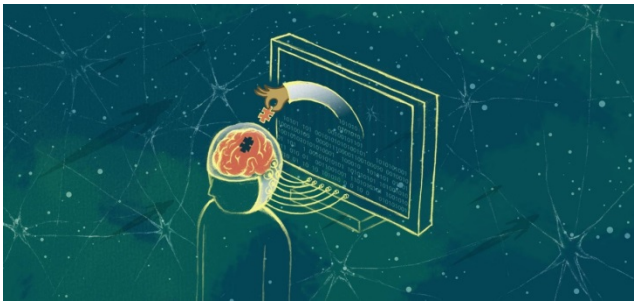
SINCE THE 19TH CENTURY AT LEAST, HUMANS HAVE WONDERED WHAT COULD BE ACCOMPLISHED BY LINKING OUR BRAINS – SMART AND FLEXIBLE BUT PRONE TO DISEASE AND DISARRAY – DIRECTLY TO TECHNOLOGY IN ALL ITS COLD, HARD PRECISION.

自 19 世紀以來，人類不斷探索如何連結人腦與科技的問題

By Nathan Collins • October 18, 2017

ENGINEERING

While these remain inconceivably far-fetched, the melding of brains and machines for treating disease and improving human health is now a reality. Brain-machine interfaces that connect computers and the nervous system can now restore rudimentary vision in people who have lost the ability to see, treat the symptoms of Parkinson's disease and prevent some epileptic seizures. And there's more to come.



But the biggest challenge in each of those cases may not be the hardware that science-fiction writers once dwelled on. Instead, it's trying to understand, on some level at least, what the brain is trying to tell us – and how to speak to it in return. Like linguists piecing together the first bits of an alien language, researchers must search for signals that indicate an oncoming seizure or where a person wants to move a robotic arm. Improving that communication in parallel with the hardware, researchers say, will drive advances in treating disease or even enhancing our normal capabilities.

Listening to the language of the brain

The scientific interest in connecting the brain with machines began in earnest in the early 1970s, when computer scientist Jacques Vidal embarked on what he called the Brain Computer Interface project. As he described in a 1973 review paper, it comprised an electroencephalogram, or EEG, for recording electrical signals from the brain and a series of computers to process that information and translate it into some sort of action, such as playing a simple video game. In the long run, Vidal imagined brain-machine interfaces could control "such external apparatus as prosthetic devices or spaceships."

Although brain-controlled spaceships remain in the realm of science fiction, the prosthetic device is not. Stanford researchers including Krishna Shenoy, a professor of electrical engineering, and Jaimie Henderson, a professor of neurosurgery, are bringing neural prosthetics closer to clinical reality. Over the course of nearly two decades, Shenoy, the Hong Seh and Vivian W. M. Lim Professor in the School of Engineering, and Henderson, the John and Jene Blume–Robert and Ruth Halperin Professor, developed a device that, in a clinical research study, gave people paralyzed by accident or disease a way to move a pointer on a computer screen and use it to type out messages. In similar research studies, people were able to move robotic arms with signals from the brain.

Reaching those milestones took work on many fronts, including developing the hardware and surgical techniques needed to physically connect the brain to an external computer.

But there was always another equally important challenge, one that Vidal anticipated: taking the brain's startlingly complex language, encoded in the electrical and chemical signals sent from one of the brain's billions of neurons on to the next, and extracting messages a computer could understand. On top of that, researchers like Shenoy and Henderson needed to do all that in real time, so that when a subject's brain

signals the desire to move a pointer on a computer screen, the pointer moves right then, and not a second later.

One of the people that challenge fell to was Paul Nuyujukian, now an assistant professor of bioengineering and neurosurgery. First as a graduate student with Shenoy's research group and then a postdoctoral fellow with the lab jointly led by Henderson and Shenoy. Nuyujukian helped to build and refine the software algorithms, termed decoders, that translate brain signals into cursor movements.

Actually, "translate" may be too strong a word – the task, as Nuyujukian put it, was a bit like listening to a hundred people speaking a hundred different languages all at once and then trying to find something, anything, in the resulting din one could correlate with a person's intentions. Yet as daunting as that sounds, Nuyujukian and his colleagues found some ingeniously simple ways to solve the problem, first in experiments with monkeys. For example, Nuyujukian and fellow graduate student Vikash Gilja showed that they could better pick out a voice in the crowd if they paid attention to where a monkey was being asked to move the cursor.

