Controlling electron emissions

Researchers have developed a method for more precisely controlling the emission of electrons through the tiny metal tip of an electron microscope.

X-ray laser images chemical flipping biological switch, a first

For the first time, scientists have observed a chemical interaction between two biomolecules.

Using the X-ray laser at the Department of Energy's Stanford Linear Accelerator Center (SLAC) National Accelerator Laboratory, scientists imaged a biomolecule as it flipped an RNA 'switch', a mechanism that controls the production of proteins, UPI reported.

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Scientists liken the coordinated movements of RNA mechanisms like riboswitches to synchronized swimmers.

"Previous experiments at SLAC's X-ray laser have studied biological reactions like photosynthesis that are triggered by light," lead researcher Yun-Xing Wang, a structural biologist at the National Cancer Institute's Center for Cancer Research, said.

"But this is the first to observe one that is triggered by the chemical interaction of two biomolecules in real time and at the atomic scale."

The ability to watch biochemical processes play out in real time was made possible by SLAC's X-ray free-electron laser.

"This really demonstrates the unique capability that X-ray free-electron lasers offer that no current technology, or any other technology on the horizon, can do," Wang said.

"It's like you have a camera with a very fast shutter speed, so you can catch every move of the biomolecules in action."

Scientists hope their latest findings — detailed in the journal Nature — and the technology that made it possible will pave the way for an improved understanding of riboswitches.

Riboswitches and other RNA mechanisms are genetic interpreters, translating DNA into biochemical instructions for the production of the proteins that fuel the biological processes that sustain life.

Understanding how RNA mechanisms regulate biological process could help scientists identify where and how switches sometimes fail, and how these malfunction yield diseases like cancer.

Wang and his colleagues looked at a specific riboswitch in the bacterium Vibrio vulnificus — a switch that regulates the abundance of adenine. Too much adenine triggers the riboswitch to shut down production of the molecule.

To see the mechanism in action, researchers incorporated millions of synthetic riboswitch copies into nanocrystals and then mixed the nanocrystals with a solution containing adenine.

The adenine molecules quickly penetrated the nanocrystals and flipped the switches.

Scientists likened the simultaneous flipping of millions of riboswitches to the coordinated movements of synchronized swimmers.

High-speed X-ray laser pulses offered scientists a play-by-play of the chemical interaction.

Scientists were surprised to find the flipping of the riboswitches caused the nanocrystals to change shape.

"To me it's still a mystery how the crystal managed to do that," said Soichi Wakatsuki, a professor at the Stanford School of Medicine who did not participate in the research.

"This actually opens up a lot of new possibilities and gives us a new way to look at how RNA and proteins interact with small molecules, so this is very exciting."

ISC, UPM ink MoU in Shiraz

ISC President Mohammad Javad Dehqani (Second R) and Vice-Chancellor of UPM Aini Ideris (Third L) sign MoU on scientific collaboration.

Following a meeting to discuss bilateral ties and reciprocal cooperation, Dr. Mohammad Javad Dehqani, president of Islamic World Science Citation Center (ISC) and Dr. Aini Ideris, vice-chancellor of University of Putra Malaysia (UPM) signed the MoU on scientific collaboration.

The MoU was signed in the presence of Dr. Abbas Qanbari, scientific counselor and director of Iranian students in East Asia and Malaysian delegation — consisting of 13 top officials including deputy vice chancellor in students and alumni affairs, chairman of the board of director, director of international center, dean of the school of graduate studies, chief executive officer of UPM education and training and executive officer of alumni center of UPM.

The meeting — arranged by Qanbari — ensured that ISC helps UPM to promote its status scientifically, assist it in internationalizing UPM by organizing training courses and consultations, tracing the scientific status of UPM and providing its reports periodically, indexing UPM scientific journals in its database, assess and monitor UPM research performance, ranking and evaluating scientific journals, analyze according to bibliometric indicators and report the results to UPM.

ISC will also provide access to its products and databases to UPM, organize training courses on how to use each of their products, hold Scientometric workshops to increase researchers' performance.

ISC will also rank faculty members and researchers of UPM. Both parties will endeavor to strengthen, promote and develop cooperation between ISC and UPM.

UPM will collect and submit journals to ISC for indexing. Both parties will also hold joint workshops, seminars and conferences on issues of mutual interest.

Joint information databases and databanks will be established for the benefit of users in both countries. Both agreements are for a period of five years which can be extended.

Introducing missions and services of ISC, Dehqani emphasized the role of this center in assessing the research performance of scientists, universities, institutions and scientific journals of Muslim countries and providing necessary grounds for enhancing the quality of research and establishing an efficient scientific network in the Islamic World.

He said this database compiles, analyzes and shares high quality, multidisciplinary scientific information.

ISC collects and indexes scientific documents of non-English speaking OIC countries published in native languages, including Malaysian journals.

Ideris, vice-chancellor of University of Putra Malaysia (UPM), stated that cooperation with ISC would definitely result in conducting mutual research projects and enhancement of quality and quantity of UPM's scholarly publications.

At end, she asked ISC to hold scientometric training workshops in UPM for researchers and university students of Malaysia to get further acquainted with ISC's missions and services.

Affordable VR will take immersive therapy mainstream

A stroke patient stretches out a weak arm and grabs a hovering spaceship. A chronic pain sufferer uses her head to bat balls at cartoon bears. A veteran relives his battlefield experiences in a safe environment to help deal with post-traumatic stress disorder.

Therapeutic approaches that immerse patients in virtual environments abound. Until recently, though, the treatments were mostly limited to severe cases in clinical settings because the commercial hardware was expensive, livescience.com reported.

High-end virtual reality setups require not just the headset, which can run several hundreds of dollars, but motion-tracking sensors as well as a dedicated game console or a fast-processing PC with a heavy-duty graphics card.