"Design insights like that turned out to have a huge impact on performance of the decoder," said Nuyujukian, who is also a member of Stanford Bio-X and the Stanford Neurosciences Institute. In fact, it more than doubled the system's performance in monkeys, and the algorithm the team developed remains the basis of the highest-performing system to date. Nuyujukian went on to adapt those insights to people in a clinical study – a significant challenge in its own right – resulting in devices that helped people with paralysis type at 12 words per minute, a record rate.

Although there's a lot of important work left to do on prosthetics, Nuyujukian said he believes "there are other very real and pressing needs that brain-machine interfaces can solve," such as the treatment of epilepsy and stroke – conditions in which the brain speaks a language scientists are only beginning to understand.

Listening for signs something's wrong

Indeed, if one brain-machine interface can pick up pieces of what the brain is trying to say and use that to move a cursor on a screen, others could listen for times when the brain is trying to say something's wrong.

One such interface, called NeuroPace and developed in part by Stanford researchers, does just that. Using electrodes implanted deep inside or lying on top of the surface of the brain, NeuroPace listens for patterns of brain activity that precede epileptic seizures and then, when it hears those patterns, stimulates the brain with soothing electrical pulses.

Learning to listen for – and better identify – the brain's needs could also improve deep brain stimulation, a 30-year-old technique that uses electrical impulses to treat Parkinson's disease, tremor and dystonia, a movement disorder characterized by repetitive movements or abnormal postures brought on by involuntary muscle contractions, said Helen Bronte-Stewart, professor of neurology and neurological sciences.

Although the method has proven successful, there is a problem: Brain stimulators are pretty much always on, much like early cardiac pacemakers. Although the consequences are less dire – the first pacemakers "often caused as many arrhythmias as they treated," Bronte-Stewart, the John E. Cahill Family Professor, said – there are still side effects, including tingling sensations and difficulty speaking. For cardiac pacemakers, the solution was to listen to what the heart had to say and turn on only when it needed help, and the same idea applies to deep brain stimulation, Bronte-Stewart said. To that end, "we're developing brain pacemakers that can interface with brain signaling, so they can sense what the brain is doing" and respond appropriately.

The challenge is much the same as in Nuyujukian's work, namely, to try to extract useful messages from the cacophony of the brain's billions of neurons, although Bronte-Stewart's lab takes a somewhat different approach. In one recent paper, the team focused on one of Parkinson's more unsettling symptoms, "freezing of gait," which affects around half of Parkinson's patients and renders them periodically unable to lift their feet off the ground.

Bronte-Stewart's question was whether the brain might be saying anything unusual during freezing episodes, and indeed it appears to be. Using methods originally developed in physics and information theory, the researchers found that low-frequency brain waves were less predictable, both in those who experienced freezing compared to those who didn't, and, in the former group, during freezing episodes compared to normal movement. In other words, although no one knows exactly what the brain is trying to say, its speech – so to speak – is noticeably more random in freezers, the more so when they freeze.

By listening for those signs, well-timed brain stimulation may be able to prevent freezing of gait with fewer side effects than before, and one day, Bronte-Stewart said, more sophisticated feedback systems could treat the cognitive symptoms of Parkinson's or even neuropsychiatric diseases such as obsessive compulsive disorder and major depression.

Do we need to speak the brain's language?

Both Nuyujukian and Bronte-Stewart's approaches are notable in part because they do not require researchers to

understand very much of the language of brain, let alone speak that language. Indeed, learning that language and how the brain uses it, while of great interest to researchers attempting to decode the brain's inner workings, may be beside the point for some doctors and patients whose goal is to find more effective prosthetics and treatments for neurological disease.

But other tasks will require greater fluency, at least according to E.J. Chichilnisky, a professor of neurosurgery and of ophthalmology, who thinks speaking the brain's language will be essential when it comes to helping the blind to see. Chichilnisky, the John R. Adler Professor, co-leads the NeuroTechnology Initiative, funded by the Stanford Neuroscience Institute, and he and his lab are working on sophisticated technologies to restore sight to people with severely damaged retinas – a task he said will require listening closely to what individual neurons have to say, and then being able to speak to each neuron in its own language.

The problem, Chichilnisky said, is that retinas are not simply arrays of identical neurons, akin to the sensors in a modern digital camera, each of which corresponds to a single pixel. Instead, there are different types of neurons, each of which sends a different kind of information to the brain's vision-processing system.

HOW CITIZEN SCIENTISTS CAN CONTRIBUTE TO WORLDWIDE MOSQUITO TRACKING

公眾科學有助追蹤全球蚊子分布

By Taylor Kubota• October 31, 2017

It's a sound that can keep even the weariest among us from falling asleep: the high-pitched whine of a mosquito.

This irritating buzz already makes us run, slap and slather on repellent. But if Stanford University researchers have their way, it may also prompt us to take out our cellphones and do a little science.

The Prakash Lab at Stanford, led by Manu Prakash, assistant professor of bioengineering, is looking for citizen scientists to contribute to Abuzz, a mosquito monitoring platform the lab developed to produce the most detailed global map of mosquito distribution. All that's

required to participate is a cellphone to record and submit the buzz of a mosquito, which means almost anyone from around the world can take part in this work.

More than mere pests, mosquitoes can carry deadly diseases, including malaria, yellow fever, dengue, West Nile virus, chikungunya and Zika. Diseases spread by mosquitoes result in millions of deaths each year and the burden of their effects is carried most strongly by places with the fewest resources.

“We could enable the world’s largest network of mosquito surveillance – just purely using tools that almost everyone around the world now is carrying in their pocket,” Prakash.

“There are very limited resources available for vector surveillance and control and it’s extremely important to understand how you would deploy these limited resources where the mosquitoes are,” said Prakash, who is senior author of a paper that demonstrates the feasibility of this approach, published in the Oct. 31 issue of eLife.

With enough contributions from citizen scientists around the world, Abuzz could create a map that tells us exactly when and where the most dangerous species of mosquitoes are most likely to be present and that could lead to highly targeted and efficient control efforts.

“If you see a mosquito and you swat it, you’ve saved yourself an itch for one day. But if you see a mosquito and you record it and you send the data to the Abuzz project, then you’ve potentially contributed to an effort that can reduce the burden of mosquito-borne disease for many generations in the future, hopefully,” said Haripriya Mukundarajan, a graduate student in the Prakash Lab and lead author of the paper.

Abuzz is a low-cost, fast, easy way to gain an incredible amount of new data about mosquitoes. Contributing to this research is as simple as holding a cellphone microphone near a mosquito, recording its hum as it flies and uploading the recording to the Abuzz website. The researchers take the raw signal, clean up that audio to reduce background noise and run it through an algorithm that matches that particular buzz with the species that is most likely to have produced it.

Once the match is found, the researchers will send the person who submitted the recording information about the mosquito they found and mark every recording on a map on the website, showing exactly where and when that mosquito species was sighted.

Critical to the success of Abuzz is the fact that mosquito species can be differentiated by the frequency of their wingbeats, which is what produces their characteristic whine. Knowing this, Prakash and his team created a mosquito sound library, organized by species, which powers the matching algorithm. Overall, the researchers captured about 1,000 hours of mosquito buzzing from 18 lab-reared and two wild mosquito species, all of which were species relevant to human health.

Recognizing that people who could benefit most from Abuzz may not have access to the latest smartphones, the researchers designed the platform so that it can work off recordings from almost any model of cellphone. Most of the

data they focused on in the study was recorded on a $20 clamshell-style cellphone from 2006.

Further simplifying the process, the Abuzz algorithm has worked using as little as one fifth of a second of sound – although recordings that are a second or longer are the most desirable. Such basic requirements mean that merely recording near a mosquito just as it takes off from a surface is enough to create an Abuzz-worthy recording.

To assure that Abuzz works the way they've intended, the researchers ran a field test with 10 local volunteers in a village in Ranomafana, Madagascar in 2016. It took about 10 minutes to train these citizen scientists. The next day, they returned with 60 recordings that spanned three hours.

"It was very easy to tell people what to do and people were very eager to participate," recalled Felix Hol, a postdoctoral research fellow and co-author of the paper who helped conduct this field study. "Just 10 minutes of training and they could actually produce a lot of very usable data. That was a very beautiful experience for me."

Manu Prakash, assistant professor of bioengineering.

For any of the grandest aims of Abuzz to be possible, it needs engagement from citizen scientists. Without those contributions, it cannot reach its full potential. The group intends to release an app to facilitate community engagement in the near future and have already produced detailed training videos.

"What I would love to see is people engaging in the problem," Prakash said. "Try to join the platform. Record mosquitoes. Learn about the biology. And in that process, you will be supporting the kind of research and scientific data that we and medical entomologists around the world so desperately need and, at the same time, you will be making your own community safer."