The costs can start adding up into the thousands of dollars.

But thanks to a recent proliferation of VR hardware, including headsets that incorporate a user's smartphone, prices are falling faster than you can blast a bear.

Samsung's Gear VR costs $99. Google's new soft Daydream View, which comes with a Bluetooth controller and limited motion-tracking controller, currently sells for $79.

The Mi VR Play from Chinese tech giant Xiaomi is only $29. Mobile VR startup, VicoVR, which is developing an affordable full-body tracking system, is expected to ship their first units by the end of the year.

A price hasn't been announced yet, but when the company launched their IndieGoGo funding campaign earlier this spring, the all-inclusive gaming bundle went for $219.

"Anytime anybody has written a paper about virtual reality they say, 'I found out this cool thing and someday when VR is in the home to help people with chronic pain or with physical therapy...' It was always something that was coming," said Andrea Stevenson Won, an assistant professor in the Communication Department at Cornell University who studies virtual embodiment.

Well, that someday has come, and for researchers and patients alike, this accessible tech could transform the way we treat physical and mental ailments. Here's how:

True immersion

Because of the increasing affordable of virtual reality setups, medical professionals won't need sprawling setups to achieve full immersion.

Sensors will be embedded in the hardware, in clothing and in other wearables.

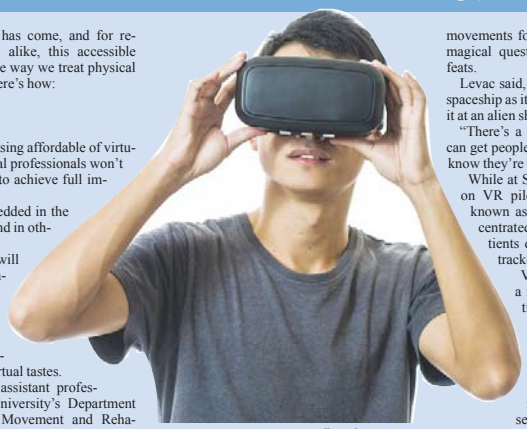
Alternate realities will be achieved with temperature-changing gloves, full-body suits that vibrate for physical sensations and devices that produce realistic smells and even virtual tastes.

Danielle Levac, an assistant professor in Northeastern University's Department of Physical Therapy, Movement and Rehabilitation Sciences as well as the director of the Rehabilitation Games and Virtual Reality Laboratory, said, "We're going to make these as immersive as possible — not just visually immersive but sensorially immersive."

The technology could help speed the recovery of someone who's had a stroke, for example. In the aftermath, stroke victims suffer from physical and cognitive impairments that turn simple errands into incredible challenges.

"Grocery shopping involves mobility, planning, organization and decision-making", Levac explained.

With virtual reality, the patient could practice navigating a store, reaching for objects on a shelf, asking for assistance and checking out.



livescience.com

And because gaming companies are working on algorithms that change virtual interactions in real time to match the patient's capabilities, therapists can set the VR program to a beginner level and then gradually scale up the difficulty until the person feels confident enough to visit an actual store.

It's almost like having your therapist inside the game, personalizing exactly how far you should extend an arm to grab a fake spaceship.

Brainpower

When a VR experience is truly interactive, that tricks the brain. Mind-numbing, repetitive movements for rehab can be transformed into magical quests, sci-fi adventures and daring feats.

Levac said, "Maybe your goal is to grab the spaceship as it goes across the screen and throw it at an alien ship or planet.

"There's a body of literature that says VR can get people to move in ways they might not know they're capable of in a real session."

While at Stanford, Stevenson Won worked on VR pilot studies to treat a syndrome known as CRPS that causes intense concentrated body pain. Several CRPS patients donned headsets and put optical trackers on their ankles.

Virtual balloons materialized in a random sequence. When the patient moved in a way so the avatar landed a kick, the balloon made a popping sound.

The haptic floor also vibrated. Gone was the wincing and groaning that usually accompanied standard physical therapy sessions to move their affected limbs.

Layered reality

Virtual reality doesn't work for everyone. Some people have a hard time and although simulation sickness isn't common, it can happen, Andrea Stevenson Won cautioned.

Augmented reality, where your surroundings get overlaid with holographic images, could come to the rescue.

"You're not placing this huge heavy thing over your eyes and that's all you're seeing," Levac said.

"You're still present with the real world." Last summer we saw augmented reality in 2D with Pokémon Go, but new wearable devices like Microsoft's forthcoming HoloLens and a display from the secretive startup Magic Leap promise to do the same in 3D.

Levac said that augmented reality for rehab is still in the beginning stages, but pictures a proliferation of downloadable game apps.

"I can really see that capitalizing on the motivating, engaging gaming aspect of VR but being more accessible and less intimidating," she said.

Measurable results

"The good and bad of virtual reality is that it's fun," Stevenson Won said.

"More people want to try it and we can leverage that fun for therapeutic purposes, but you want to figure out what the effects are."

Researchers and developers are beginning to bring a systematic, clinical approach to creating immersive therapies.

Levac called this evidence-based game mechanics. "Instead of just putting chocolate over the broccoli — just gamifying everything — we're really starting to think, what do we know about what makes a good game, and reward, and interaction, and challenge?" she said.

When researchers studied children who were asked to do virtual reality rehabilitation every day for several weeks, they found that the novelty wore off.

Levac envisions better ways to look at brain activity during tasks so researchers can quantitatively measure engagement. Once we understand how to keep boredom at bay over time, we can design stronger virtual reality treatments.

Stevenson Won expected that, in the future, more healthcare professionals will be able to see what virtual reality technology can do for their patients.

"It's not a cure-all," she cautioned. "But it's just a great tool, especially when you compare it to more invasive treatments."